Publication

PISA 2022 Results

Creative Minds, Creative Schools

Volume III

OECD
BETTER POLICIES FOR BETTER LIVES

PISA 2022 Results (Volume III)

CREATIVE MINDS, CREATIVE SCHOOLS

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Preface

In 2022, as countries were still dealing with the lingering impacts of the COVID-19 pandemic, nearly 700 000 students from 81 OECD Member and partner economies, representing 29 million across the world, took the Programme for International Student Assessment (PISA) test.

It makes 2022 PISA the first large-scale study to collect data on student performance, well-being, and equity before and after the COVID-19 disruptions. The report finds that in spite of the challenging circumstances, 31 countries and economies managed to at least maintain their performance in mathematics since PISA 2018. Among these, Australia*, Japan, Korea, Singapore, and Switzerland maintained or further raised already high levels of student performance, with scores ranging from 487 to 575 points (OECD average 472). These systems showed common features including shorter school closures, fewer obstacles to remote learning, and continuing teachers' and parental support, which can further offer insights and indications of broader best practices to address future crises.

Many countries also made significant progress towards universal secondary education, key to enabling equality of opportunity and full participation in the economy. Among them, Cambodia, Colombia, Costa Rica, Indonesia, Morocco, Paraguay and Romania have rapidly expanded education to previously marginalised populations over the past decade.

Ten countries and economies saw a large share of all 15-year-olds gain basic proficiency in maths, reading and science and achieve high levels of socio-economic fairness: Canada*, Denmark*, Finland, Hong Kong (China)*, Ireland*, Japan, Korea, Latvia*, Macao (China) and the United Kingdom*. While socioeconomic status remains a significant predictor of performance in these and other OECD countries and economies, education in these countries can be considered highly equitable.

At the same time, on average, the PISA 2022 assessment saw an unprecedented drop in performance across the OECD. Compared to 2018, mean performance fell by ten score points in reading and by almost 15 score points in mathematics, which is equivalent to three-quarters of a year's worth of learning. The decline in mathematics performance is three times greater than any previous consecutive change. In fact, one in four 15-year-olds is now considered a low performer in mathematics, reading, and science on average across OECD countries. This means they can struggle to do tasks such as use basic algorithms or interpret simple texts. This trend is more pronounced in 18 countries and economies, where more than 60% of 15-year-olds are falling behind.

Yet the decline can only partially be attributed to the COVID-19 pandemic. Scores in reading and science had already been falling prior to the pandemic. For example, negative trends in maths performance were already apparent prior to 2018 in Belgium, Canada*, Czechia, Finland, France, Hungary, Iceland, the Netherlands*, New Zealand*, and the Slovak Republic.

The relationship between pandemic-induced school closures, often cited as the main cause of performance decline is not so direct. Across the OECD, around half of the students experienced closures for more than three months. However, PISA results show no clear difference in performance trends between education systems with limited school closures such as Iceland, Sweden and Chinese Taipei and systems that experienced longer school closures, such as Brazil, Ireland* and Jamaica*.

School closures also drove a global conversion to digitally enabled remote learning, adding to long-term challenges that had already emerged, such as the use of technology in classrooms. How education systems grapple with technological change and whether policymakers find the right balance between risks and opportunities, will be a defining feature of effective education systems.

According to our results, on average across OECD countries, around three-quarters of students reported being confident using various technologies, including learning-management systems, school learning platforms and video communication programs. Students who spent up to one hour per day on digital devices for learning activities in school scored 14 points higher in mathematics than students who spent no time, and this positive relationship is observed in over half (46 countries and economies) of all systems with available data. Yet technology used for leisure rather than instruction, such as mobile phones, often seems to be associated with poorer results. Students who reported that they become distracted by other students who are using digital devices in at least some mathematics lessons scored 15 points lower than students who reported that this never or almost never happens, after accounting for students' and schools' socio-economic profile.

PISA data show that teacher support is particularly important in times of disruption, including by providing extra pedagogical and motivational support to students. The availability of teachers to help students in need had the strongest relationship to mathematics performance across the OECD, compared to other experiences linked to COVID-19 school closure. Mathematics scores were 15 points higher on average where students agreed they had good access to teacher help. These students were also more confident than their peers to learn autonomously and remotely. Despite this, only one in five students overall reported that they received extra help from teachers in some lessons in 2022. Around eight percent never or almost never received additional support.

Overall, education systems with positive trends in parental engagement in student learning between 2018 and 2022 showed greater stability or improvement in mathematics performance. This was particularly true for disadvantaged students. These figures, which consider students' and schools' socio-economic profile, show that the level of active support that parents offer their children might have a decisive effect. Yet parental involvement in students' learning at school decreased substantially between 2018 and 2022. On average across OECD countries, the share of students in schools where most parents independently initiated discussions about their child's progress with a teacher dropped by ten percentage points.

Finally, we see a positive relationship between investment in education and average performance up to a threshold of USD 75 000 in cumulative spending per student from ages 6 to 15. For many OECD countries that spend more per student, there is no relationship between extra investment and student performance. Countries like Korea and Singapore have demonstrated that it is possible to establish a top-tier education system even when starting from a relatively low income level, by prioritising the quality of teaching over the size of classes and funding mechanisms that align resources with needs.

To strengthen the role of education in empowering young people to succeed and ensuring merit-based equality of opportunity, the resilience of our education systems will be critical not only to improve learning outcomes measured through PISA, but to their long-term effectiveness. I'm pleased to share the 2022 PISA report with you, to provide policymakers across OECD Members and partner economies with evidence-based policy advice to design resilient and effective education systems that will help give our children and adolescents the best possible future.

Mathias Cormann,

OECD Secretary-General

Foreword

For the first time, the Programme on International Student Assessment (PISA) has measured the creative thinking skills of 15-year-old students, assessing their ability to engage productively in the generation, evaluation and improvement of ideas. As we navigate the complex environmental, social and economic changes of the 21st century, it is crucial for students to be innovative, enterprising and to use critical and creative thinking purposefully.

Many jobs, especially those in highly skilled fields, place a premium on creative thinking. According to the World Economic Forum's Future of Jobs 2023 report, creative thinking is ranked as the second most important skill for workers, just behind analytical thinking. Similar findings by companies like LinkedIn and Deloitte underscore the essential role of creative thinking in the modern workforce.

Today, workers are expected to contribute to change, to continually seek ways to leverage new technologies and adapt working methods to remain competitive. As digitalisation and artificial intelligence advance, the premium on innovation, creativity and critical thinking increases compared to routine skills, which are more susceptible to automation.

Yet creative thinking isn't only about remaining competitive in the job market. It also acts as a powerful stimulus to learning itself, deepening students' absorption in their learning, activating higher-order cognitive skills and stimulating emotional development and resilience and well-being.

Despite its importance, we cannot take the development of creative skills for granted. In fact, OECD's 2023 survey of social and emotional skills showed that 15-year-olds tend to feel less creative and less self-aware than 10-year-olds. Developmental psychologists can explain part of that decline with adolescence, but the variability of this trend across countries is sufficiently large to suggest that education and the environment also play their part in this. While children are born with an abundance of creativity, always willing to learn, unlearn and relearn, school often reinforces compliance and rewards students for reproducing the established wisdom of our times, rather than questioning it.

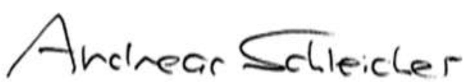
While academic performance and creative thinking performance can be mutually supportive, they are not necessarily prerequisites for one another. In fact, while education systems such as Singapore, Korea and Canada* are among the highest performing systems in terms of both creative thinking and performance in mathematics, reading and science, four other high PISA-scoring systems – Czechia, Hong Kong (China)*, Macao (China) and Chinese Taipei – performed at or below the OECD average in creative thinking. Results even show that individual students can excel in creative thinking without excelling in core academic domains.

Not surprisingly, many students from disadvantaged backgrounds scored significantly lower than advantaged students in creative thinking. Many students in challenging environments deal with issues like food insecurity, housing instability and significant family responsibilities, which consume their time and energy, leaving little room for creative pursuits. In addition, teachers in under-resourced schools may prioritise standardised testing and basic skills to boost academic performance, unintentionally sidelining creative activities and practices. More needs to be done across PISA participating countries to tackle the socio-economic factors behind creative thinking gaps.

It is important to reiterate that creative thinking skills can be taught. Teachers can unlock student creativity by encouraging students to explore, generate and reflect upon ideas. It's no coincidence that high-performing systems integrate formal guidelines on developing and assessing student creativity directly. Yet, worryingly, only about half of students believe that their creativity is something that they can change.

Nurturing and teaching creative thinking skills in students empowers them to innovate, problem-solve, and adapt in an ever-changing world. It's especially important to focus on boys, who typically score lower on creative thinking assessments than girls. Encouraging students to better engage with more open and student centred-learning tasks can help to build self-confidence and inspire curious and creative learners. By providing students with opportunities and support to explore their creative abilities, educators can help them realise that creativity is not an innate trait but a skill that can be honed and improved.

To achieve meaningful policy change, it is important to understand not only what students learn but how they learn. I hope that this PISA report will provide valuable insights for policymakers into how young people are developing the skills that they need to thrive in the future. The credibility and consistency of PISA's methodology ensure that its findings are an indispensable tool for shaping education policies and fostering international collaboration in the pursuit of better educational outcomes.



Andreas Schleicher

Director for Education and Skills

Special Advisor on Education Policy

to the Secretary-General

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This report is the product of a collaborative effort between the countries and economies participating in PISA, the national and international experts and institutions working within the framework of the PISA Consortium, and the OECD Secretariat.

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To support the technical implementation of PISA, the OECD contracted an international consortium of institutions and experts, led by Irwin Kirsch, Claudia Tamassia, Ann Kennedy and Eugenio Gonzalez at the Educational Testing Service (ETS). Overall co-ordination of the PISA 2022 assessment, the computer-delivery platform, the development of instruments, scaling and analysis and all data products were managed by at ETS. The development of the cognitive assessment framework for mathematics and of the framework for the questionnaire was carried out by the Research Triangle Institute (RTI), led by Kimberly O'Malley. The development of the cognitive assessment framework for creative thinking was undertaken by the OECD Secretariat, led by Mario Piacentini and Natalie Foster, in collaboration with the creative thinking expert group. The test development and development of the questionnaire items for creative thinking were performed by ACT/ACTNext in collaboration with the OECD Secretariat, and led at ACT/ACTNext by Ken Kobell, Yigal Rosen, Gunter Maris, Kristin Stoeffler, Matthew Lumb and Alina von Davier. Sampling and weighting services were provided by Westat, led by Keith Rust. Linguistic quality control and the development of the French source version were under the responsibility of cApStAn, led by Steve Dept. The support for country preparation and implementation was managed by the Australian Council for Educational Research (ACER), led by Jeaniene Spink and Maurice Walker.

Joan Ferrini-Mundy, Zbigniew Marciniak and William Schmidt chaired the expert group that guided the preparation of the mathematics assessment framework and instruments. This group included Takuya Baba, Joan Ferrini-Mundy, Jenni Ingram, Julián Mariño and William Schmidt. Nina Jude chaired the expert group that guided the preparation of the questionnaire framework and instruments. This group included Hunter Gehlbach, Kit-Tai Hau, Therese Hopfenbeck, David Kaplan, Jihyun Lee, RicardoPrimi and Wilima Wadhwa. Leslie Rutkowski chaired the Technical Advisory Group, whose members include Maria Bolsinova, Eugenio Gonzalez, Kit-Tai Hau, Oliver Lüdtke, Sabine Meinck, Christian Monseur, Keith Rust, Kathleen Scalise and Kentaro Yamamoto. The Creative Thinking expert group included Baptiste Barbot, James Kaufman, Ido Roll, Marlene Scardamalia, Valerie Shute, Lene Tanggaard and Nathan Zoanetti, and built on the work of the Strategic Advisory Group led by Jack Buckley and Bill Lucas. The ICT Expert Group included Jepe Bundsgaard, Cindy Ong, Michael Trucano, Patricia Wastiau and Pat Yongpradit.

The development of the report was steered by the PISA Governing Board, chaired by Michele Bruniges (Australia), with Peggy Carr (United States), Akiko Ono (Japan) and Carmen Tovar Sánchez (Spain) as vice chairs. Annex D of this volume lists the members of the various PISA bodies, including Governing Board members and National Project Managers in participating countries and economies, the PISA Consortium and the individual experts and consultants who have contributed to PISA 2022.

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Reader's Guide

PISA in the context of the COVID-19 pandemic

This edition of PISA was originally planned to take place in 2021 but was delayed by one year due to the COVID-19 pandemic. The exceptional circumstances throughout this period, including lockdowns and school closures in many places, led to occasional difficulties in collecting some data. While the vast majority of countries and economies met PISA's technical standards (available online), a small number did not. In prior PISA rounds, countries and economies that failed to comply with the standards, and which the PISA Adjudication Group judged to be consequential, could face exclusion from the main part of reporting. However, given the unprecedented situation caused by the pandemic, PISA 2022 results include data from all participating education systems, including those where there were issues such as low response rates (see Annexes A2 and A4). The next section explains the potential limitations of data from countries not meeting specific technical standards. Readers are alerted to these limitations throughout the volume wherever appropriate.

It is important to note that the limitations and implications were assessed by the PISA Adjudication Group in June 2023. There may be a need for subsequent adjustments as new evidence on the quality and comparability of the data emerges. PISA will return to the standard ways of reporting for the 2025 assessment.

Adjudicated entities not meeting the sampling standards

The results of 12 adjudicated entities (i.e. countries, economies and regions within countries), listed below, will be reported with annotations in this volume. Caution is required when interpreting estimates for these countries/economies because one or more PISA sampling standards listed below were not met.

- **Overall exclusion rate. Standard 1.7**: The PISA Defined Target Population covers 95% or more of the PISA Desired Target Population. That is, school-level exclusions and within-school exclusions combined do not exceed 5%.
- **School response rate. Standard 1.11**: The final weighted school response rate is at least 85% of sampled schools. If a response rate is below 85% then an acceptable response rate can still be achieved through agreed-upon use of replacement schools.
- **Student response rate. Standard 1.12**: The student response rate is at least 80% of all sampled students across responding schools.

The 12 entities can be grouped into two categories:

(i) Entities that submitted technically strong analyses, which indicated that more than minimal bias was most likely introduced in the estimates due to low response rates (falling below PISA standards): Canada, Ireland, New Zealand, the United Kingdom and Scotland.

(ii) Entities that did not meet one or more PISA sampling standards and it is not possible to exclude the possibility of more than minimal bias based on the information available at the time of data adjudication: Australia, Denmark, Hong Kong (China), Jamaica, Latvia, the Netherlands and Panama.

The Adjudication Group also noted that the bias associated with trend and cross-country comparisons might be smaller, if past data or data for other countries are biased in the same direction. Therefore, the deviations from the standards in PISA 2022 are compared with those in PISA 2018 where necessary.

(i) Entities that submitted technically strong analyses, which indicated that more than minimal bias was most likely introduced in the estimates due to low response rates (falling below PISA standards)

Canada

- **Overall exclusion rate: 5.8%.** Exclusions exceeded the acceptable rate by less than one percentage point; at the same time, the exclusion rates observed in 2022 remained relatively close to exclusion rates observed in 2018 (6.9%).
- **Student response rate: 77%. School response rates: 81% before replacement, 86% after replacement.** Student response rates decreased from 84% with respect to PISA 2018, and fell short of the target in 7 out of 10 provinces (all but New Brunswick, Prince Edward Island and Saskatchewan). A thorough non-response bias analysis was submitted, with analyses conducted separately for each province, using students' academic achievement data as auxiliary information. School response rates also fell short of the target, driven by low participation rates in two provinces (Alberta and Quebec). For these provinces, non-response bias was also examined at the school level. The analyses clearly indicate that school nonresponse has not led to any appreciable bias, but student nonresponse has given rise to a small upwards bias.

Ireland

- **Student response rate: 77%.** Student response rates decreased from 86% with respect to PISA 2018. A thorough non-response bias analysis was submitted, using external achievement data at the student level as auxiliary information. The analysis provided evidence to suggest a residual upwards bias of about 0.1 standard deviations, after non-response adjustments are taken into account. On the PISA scale, considering that the standard deviation in Ireland ranged (in 2018) from 78 score points in mathematics to 91 score points in reading, this could translate in an estimated upwards bias of approximately 8 or 9 points.

New Zealand

- **Overall exclusion rate: 5.8%.** Exclusions exceeded the acceptable rate by less than one percentage point; at the same time, the exclusion rates observed in 2022 remained relatively close to exclusion rates observed in 2018 (6.8%).
- **Student response rate: 72%. School response rate: 61% before replacement, 72% after replacement.** Student response rates decreased from 83% with respect to PISA 2018. School response rates also fell short of the target. A thorough and detailed non-response bias analysis was submitted, using external achievement data at the student level, but also information on chronic absenteeism, as auxiliary information, along with demographic characteristics. The analysis provided evidence to suggest a residual upwards bias of about 0.1 standard deviations, after non-response adjustments are taken into account, driven entirely by student non-response (school non-participation did not result in significant bias, in contrast). The analysis also suggested that chronically absent students are over-represented among non-respondents in PISA. On the PISA scale, considering that the standard deviation in New Zealand ranged (in 2018) from 93 score points in mathematics to 106 score points in reading, this could translate in an estimated upwards bias of approximately 10 points. The Adjudication Group also noted that the bias associated with trend and cross-country comparisons might be smaller, if past data or data for other countries are biased in the same direction. For more information, see the educationcounts.govt.nz website.

The United Kingdom

The United Kingdom (excluding Scotland)

- **Student response rate: 75%. School response rates: 66% before replacement, 80% after replacement.** Student response rates decreased from 83% with respect to PISA 2018. School response rates also fell short of the target. An informative non-response bias analysis was submitted, using external achievement data at the student level as auxiliary information, along with demographic characteristics; the analysis was limited to England as the largest subnational entity within the United Kingdom (excluding Scotland), and thus covered over 90% of the intended sample. The analysis provided evidence to suggest a small residual upwards bias of about 0.07 standard deviations for reading and 0.09 standard deviations for mathematics, after non-response adjustments are taken into account, driven entirely by student non-response (school non-participation did not result in significant bias, in contrast). On the PISA scale, considering that the standard deviation in England (in 2018) was about 101 score points in reading and 93 score points in mathematics, this could translate in an estimated upwards bias of approximately 7 or 8 points.

Scotland

- **Overall exclusion rate: 6.6%.** Exclusions exceeded the acceptable rate by a small margin; at the same time, the exclusion rates observed in 2022 remained relatively close to exclusion rates observed in 2018 (5.4%).
- **Student response rate: 79%.** Student response rates missed the standard by a small margin, but were otherwise similar to response rates in PISA 2018 (81%). A thorough non-response bias analysis was submitted, using several external achievement variables at the student level as auxiliary information, along with demographic characteristics. The analysis provided evidence to suggest a residual upwards bias of about 0.1 standard deviations, after non-response adjustments are taken into account. On the PISA scale, considering that the standard deviation in Scotland (in 2018) was about 95 score points in reading and mathematics, this could translate in an estimated upwards bias of approximately 9 or 10 points. Given the similarity of response rates between 2018 and 2022, it cannot be excluded that a similar bias might be present in 2018 as well, and in many PISA 2022 participants whose response rates were similarly close to the target. For this reason, data were deemed to be comparable to previous cycles.

(ii) Entities that did not meet one or more PISA sampling standards and it is not possible to exclude the possibility of more than minimal bias based on the information available at the time of data adjudication.

Australia

- **Overall exclusion rate: 6.9%.** Exclusions exceeded the acceptable rate by a small margin; at the same time, the exclusion rates observed in 2022 remained relatively close to exclusion rates observed in 2018 (5.7%).
- **Student response rate: 76%.** Student response rates decreased from 85% with respect to PISA 2018. A technically sound non-response bias analysis was submitted; however, the strength of the evidence was limited by the fact that no external student-level achievement variables could be used in the analysis. Based on the available evidence, and on the experience of other countries participating in PISA, the Adjudication Group considered that while non-response adjustments likely limited the severity of non-response biases, a small residual upward bias could not be excluded.

Denmark

- **Overall exclusion rate**: 11.6%. Exclusions exceeded the acceptable rate by a large margin and showed a marked increase, with respect to 2018 (5.7%). The Adjudication Group noted that high levels of student exclusions may bias performance results upwards. In Denmark, a major cause behind the rise appears to be the increased share of students with diagnosed dyslexia, and the fact that more of these students are using electronic assistive devices to help them read on the screen, including during exams. The lack of such an accommodation for students with diagnosed dyslexia in the PISA assessment led schools to exclude many of these students. In order to reduce exclusion rates in the future, PISA may need to further accommodate dyslexic students, allowing the use of assistive devices.

Hong Kong (China)

- **Student response rate: 75%. School response rates: 60% before replacement, 80% after replacement.** Student response rates decreased from 85% with respect to PISA 2018. School response rates also fell short of the target (as they did in 2018). At the school level, the fact that a raw, but direct measure of school performance is used to assign schools to sampling strata (and therefore, differential non-response across strata is unlikely to cause bias), limits the risk of bias due to non-response. A non-response bias analysis was submitted; however, the strength of the evidence was limited by the fact that no external student-level achievement variables could be used in the analysis (only student grade information, already used in non-response adjustments, was available). The proxies for school and student achievement (school size and student grade) that were used in the analyses showed no or very limited relationship with participation rates. Nevertheless, based on the available evidence, and on the experience of other countries participating in PISA, the Adjudication Group considered that while non-response adjustments likely limited the severity of non-response biases, a small residual upward bias could not be excluded.

Jamaica

- **Student response rate: 68%.** Student response rates were substantially below the standard. A simple non-response bias analysis was submitted, analysing student response rates by school characteristics: this showed in particular lower response rates in rural schools and regions. A limited non-response bias analysis was also prepared by the Core C contractor, to compare respondent characteristics (both before and after nonresponse adjustment) to characteristics of the full eligible sample of students. This suggested that non-response was also related to students' grade level and gender (both variables are used in non-response adjustments). Based on the available information, it is not possible to exclude the possibility of bias; considering the analyses on student non-response conducted in other countries, the residual bias after non-response adjustments are taken into account is likely to correspond to an upward bias. The Adjudication Group also noted that a number of issues encountered during the main survey data collection could have been prevented, had Jamaica been able to do a full field trial. This was not possible because of COVID-related disruptions to schooling in 2021. In particular, enrolment information available to the national centre for school-level sampling often turned out to be imprecise; and low student participation rates could have been anticipated, had a regular field trial been conducted. As a result of inaccurate sampling frames and low student response rates, the achieved sample size for the main survey was well below target, and sampling errors for Jamaica are larger than desired. The Adjudication Group noted that apart from the challenges around sampling operations, the quality of the data met expectations for reporting.

Latvia

- **Overall exclusion rate: 7.9%.** Exclusions exceeded the acceptable rate by a large margin and showed a marked increase, with respect to 2018 (4.3%). Most of these students were excluded because they were attending school in remote or virtual mode. The Adjudication Group noted that high levels of student exclusions may bias performance results upwards.

The Netherlands

- **Overall exclusion rate: 8.4%.** Exclusions exceeded the acceptable rate by a large margin and showed a marked increase, with respect to 2018 (6.2%). Most of these students were excluded because they had a physical or intellectual disability and no adaptation was available for them. The Adjudication Group noted that high levels of student exclusions may bias performance results upwards.
- **School response rates: 66% before replacement, 90% after replacement.** A non-response bias analysis was submitted, analysing differences in performance and in other characteristics between responding schools and the total population of schools, as well as differences between replacement schools and originally sampled, but non-responding schools. This supported the case that no large bias would result from non-

response; furthermore, given the available evidence, there is no clear indication about the direction of any residual bias.

Panama

- **Student response rate: 77%.** In the challenging circumstances surrounding schooling in Panama in 2022 (teacher strikes, road blockades and student absenteeism), student response rates decreased from 90% with respect to PISA 2018. No non-response bias analysis was submitted; the PISA national centre explained that non-response was potentially related to the agitated school climate the students found themselves when returning to their schools after the strikes. A limited non-response bias analysis was prepared by the Core C contractor, to compare respondent characteristics (both before and after nonresponse adjustment) to characteristics of the full eligible sample of students. This analysis suggested that (before non-response adjustments were taken into account), non-response was related to students' grade level, and to special needs status. Based on the available information, it is not possible to exclude the possibility of bias; considering the analyses on student non-response conducted in other countries, the residual bias after non-response adjustments are taken into account is likely to correspond to an upward bias.

Adjudication entity not reaching a strong level of comparability

The ability to compare PISA results with those of other countries, and over time, depends on the use of common test items and of standardised test-administration procedures. In addition, the common items must consistently indicate high, medium or low proficiency, regardless of the country/economy or of the language of the test. When this condition is met, a common set of (international) parameters is used to convert students' correct, partially correct or incorrect responses into an estimated score on the PISA scale.

The PISA Technical Advisory Group issued a memo in December 2021 stating that, in each country and economy, over two-thirds of items are expected to use the international item parameters to ensure strong comparability of PISA scores across countries and economies. Where the proportion is lower, greater uncertainty (beyond the uncertainty of estimates reflected in standard errors) is associated with cross-country comparisons.

During the review of PISA 2022 results, invariance of item parameters with respect to the international ones was examined for each major language of assessment within a participating country/economy. For Albania and the Dominican Republic, around 50% of the items were assigned unique parameters in creative thinking (16 and 17 out of 32 items, respectively). For both Albania and the Dominican Republic, results are therefore reported in this volume with an annotation indicating that a strong linkage to the international PISA scale could not be established.

Data underlying the figures

The data referred to in this volume are presented in Annex B and, in greater detail, including additional tables, on the PISA website (www.oecd.org/pisa). Five symbols are used to denote missing data:

- a The category does not apply in the country concerned or economy; data are therefore missing.
- c There were too few observations to provide reliable estimates (i.e. there were fewer than 30 students or fewer than 5 schools with valid data).
- m Data are not available. There was no observation in the sample; these data were not collected by the country or economy; or these data were collected but subsequently removed from the publication for technical reasons.
- w Results were withdrawn at the request of the country or economy concerned.
- x Data included in another category or column of the table (e.g. x(2) means that data are included in Column 2 of the table).

Coverage

PISA 2022 was implemented in 81 countries and economies, including all OECD Member countries except Luxembourg and 44 non-OECD Member countries and economies (see map of PISA countries and economies in "What is PISA?"). 64 countries and economies implemented the creative thinking cognitive test and 74 countries and economies implemented the creative thinking questionnaire items.

The designation "Ukrainian regions (18 of 27)" refers to the 18 PISA-participating jurisdictions of Ukraine: Cherkasy Oblast, Kirovohrad Oblast, Poltava Oblast, Vinnytsia Oblast, Chernihiv Oblast, Kyiv Oblast, Sumy Oblast, the City of Kyiv, Zhytomyr Oblast, Odesa Oblast, Chernivtsi Oblast, Ivano-Frankivsk Oblast, Khmelnytskyi Oblast, Lviv Oblast, Rivne Oblast, Ternopil Oblast, Volyn Oblast and Zakarpattia Oblast. Due to Russia's large-scale aggression against Ukraine, the following nine jurisdictions were not covered: Dnipropetrovsk Oblast, Donetsk Oblast, Kharkiv Oblast, Luhansk Oblast, Zaporizhzhia Oblast, Kherson Oblast, Mykolaiv Oblast, the Autonomous Republic of Crimea and the city of Sevastopol.

Note on Kosovo:

This designation is without prejudice to positions on status, and is in line with United Nations Security Council Resolution 1244/99 and the Advisory Opinion of the International Court of Justice on Kosovo's declaration of independence.

Following OECD data regulations, a visual separation between countries and territories has been used in all charts to reduce the risk of data misinterpretation.

International averages

The OECD average corresponds to the arithmetic mean of the respective country estimates. It was calculated for most indicators presented in this report.

In this publication, the OECD average is generally used when the focus is on comparing performance across education systems. In the case of some countries, data may not be available for specific indicators, or specific categories may not apply. Readers should, therefore, keep in mind that the term "OECD average" refers to the OECD Member countries included in the respective comparisons. In cases where data are not available or do not apply for all sub-categories of a given population or indicator, the "OECD average" is not necessarily computed on a consistent set of countries across all columns of a table.

Rounding figures

Because of rounding, some figures in tables may not add up exactly to the totals. Totals, differences and averages are always calculated on the basis of exact numbers and are rounded only after calculation.

All standard errors in this publication have been rounded to one or two decimal places. Where the value 0.0 or 0.00 is shown, this does not imply that the standard error is zero, but that it is smaller than 0.05 or 0.005, respectively.

Reporting student data

The report uses "15-year-olds" as shorthand for the PISA target population. PISA covers students who are aged between 15 years 3 months and 16 years 2 months at the time of assessment and who are enrolled in school and have completed at least 6 years of formal schooling, regardless of the type of institution in which they are enrolled, and whether they are in full-time or part-time education, whether they attend academic or vocational programmes, and whether they attend public or private schools or foreign schools within the country.

Reporting school data

The principals of the schools in which students were assessed provided information on their schools' characteristics by completing a school questionnaire. Where responses from school principals are presented in this publication, they are weighted so that they are proportionate to the number of 15-year-olds enrolled in the school.

Focusing on statistically significant differences

This volume discusses only statistically significant differences or changes. These are denoted in darker colours in figures and in bold font in tables. Unless otherwise specified, the significance level is set to 5%. See Annex A3 for further information.

Abbreviations used in this report

ESCS	PISA index of economic, social, and cultural status
ICT	Information and communications technology
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
Score dif.	Score-point difference
S.D.	Standard deviation
S.E.	Standard error
% dif.	Percentage-point difference

Box 1. Interpreting differences in PISA scores

PISA scores do not have a substantive meaning as they are not physical units such as metres or grams. Instead, they are set in relation to the variation in results observed across all test participants. For the PISA assessments of mathematics, reading and science there is, theoretically, no minimum or maximum score in PISA; rather, the results are scaled to fit approximately normal distributions (i.e. means around 500 score points, standard deviations around 100 score points). In statistical terms, a one-point difference on the PISA scale therefore corresponds to an effect size (Cohen's d) of 0.01; and a 10-point difference to an effect size of 0.10.

The creative thinking data are summarised according to a different PISA scale than the assessments of mathematics, reading and science, with which readers may be more familiar. The creative thinking scale is a bounded scale between 0 and 60 score points, where 60 score points represents the total number of points available across all 32 items within the creative thinking test-item pool. Scores on the creative thinking scale therefore represent students' estimated scores (i.e. the sum of partial and full credit responses) if they were to sit a hypothetical test containing all 32 items from the test-item pool. This bounded, two-digit scale addresses the relatively lower measurement precision of the creative thinking test compared to the PISA assessments of mathematics, reading and science, given the smaller number of items in the creative thinking item pool (see Annex A5). In statistical terms, a one-point difference on the PISA creative thinking scale signals about 10% of a standard deviation of proficiency. This approach to scaling the PISA creative thinking data also means that results will differ more where there is more information available in the test (i.e. where there are more items that correspond to a given proficiency level).

Interpreting large differences in scores: Proficiency levels

PISA scales are divided into proficiency levels. For example, for PISA 2022, the range of difficulty of creative thinking items is represented by six described levels of creative thinking proficiency: the simplest items correspond to Level 1, with Levels 2, 3, 4, 5 and 6 corresponding to increasingly difficult items. Individuals who are proficient within the range of Level 1 are likely to be able to complete Level 1 items but are unlikely to be able to complete items at higher levels. See Chapter 1 for a detailed description of the proficiency levels in creative thinking.

In creative thinking, each proficiency level corresponds to a range of between seven and nine score points. Hence, score-point differences of that magnitude can be interpreted as the difference in described skills and knowledge between successive proficiency levels in creative thinking.

Interpreting small differences in scores: Statistical significance

Smaller differences in PISA scores cannot be expressed in terms of the difference in skills and knowledge between proficiency levels. However, they can still be compared with each other by means of verifying their “statistical significance”.

A difference is called “statistically significant” if it is unlikely that such a difference can be observed in the estimates based on samples when, in fact, no true difference exists in the populations from which the samples are drawn. The results of the PISA assessments are “estimates” because they are obtained from samples of students rather than from a census of all students (i.e. which introduces a “sampling error”), and because they are obtained using a limited set of assessment tasks rather than the universe of all possible assessment tasks (i.e. which introduces a “measurement error”).

It is possible to determine the magnitude of the uncertainty associated with the estimate and to represent it as a “confidence interval”, i.e. a range defined in such a way that if the true value lies above its upper bound or below its lower bound, an estimate different from the reported estimate would be observed only with a small probability (typically less than 5%). The confidence interval needs to be taken into account when making comparisons between estimates so that differences that may arise simply due to the sampling error and measurement error are not interpreted as real differences.

Interpreting differences in scores on the creative thinking scale

In this report, a difference of three score points is considered to be a “large” change in creative thinking performance. Typically, in the PISA core domain assessments of mathematics, reading and science, a “large” difference is defined as a change of 20 score points or more. This is approximately equivalent to the typical annual learning gain by students around the age of 15 and is around one-fifth of the OECD standard deviation in performance. Given the broader grain size of the creative thinking scale (i.e. the bounded, two-digit scale), a change of three score points is approximately equivalent to one-quarter of the OECD standard deviation in creative thinking performance.

A “small” change in creative thinking performance is defined as a change of one score point. Changes of up to one score point correspond to just under one-tenth of the OECD standard deviation in creative thinking performance. Consequently, score changes of between one and three points can thus be considered “moderate” differences in creative thinking performance.

Further documentation

For further information on the PISA assessment instruments and the methods used in PISA, see the *PISA 2022 Assessment and Analytical Framework* (OECD, 2023[1]) and *PISA 2022 Technical Report* (OECD, 2024[2]).

StatLink

This report has StatLinks for tables and graphs at the end of each chapter. To download the matching Excel® spreadsheet, just type the link into your Internet browser, starting with the https://doi.org prefix, or click on the link from the e-book version.

References

OECD (2024), *PISA 2022 Technical Report*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/01820d6d-en. [2]

OECD (2023), *PISA 2022 Assessment and Analytical Framework*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/dfe0bf9c-en. [1]

Executive Summary

PISA 2022 assessed 15-year-old students' capacity to think creatively, defined as the competence to engage in the generation, evaluation and improvement of original and diverse ideas. The PISA 2022 creative thinking data provide insights into how well education systems are preparing students to think outside the box in different task contexts.

Student performance in creative thinking

What students can do in creative thinking

- Singapore, Korea, Canada*, Australia*, New Zealand*, Estonia and Finland (in descending order) are the highest-performing systems in creative thinking, with a mean score of 36 points or above – significantly above the OECD average (33 points). Students in Singapore score 41 points on average in creative thinking.
- There is a large performance gap in creative thinking between the highest-performing and lowest-performing country of 28 score points – or around four proficiency levels. 97 out of 100 students in the five best-performing countries performed above the average student in the five lowest performing countries (Albania**, the Philippines, Uzbekistan, Morocco and the Dominican Republic**).
- On average across OECD countries, around 1 in 2 students can think of original and diverse ideas in simple imagination tasks or everyday problem-solving situations (i.e. Proficiency Level 4). In Singapore, Korea and Canada*, over 70% of students performed at or above Level 4.
- In Singapore, Latvia*, Korea, Denmark*, Estonia, Canada* and Australia*, more than 88% of students demonstrated a baseline level of creative thinking proficiency (Level 3), meaning they can think of appropriate ideas for a range of tasks and begin to suggest original ideas for familiar problems (OECD average 78%). In 20 low-performing countries/economies, less than 50% of students reached this baseline level.

Creative thinking performance and performance in mathematics and reading

- Most countries and economies that scored above the OECD average in creative thinking outperformed the OECD average in mathematics, reading and science. Only Portugal performed above the OECD average in creative thinking (34 points) but not significantly different from the average in the three PISA core domains. Czechia, Hong Kong (China), Macao (China) and Chinese Taipei performed at or below the OECD average in creative thinking despite scoring above the OECD average in mathematics, reading and science.
- In Chile, Mexico, Australia*, New Zealand*, Costa Rica, Canada* and El Salvador, students scored over 4.5 points higher than expected in creative thinking after accounting for their mathematics performance. In Singapore, Australia*, Canada*, Latvia*, Korea, Belgium, Finland and New Zealand*, students scored around 3 points or more higher than expected after accounting for their reading performance.
- Australia*, Canada*, Finland and New Zealand* combined high mean performance and overall relative performance in creative thinking (i.e. a large relative strength in creative thinking after accounting for students' reading and mathematics scores, respectively), with at least 75% of students reaching proficiency Level 3.

- Academic excellence is not a pre-requisite for excellence in creative thinking. While around half of all students who performed at the highest level in creative thinking performed at the highest level in mathematics, similar proportions of students (over one-quarter, OECD average) within the third quintile of creative thinking performance scored within the second, third and fourth quintiles, respectively, in mathematics. However, very few students below a baseline proficiency in mathematics excelled in creative thinking.

Performance differences across types of tasks

- Students in Singapore were the most successful across several task types, especially social problem-solving tasks. Students in Korea were the most successful in scientific problem-solving contexts and evaluate and improve ideas tasks. Students in Portugal performed the most successfully in visual expression tasks.
- In general, and after accounting for the difficulty of items across different task groupings, students demonstrated a relative strength in creative expression tasks (both written and visual) compared to their performance across all other tasks, and a relative weakness in creative problem-solving tasks.

Gender and equity gaps in performance

- In no country or economy did boys outperform girls in creative thinking, with girls scoring 3 points higher in creative thinking on average across the OECD. The gender gap is significant in all countries/economies after accounting for mathematics performance and in around half of all countries/economies even after accounting for students' reading performance.
- Students with higher socio-economic status performed better in creative thinking, with advantaged students scoring around 9.5 points higher than their disadvantaged peers on average across the OECD. In general, the strength of the association between socio-economic status and performance is weaker in creative thinking than it is for mathematics, reading and science.
- Gender and socio-economic differences in performance persist across all types of tasks. Girls performed particularly better than boys in written expression tasks and those requiring them to build on others' ideas, and socio-economic differences in performance are largest in the written expression domain.

Students' beliefs and attitudes associated with creative thinking

- Around 8 out of 10 students (OECD average) believe that it is possible to be creative in nearly any subject. Students with positive beliefs about the nature of creativity scored around 3 score points higher in creative thinking than other students. However, only around 1 in 2 students (OECD average) believe their creativity is something about them that they can change. Holding a growth mindset on creativity also positively relates to performance (+1 score point, OECD average).
- Indices of imagination and adventurousness, openness to intellect, curiosity, perspective taking and persistence are positively associated with creative thinking performance.

School environment

- Classroom pedagogies can make a difference. Across OECD countries, between 60-70% of students reported that their teachers value their creativity, that they encourage them to come up with original answers, and that they are given a chance to express their ideas in school. These students scored slightly higher than their peers in creative thinking, even after accounting for students and school characteristics and their mathematics and reading performance.
- Participating in school activities such as art, drama, creative writing or programming classes regularly (once a week) is associated with better performance in creative thinking than doing so infrequently or every day.

Table III.1. Snapshot of performance in creative thinking

(light blue)	Countries/economies with a mean performance/variation of performance/share of top performers **above** the OECD average Countries/economies with a share of low performers **below** the OECD average
(white)	Countries/economies with a mean performance/variation of performance/share of top performers/share of low performers **not significantly different** from the OECD average
(grey)	Countries/economies with a mean performance/variation of performance/share of top performers **below** the OECD average Countries/economies with a share of low performers **above** the OECD average

	Creative thinking performance					
		Relative performance[1] (i.e. score-point difference between actual and expected performance) based on performance in:			Top-performing and low-performing students	
	Mean score in creative thinking	Mathematics	Reading	Variation uniquely associated with mathematics performance[2]	Share of top performers (Level 5 or 6)	Share of students below the baseline (Level 2 or below)
	Mean score	Score dif.	Score dif.	%	%	%
OECD average	33	**33**	**33**	33	33	33
Singapore	41	**2**	**4**	29.7	57.8	5.7
Korea	38	**3**	**3**	26.8	45.9	9.8
Canada*	38	**5**	**4**	24.5	44.8	11.2
Australia*	37	**5**	**4**	30.3	42.7	11.9
New Zealand*	36	**5**	**3**	30.0	39.6	13.3
Estonia	36	**1**	**1**	31.1	34.3	11.0
Finland	36	**3**	**3**	35.3	39.0	16.6
Denmark*	35	**2**	**3**	32.0	31.3	10.2
Latvia*	35	**3**	**3**	23.6	26.4	8.4
Belgium	35	**2**	**3**	26.4	32.8	14.8
Poland	34	**2**	**2**	23.7	32.9	17.5
Portugal	34	**3**	**2**	36.4	29.4	17.0
Lithuania	33	**1**	**1**	31.0	26.4	20.5
Spain	33	**1**	**1**	26.9	25.4	20.0
Czechia	33	0	0	25.6	25.4	20.5
Germany	33	**1**	**1**	31.5	26.6	22.4
France	32	**1**	**1**	25.4	25.6	22.0
Netherlands*	32	0	**2**	26.8	27.8	24.1
Israel	32	**3**	**1**	31.8	30.3	24.9
Italy	31	0	**-1**	25.5	21.9	24.0
Malta	31	**1**	**2**	40.7	24.9	26.7
Hungary	31	0	**-1**	24.0	22.3	26.4
Chile	31	**5**	**1**	28.6	19.9	26.4
Croatia	30	0	**-1**	30.1	18.5	26.1
Iceland	30	0	**2**	35.6	21.4	28.3
Slovenia	30	**-2**	**-1**	16.8	16.3	26.5
Slovak Republic	29	**-1**	0	28.9	21.0	33.3
Mexico	29	**5**	**3**	29.3	13.8	30.0
Serbia	29	0	0	31.4	17.5	34.7
Uruguay	29	**3**	**1**	30.9	15.1	33.4
United Arab Emirates	28	**1**	**2**	39.7	24.3	39.1
Qatar	28	**2**	**1**	32.7	19.7	40.8

The Statlink URL of this table is available below Snapshot Table III.6

(light blue)	Countries/economies with a mean performance/variation of performance/share of top performers **above** the OECD average Countries/economies with a share of low performers **below** the OECD average
(white)	Countries/economies with a mean performance/variation of performance/share of top performers/share of low performers **not significantly different** from the OECD average
(grey)	Countries/economies with a mean performance/variation of performance/share of top performers **below** the OECD average Countries/economies with a share of low performers **above** the OECD average

	Creative thinking performance					
		Relative performance[1] (i.e. score-point difference between actual and expected performance) based on performance in:		Variation uniquely associated with mathematics performance[2]	Top-performing and low-performing students	
	Mean score in creative thinking	Mathematics	Reading		Share of top performers (Level 5 or 6)	Share of students below the baseline (Level 2 or below)
	Mean score	Score dif.	Score dif.	%	%	%
Costa Rica	27	**5**	**1**	m	10.8	35.8
Greece	27	**0**	**-1**	31.6	9.5	36.2
Romania	26	**-1**	**-1**	25.4	14.3	42.1
Colombia	26	**3**	**0**	28.4	11.9	45.3
Jamaica*	26	**3**	0	22.6	16.0	47.7
Malaysia	25	0	**1**	39.9	11.7	45.6
Mongolia	25	**-2**	**2**	33.4	7.7	45.6
Moldova	24	**-2**	**-2**	30.3	9.4	50.9
Kazakhstan	24	**-3**	0	21.9	11.5	52.6
Brunei Darussalam	24	**-5**	**-4**	37.9	10.9	51.9
Peru	23	0	**-2**	29.1	10.3	53.2
Brazil	23	**1**	**-2**	28.4	10.8	54.3
Saudi Arabia	23	0	0	37.5	9.0	54.0
Panama*	23	**3**	**-1**	20.9	6.8	53.0
El Salvador	23	**5**	**1**	25.8	8.7	55.5
Thailand	21	**-3**	**-2**	28.0	6.7	63.1
Bulgaria	21	**-5**	**-5**	27.1	7.8	61.4
Jordan	20	0	**1**	34.4	6.5	64.0
North Macedonia	19	**-4**	**-2**	32.5	7.7	66.1
Indonesia	19	**-2**	**-2**	23.7	4.8	68.8
Dominican Republic**	15	**-3**	**-5**	26.7	1.3	80.9
Morocco	15	**-5**	**-4**	41.9	5.2	76.7
Uzbekistan	14	**-6**	**-4**	40.8	1.7	83.5
Philippines	14	**-5**	**-6**	43.6	5.7	77.7
Albania**	13	**-8**	**-8**	34.7	2.9	84.2
Chinese Taipei	33	**-4**	**-2**	29.2	27.2	22.3
Macao (China)	32	**-6**	**-3**	37.1	22.4	23.1
Hong Kong (China)*	32	**-5**	**-2**	29.2	21.7	22.7
Ukrainian regions (18 of 27)	27	**-1**	-1	33.4	13.7	39.7
Cyprus	24	**-2**	**1**	33.9	10.4	52.5
Baku (Azerbaijan)	23	**-1**	**1**	34.2	7.7	56.4
Palestinian Authority	18	**-2**	**-2**	37.3	5.7	69.5

* Caution is required when interpreting estimates because one or more PISA sampling standards were not met. ** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
1: A student's relative performance in creative thinking is defined as the residual obtained upon a cubic polynomial regression of the student's performance in creative thinking over his or her performance in mathematics (reading). The regression is performed at an international level, pooling data from all countries and economies that participated in the creative thinking assessment. 2. Explained variance is the R squared coefficient from a regression of creative thinking score on mathematics performance, gender and students' and schools' socio-economic profile (ESCS). Variation uniquely associated with mathematics performance is measured as the difference between the R squared of the full regression and the R squared of the same regression without mathematics performance.
Note: Values that are statistically significant are marked in bold (see Annex A3). *Countries and economies are ranked in descending order of the mean performance in creative thinking.*
Source: OECD, PISA 2022 Database, Tables III.B1.2.1, III.B1.2.2 and III.B1.2.4. The StatLink URL of this table is available below Snapshot Table III.6

Table III.2. Snapshot of gender gaps in performance

Countries/economies with a mean score/share of high achievers **above** the OECD average
Countries/economies with a mean score/share of high achievers **not significantly different** from the OECD average
Countries/economies with a mean score/share of high achievers **below** the OECD average

	Creative thinking performance			High achievers (75th percentile within their country/economy)		
	Girls	Boys	Difference between boys and girls	Girls	Boys	Difference between boys and girls
	Mean score	Mean score	Score dif.	%	%	% dif.
OECD average	34	31	**-3**	28.8	21.3	**-7.4**
Mexico	29	29	0	25.0	25.0	0.0
Peru	24	23	0	25.7	24.3	-1.4
Chile	31	30	-1	25.8	24.3	-1.4
Costa Rica	28	27	**-1**	26.4	23.7	-2.7
El Salvador	24	22	**-1**	26.6	23.4	-3.2
Uruguay	29	28	**-1**	26.5	23.6	-3.0
Panama*	24	23	**-1**	27.3	22.8	**-4.4**
Indonesia	20	18	**-1**	27.1	22.8	**-4.3**
Colombia	26	25	**-2**	27.2	22.6	**-4.6**
Uzbekistan	15	14	**-2**	27.3	22.8	**-4.5**
Italy	32	30	**-2**	26.9	23.1	**-3.8**
Singapore	42	40	**-2**	28.0	22.2	**-5.8**
Portugal	35	33	**-2**	27.9	22.2	**-5.8**
Romania	27	25	**-2**	27.1	22.9	**-4.2**
Hungary	32	30	**-2**	28.0	22.0	**-5.9**
Spain	34	32	**-2**	28.1	22.0	**-6.0**
Belgium	36	34	**-2**	28.2	21.8	**-6.4**
Brazil	25	22	**-2**	27.9	22.1	**-5.7**
France	34	31	**-3**	28.3	21.6	**-6.6**
Israel	34	31	**-3**	26.8	23.3	-3.5
Canada*	39	37	**-3**	28.5	21.6	**-6.9**
Dominican Republic**	17	14	**-3**	28.7	20.8	**-7.9**
Latvia*	36	34	**-3**	29.9	20.0	**-9.8**
Serbia	30	27	**-3**	28.4	21.7	**-6.7**
Denmark*	37	34	**-3**	29.5	20.7	**-8.9**
Australia*	39	36	**-3**	29.0	21.0	**-8.0**
Poland	36	33	**-3**	28.9	21.2	**-7.6**
Czechia	34	31	**-3**	29.1	21.0	**-8.1**
Greece	28	26	**-3**	29.3	20.9	**-8.4**
Morocco	17	14	**-3**	29.1	21.0	**-8.2**
Croatia	32	29	**-3**	29.2	21.1	**-8.1**
Kazakhstan	25	22	**-3**	28.0	22.1	**-5.9**

The StatLink URL of this table is available below Snapshot Table III.6

Countries/economies with a mean score/share of high achievers **above** the OECD average
Countries/economies with a mean score/share of high achievers **not significantly different** from the OECD average
Countries/economies with a mean score/share of high achievers **below** the OECD average

	Creative thinking performance			High achievers (75th percentile within their country/economy)		
	Girls	Boys	Difference between boys and girls	Girls	Boys	Difference between boys and girls
	Mean score	Mean score	Score dif.	%	%	% dif.
Moldova	26	23	**-3**	29.0	21.4	**-7.6**
Korea	40	37	**-3**	28.7	21.6	**-7.1**
Germany	34	31	**-3**	29.3	20.9	**-8.4**
North Macedonia	21	18	**-3**	29.1	21.3	**-7.8**
Netherlands*	34	31	**-3**	30.0	20.3	**-9.6**
Bulgaria	22	19	**-3**	28.7	21.8	**-6.9**
New Zealand*	38	35	**-3**	29.6	20.5	**-9.1**
Malaysia	27	23	**-3**	28.4	21.6	**-6.9**
Slovak Republic	31	28	**-3**	30.2	20.4	**-9.8**
Albania**	15	11	**-3**	31.1	19.4	**-11.7**
Estonia	38	34	**-3**	30.6	19.8	**-10.9**
Lithuania	35	31	**-3**	29.5	20.4	**-9.1**
Mongolia	27	23	**-4**	30.5	19.6	**-10.9**
Thailand	23	19	**-4**	29.4	20.3	**-9.0**
Brunei Darussalam	26	22	**-4**	29.4	20.8	**-8.6**
Philippines	16	12	**-4**	30.3	19.6	**-10.7**
Slovenia	32	28	**-4**	30.9	19.5	**-11.4**
Malta	34	29	**-5**	31.0	19.4	**-11.6**
Iceland	33	28	**-5**	31.5	18.8	**-12.7**
Qatar	30	25	**-5**	30.9	19.2	**-11.7**
United Arab Emirates	31	26	**-5**	29.4	20.8	**-8.5**
Jamaica*	28	23	**-5**	30.9	18.1	**-12.8**
Saudi Arabia	26	20	**-6**	32.6	17.1	**-15.5**
Finland	39	33	**-6**	33.1	17.2	**-15.9**
Jordan	23	17	**-7**	34.0	15.3	**-18.7**
Ukrainian regions (18 of 27)	28	26	**-2**	26.3	23.7	-2.6
Chinese Taipei	34	31	**-4**	29.7	20.6	**-9.0**
Baku (Azerbaijan)	25	21	**-4**	30.6	20.0	**-10.6**
Hong Kong (China)*	34	30	**-4**	30.0	20.7	**-9.3**
Macao (China)	34	30	**-4**	30.6	19.7	**-10.9**
Cyprus	26	21	**-5**	31.1	19.2	**-11.9**
Palestinian Authority	21	15	**-6**	32.3	15.9	**-16.4**

* Caution is required when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).
** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Note: Values that are statistically significant are marked in bold (see Annex A3).
Countries and economies are ranked in descending order of the gender gap (boys-girls) in creative thinking performance.
Source: OECD, PISA 2022 Database, Tables III.B1.3.2 and III.B1.3.3. The StatLink URL of this table is available below Snapshot Table III.6

Table III.3. Snapshot of socio-economic disparities in performance

(light blue)	Countries/economies with a strength of socio-economic gradient **below** the OECD average Countries/economies with a mean score or a share of resilient students **above** the OECD average
(white)	Countries/economies with a strength of socio-economic gradient/mean score/share of resilient students **not significantly different** from the OECD average
(grey)	Countries/economies with a strength of socio-economic gradient **above** the OECD average Countries/economies with a mean score or a share of resilient students **below** the OECD average

	Socio-economic disparities in performance					
	At the student level					At the school level
	Strength: Percentage of variance explained by ESCS[1] (R^2)	Disadvantaged students[2]	Advantaged students	Difference between advantaged and disadvantaged students, after accounting for mathematic and reading performance	Share of resilient students[3]	Difference between students in advantaged and disadvantaged schools
	%	Mean score	Mean score	Score dif.	%	Score dif.
OECD average	11.6	28	38	2	12.5	**11**
Uzbekistan	1.5	13	16	0	20.1	**5**
Kazakhstan	3.0	22	27	1	18.2	**9**
Jamaica*	3.4	23	29	0	18.5	**17**
Jordan	3.7	18	24	0	16.9	**6**
Morocco	4.3	13	19	0	17.4	**10**
United Arab Emirates	4.7	23	32	**2**	13.6	**11**
Indonesia	4.9	16	22	**2**	16.2	**8**
Albania**	5.0	11	17	**2**	18.3	**7**
Saudi Arabia	5.5	20	28	**2**	15.5	**4**
Dominican Republic**	5.8	13	19	1	15.5	**9**
Croatia	5.8	28	34	0	15.9	**12**
Korea	6.4	35	41	0	16.7	**7**
Canada*	6.6	34	42	**2**	16.1	**6**
Chile	6.7	27	35	**1**	17.1	**8**
Philippines	6.7	10	19	**2**	11.9	**13**
Estonia	6.9	33	39	1	15.0	**6**
Denmark*	7.6	32	38	**1**	13.6	**5**
Spain	7.9	29	37	**2**	15.3	**6**
Latvia*	8.5	32	38	**2**	14.6	**6**
Qatar	8.8	22	33	**2**	11.4	**14**
Finland	9.4	32	41	**2**	13.4	**5**
Italy	9.5	27	35	**2**	12.6	**11**
Serbia	9.5	24	33	**2**	14.0	**13**
Australia*	9.6	33	42	**2**	13.6	**9**
Netherlands*	9.7	28	38	**2**	11.9	**16**
Mexico	10.0	25	33	**2**	12.1	**11**
Slovenia	10.1	26	34	**3**	12.7	**12**
Malta	10.2	27	37	**2**	13.2	**9**
Portugal	10.5	30	39	1	13.6	**8**
Thailand	10.5	17	27	**3**	13.6	**13**
Iceland	10.6	25	35	**3**	10.8	**5**
Malaysia	11.4	21	31	0	13.0	**10**

The StatLink URL of this table is available below Snapshot Table III.6

(light blue)	Countries/economies with a strength of socio-economic gradient **below** the OECD average Countries/economies with a mean score or a share of resilient students **above** the OECD average
(white)	Countries/economies with a strength of socio-economic gradient/mean score/share of resilient students **not significantly different** from the OECD average
(grey)	Countries/economies with a strength of socio-economic gradient **above** the OECD average Countries/economies with a mean score or a share of resilient students **below** the OECD average

	Socio-economic disparities in performance					
	At the student level					At the school level
	Strength: Percentage of variance explained by ESCS[1] (R^2)	Disadvantaged students[2]	Advantaged students	Difference between advantaged and disadvantaged students, after accounting for mathematic and reading performance	Share of resilient students[3]	Difference between students in advantaged and disadvantaged schools
	%	Mean score	Mean score	Score dif.	%	Score dif.
Greece	11.9	23	32	**3**	11.7	**11**
North Macedonia	12.2	14	26	**3**	11.9	**17**
Mongolia	12.2	20	30	1	11.3	**10**
Brazil	12.4	19	30	**3**	11.9	**14**
Poland	12.7	30	40	**3**	11.4	**15**
Germany	13.1	28	39	1	13.4	**15**
El Salvador	13.2	18	29	**3**	10.1	**13**
Colombia	13.5	20	32	**3**	10.6	**13**
Panama*	13.7	18	29	**3**	11.4	**13**
Uruguay	13.8	24	34	**2**	11.7	**12**
Singapore	14.1	36	45	**2**	9.9	**9**
Belgium	14.6	30	40	**1**	11.2	**12**
Moldova	14.9	19	30	**3**	10.2	**13**
Czechia	15.0	27	38	**2**	10.3	**13**
Lithuania	15.4	28	38	**3**	11.0	**12**
Brunei Darussalam	15.6	19	31	**2**	11.4	**15**
France	16.1	27	38	**2**	10.4	**14**
Israel	16.8	25	39	**2**	10.4	**16**
New Zealand*	17.1	31	42	**5**	9.0	**10**
Slovak Republic	17.7	22	36	**2**	9.4	**17**
Peru	19.1	16	30	**5**	6.5	**15**
Bulgaria	19.5	14	28	**4**	7.4	**19**
Hungary	19.8	24	37	**2**	10.1	**18**
Romania	22.7	19	34	**3**	7.9	**19**
Baku (Azerbaijan)	4.8	20	26	**2**	15.9	**6**
Hong Kong (China)*	5.1	29	35	**2**	17.3	**10**
Palestinian Authority	5.7	15	22	**1**	13.6	**5**
Macao (China)	6.4	28	35	**3**	16.0	**9**
Cyprus	7.9	20	29	**1**	13.8	**12**
Chinese Taipei	9.5	28	37	1	12.5	**12**
Ukrainian regions (18 of 27)	13.4	21	32	**3**	10.2	**13**

* Caution is required when interpreting estimates because one or more PISA sampling standards were not met. ** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
1. ESCS refers to the PISA index of economic, social and cultural status.
2. A socio-economically advantaged (disadvantaged) student (school) is a student (school) in the top (bottom) quarter of ESCS in his or her own country/economy.
3. Academically resilient students are disadvantaged students who scored in the top quarter of performance in creative thinking amongst students in their own country/economy.
Note: Values that are statistically significant are marked in bold (see Annex A3).
Countries and economies are ranked in ascending order of the percentage of variance in creative thinking performance explained by ESCS.
Source: OECD, PISA 2022 Database, Tables III.B1.3.7 and III.B1.3.15. The StatLink URL of this table is available below Snapshot Table III.6

Table III.4. Snapshot of performance across ideation processes and context domains

(light blue)	Countries/economies with values **above** the OECD average
(white)	Countries/economies with values **not significantly different** from the OECD average
(grey)	Countries/economies with values **below** the OECD average

	Success in the creative thinking test (percentage of full credit)										
	Across ideation processes			Across domain contexts							
	Generate diverse ideas (12 items)	Generate creative ideas (11 items)	Evaluate and improve ideas (9 items)	Written expression (12 items)		Visual expression (4 items)		Social problem solving (10 items)		Scientific problem solving (6 items)	
				All students	Gender gap[1]	All students	Gender gap	All students	Gender gap	All students	Gender gap
	%	%	%	%	%	%	%	%	%	%	%
OECD average	**42.9**	**44.1**	**34.2**	**50.3**	**-6.3**	**32.2**	**-7.6**	**39.0**	**-4.3**	**32.2**	**-1.6**
Singapore	61.0	57.6	44.5	66.2	**-3.3**	34.1	**-6.4**	58.1	-2.4	42.6	-1.9
Canada*	55.0	53.0	39.9	61.4	**-6.2**	35.1	**-8.8**	49.5	**-5.6**	38.4	-0.5
Korea	57.6	48.1	45.9	60.6	-3.0	37.7	**-7.4**	50.1	**-6.1**	47.4	0.4
New Zealand*	51.6	51.6	39.4	58.2	**-8.6**	36.5	-5.0	48.2	**-6.3**	35.7	-3.5
Estonia	48.0	52.1	40.5	57.9	**-7.8**	36.4	**-12.6**	44.8	**-5.3**	40.2	-2.7
Australia*	49.1	51.9	38.1	56.9	**-6.0**	38.1	**-7.5**	45.8	**-7.8**	35.5	-2.0
Denmark*	48.0	49.2	37.4	55.5	**-6.4**	37.7	**-9.6**	41.5	**-8.5**	37.7	-3.1
Czechia	40.9	49.7	36.3	55.3	**-5.5**	36.6	**-7.0**	36.9	**-2.5**	31.2	-2.6
Latvia*	42.6	48.1	38.9	54.8	**-7.5**	37.0	**-11.5**	42.0	**-6.3**	30.9	0.3
Lithuania	41.4	52.2	34.6	54.4	**-6.8**	36.3	**-7.0**	38.9	**-7.6**	31.1	**-3.4**
Poland	44.3	48.0	41.1	52.7	**-7.4**	35.9	**-8.3**	43.3	**-3.9**	34.7	-1.2
Finland	47.2	46.6	43.1	52.0	**-14.8**	32.4	**-10.9**	49.6	**-11.0**	37.2	**-5.5**
Belgium	46.2	47.8	34.1	52.0	**-6.1**	34.9	**-6.1**	42.0	-1.6	35.0	-1.7
Iceland	40.1	44.3	29.1	51.6	**-10.4**	27.0	**-9.4**	32.1	**-4.9**	27.5	-4.1
Chile	42.1	41.2	30.6	51.5	-3.0	30.6	**-11.6**	33.3	-1.2	27.4	-0.5
Italy	42.1	42.5	30.6	51.4	**-6.3**	25.4	**-4.0**	33.7	-2.3	34.0	0.2
Portugal	49.3	41.9	38.1	49.8	**-4.8**	41.1	**-4.8**	41.5	**-3.2**	36.7	1.3
Mexico	40.5	40.9	30.1	49.2	-1.2	36.6	-4.2	32.9	-1.1	25.7	3.2
Spain	45.3	40.5	36.8	48.8	**-4.4**	33.3	**-8.1**	39.3	**-2.0**	38.1	-1.6
Germany	37.1	46.7	36.8	48.6	**-7.4**	35.8	**-9.5**	38.5	**-6.8**	30.4	-1.3
France	41.3	42.1	31.3	48.4	**-5.0**	27.7	**-9.4**	37.0	-1.7	34.2	-2.4
Serbia	36.7	45.2	28.5	47.8	**-7.8**	27.9	**-5.0**	34.2	**-4.3**	25.3	-3.2
Israel	44.1	43.0	37.3	47.6	**-4.9**	31.7	**-13.8**	42.4	-2.8	35.5	-3.4
Croatia	40.7	38.6	29.5	47.0	**-4.1**	23.9	1.4	34.8	**-4.2**	29.5	**-3.9**
Hungary	41.7	40.2	28.7	47.0	**-5.7**	28.6	**-6.8**	37.2	**-5.0**	25.1	**-4.4**
Netherlands*	42.7	41.5	29.5	46.2	**-6.8**	28.5	**-6.7**	38.1	-3.4	33.4	**-4.0**
Uruguay	39.1	36.5	29.2	44.6	**-4.6**	27.0	-4.1	33.5	-0.7	24.6	1.8
Qatar	34.3	38.8	34.4	43.4	**-8.3**	30.1	**-9.1**	34.8	-2.6	27.9	-2.2
Slovak Republic	39.2	34.7	26.9	43.0	**-7.9**	29.0	-3.0	31.0	-1.4	26.1	0.7
Slovenia	30.3	39.5	29.1	42.7	**-8.9**	28.5	**-6.5**	31.5	**-3.3**	21.1	-2.7
Malta	37.1	39.9	29.3	42.2	**-5.8**	30.6	-5.7	35.5	**-4.6**	27.6	-1.4
United Arab Emirates	36.5	34.9	30.8	40.8	**-5.8**	30.5	**-7.6**	34.7	**-4.8**	26.6	-1.8

The StatLink URL of this table is available below Snapshot Table III.6

Countries/economies with values **above** the OECD average
Countries/economies with values **not significantly different** from the OECD average
Countries/economies with values **below** the OECD average

	Success in the creative thinking test (percentage of full credit)										
	Across ideation processes			Across domain contexts							
	Generate diverse ideas (12 items)	Generate creative ideas (11 items)	Evaluate and improve ideas (9 items)	Written expression (12 items)		Visual expression (4 items)		Social problem solving (10 items)		Scientific problem solving (6 items)	
				All students	Gender gap[1]	All students	Gender gap	All students	Gender gap	All students	Gender gap
	%	%	%	%	%	%	%	%	%	%	%
Romania	33.8	35.9	23.7	40.0	**-4.4**	34.6	**-11.4**	27.6	-0.2	23.4	-0.7
Colombia	29.2	33.9	25.2	38.2	**-3.9**	22.8	-3.1	26.7	-1.1	24.3	-0.6
Moldova	28.7	33.2	22.7	37.8	-2.7	20.7	**-4.3**	26.5	-2.9	22.8	0.1
Costa Rica	32.1	31.8	25.2	37.0	**-3.9**	20.2	**-4.8**	32.2	**-3.9**	23.2	0.8
Greece	32.7	33.1	23.3	36.9	**-7.3**	20.1	**-4.7**	32.1	**-3.9**	23.4	-1.1
Mongolia	27.5	29.3	24.1	35.2	**-4.6**	23.8	**-5.5**	23.2	**-4.0**	22.1	-1.8
Brunei Darussalam	27.4	32.0	22.2	34.9	**-4.8**	24.4	-4.0	25.2	1.1	16.0	-2.4
Jamaica*	26.6	32.1	25.9	34.5	**-5.8**	23.3	**-9.4**	27.9	-4.2	20.3	-3.1
El Salvador	26.9	33.9	23.0	34.4	**-3.3**	26.7	-2.3	26.3	-0.7	19.5	0.5
Peru	32.2	30.5	20.2	33.1	-1.6	19.2	-3.9	29.2	**-3.5**	23.0	1.2
Brazil	29.3	30.0	22.2	32.7	**-5.8**	22.6	**-5.3**	28.2	-1.7	19.3	-1.2
Kazakhstan	26.3	30.3	19.8	32.1	**-2.7**	21.8	**-4.0**	27.9	**-2.4**	18.6	1.4
Panama*	25.6	24.8	21.8	31.9	**-3.8**	23.1	-2.6	21.1	-6.7	16.3	0.7
Malaysia	27.3	29.2	23.8	29.8	-1.0	25.4	**-4.5**	32.1	-0.2	15.1	**-3.9**
Thailand	29.7	26.1	20.1	28.2	-1.8	23.2	-1.6	28.0	**-3.1**	25.5	-0.6
Saudi Arabia	21.5	26.1	20.7	27.0	**-7.6**	10.8	**-5.2**	25.0	-3.4	18.7	**-2.3**
Bulgaria	22.3	25.6	20.3	26.9	**-3.9**	22.6	**-5.0**	21.5	**-3.4**	19.1	-2.7
North Macedonia	19.2	25.0	18.8	25.5	**-5.0**	18.5	**-6.1**	20.0	-0.5	17.5	0.4
Jordan	23.0	22.3	17.2	23.8	**-7.5**	18.4	**-6.7**	24.0	**-3.8**	14.9	**-2.5**
Philippines	15.8	16.6	11.3	21.6	-1.5	16.9	1.1	11.4	-0.8	8.4	-0.6
Dominican Republic**	12.0	16.1	11.7	19.6	**-2.0**	20.7	0.0	10.7	-0.5	7.4	-0.2
Indonesia	17.5	14.6	12.8	19.2	-0.4	17.7	-1.1	14.5	1.7	6.0	0.1
Morocco	13.8	18.1	14.5	18.4	**-2.9**	10.8	0.0	17.1	**-2.5**	12.2	-0.9
Uzbekistan	13.0	18.9	12.8	15.9	**-2.7**	11.1	-1.2	15.7	-1.7	15.6	-1.2
Albania**	10.7	12.8	5.2	14.1	-1.8	3.0	**-1.8**	9.6	0.2	10.3	-0.5
Chinese Taipei	46.0	47.2	34.8	51.8	**-7.0**	32.9	**-8.4**	43.8	**-4.9**	35.3	-0.5
Hong Kong (China)*	37.1	40.0	33.5	47.6	**-4.9**	25.7	**-12.4**	38.3	**-7.8**	25.9	-2.5
Macao (China)	35.6	39.1	36.4	40.5	**-7.5**	30.5	-3.7	39.5	**-12.6**	35.7	-1.3
Ukrainian regions (18 of 27)	28.5	37.2	34.7	39.8	**-5.1**	23.4	**-21.7**	29.7	-1.9	33.0	2.6
Cyprus	27.2	31.3	26.3	32.3	**-6.5**	26.4	**-10.0**	28.3	**-5.8**	21.2	**-4.4**
Baku (Azerbaijan)	25.0	30.7	25.4	32.2	**-7.6**	18.1	-2.8	26.6	**-2.7**	25.7	-1.7
Palestinian Authority	16.1	21.5	15.0	20.1	**-5.8**	7.0	-8.9	21.8	-2.7	14.7	-2.1

* Caution is required when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).
** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
1. The gender gap is the difference between boys' and girls' relative successes across the four domain contexts of the test. For each domain context, the relative success is the difference between the percentage of correct responses in this domain context and the average percent correct in all other tasks (full credit only).
Note: Values that are statistically significant are marked in bold (see Annex A3).
Countries and economies are ranked in descending order of the mean percentage in written expression.
Source: OECD, PISA 2022 Database, Tables III.B1.4.1, III.B1.4.2 and III.B1.4.8. The StatLink URL of this table is available below Snapshot Table III.6

Table III.5. Snapshot of beliefs, attitudes and social-emotional characteristics positively related to creative thinking

Countries/economies with values **above** the OECD average
Countries/economies with values **not significantly different** from the OECD average
Countries/economies with values **below** the OECD average

	Percentage of students who reported						
	Beliefs		Attitudes		Social-emotional characteristics		
	Growth mindset on creativity	Nature of creativity	Imagination and adventurousness	Openness to intellect	Perspective taking	Curiosity	Persistence
	My creativity is something about me that I can change	It is possible to be creative in nearly any subject	Coming up with new ideas is satisying to me	I enjoy learning new things	I want to understand why people behave the way they do	I am curious about many different things	I apply additional effort when work becomes challenging
	%	%	%	%	%	%	%
OECD average	46.3	81.6	74.1	82.7	67.6	77.3	61.7
Ireland*	61.9	82.2	74.3	87.4	70.5	84.4	56.3
Kazakhstan	60.8	86.0	76.4	87.5	64.9	77.0	66.9
Georgia	60.2	76.7	80.6	85.5	68.9	76.9	55.2
Costa Rica	57.5	85.5	87.7	92.8	73.9	83.2	74.6
Brazil	56.9	79.3	71.7	87.4	60.7	72.0	59.0
Austria	54.6	83.0	57.2	75.9	68.1	78.9	74.8
Iceland	53.1	82.7	67.6	78.1	62.4	81.6	63.3
Latvia*	52.4	75.5	72.6	73.6	66.6	78.0	61.4
Türkiye	52.4	74.8	85.5	87.7	77.2	77.5	71.3
Estonia	52.3	77.1	71.4	79.8	69.1	75.7	56.8
Germany	52.3	87.3	56.0	78.1	73.3	78.4	72.0
Denmark*	52.1	83.8	66.8	87.1	68.7	74.8	54.6
Canada*	50.3	85.3	79.0	86.0	68.3	78.7	61.8
Korea	50.2	81.5	72.1	76.9	67.1	75.1	68.2
New Zealand*	50.2	81.2	70.7	83.7	62.0	77.8	55.7
Australia*	49.6	82.7	72.4	82.9	65.4	79.7	60.5
Slovak Republic	48.9	74.2	62.6	77.5	72.3	79.1	58.0
Croatia	48.4	88.3	65.2	80.3	69.4	73.5	56.9
Uzbekistan	48.3	80.5	75.7	84.3	69.0	84.3	69.1
Singapore	48.0	81.2	78.7	88.3	76.7	79.0	65.6
Switzerland	47.5	86.0	64.7	84.4	68.9	82.0	65.4
Czechia	47.0	73.5	72.5	76.1	67.6	71.0	64.4
Chile	47.0	85.5	80.6	86.1	64.5	74.9	76.2
Lithuania	46.8	83.6	72.8	76.3	62.5	71.5	52.1
Thailand	46.5	83.9	74.9	83.6	60.7	69.4	77.4
Poland	46.4	87.0	66.4	74.7	64.5	78.1	52.6
United Kingdom*	46.1	74.8	69.8	81.2	65.1	76.9	56.5
Finland	45.6	86.6	67.9	75.0	63.5	76.6	37.5
Mongolia	44.6	78.9	80.9	86.9	72.8	87.0	65.7
Uruguay	43.6	81.3	79.9	89.4	66.3	76.1	71.7
United Arab Emirates	43.2	81.4	80.0	85.3	65.9	68.0	67.7
Jordan	42.9	69.4	73.7	77.9	54.4	45.7	60.4
Bulgaria	42.7	77.2	71.4	78.8	63.6	71.6	61.1
Serbia	42.6	78.0	66.5	72.3	67.9	73.1	68.7
Colombia	42.6	86.2	84.8	92.1	68.9	83.6	78.3
Brunei Darussalam	42.2	81.3	79.8	90.1	73.6	74.9	60.0
Norway	42.0	74.3	m	81.3	m	71.2	42.9

The StatLink URL of this table is available below Snapshot Table III.6

Countries/economies with values **above** the OECD average
Countries/economies with values **not significantly different** from the OECD average
Countries/economies with values **below** the OECD average

	Percentage of students who reported						
	Beliefs		Attitudes		Social-emotional characteristics		
	Growth mindset on creativity	Nature of creativity	Imagination and adventurousness	Openness to intellect	Perspective taking	Curiosity	Persistence
	My creativity is something about me that I can change	It is possible to be creative in nearly any subject	Coming up with new ideas is satisying to me	I enjoy learning new things	I want to understand why people behave the way they do	I am curious about many different things	I apply additional effort when work becomes challenging
	%	%	%	%	%	%	%
Peru	41.5	86.8	86.7	94.9	72.8	83.1	79.7
Mexico	41.0	85.7	83.7	92.6	64.6	80.1	77.8
Portugal	40.9	91.1	92.4	94.3	73.1	82.4	70.8
Spain	40.0	85.9	82.7	90.6	69.5	75.2	71.4
Montenegro	39.8	71.6	71.2	84.4	63.8	63.7	67.4
Malta	39.5	73.8	78.4	85.9	72.3	81.6	64.6
Hungary	39.3	73.0	74.7	81.7	63.7	73.5	57.7
Slovenia	38.9	72.0	78.7	61.2	65.0	73.2	60.6
Italy	38.8	87.2	83.6	90.2	75.9	77.6	62.1
Belgium	38.7	82.3	66.7	84.2	66.1	71.7	52.6
Dominican Republic	38.2	74.7	73.3	81.2	66.7	75.5	69.7
Argentina	37.9	77.3	79.7	86.4	64.6	58.0	57.6
Qatar	37.6	77.5	78.2	83.4	63.9	65.8	65.2
Saudi Arabia	37.4	81.1	77.2	83.9	60.4	64.2	68.2
Greece	36.3	77.7	85.0	89.9	71.2	79.1	68.1
Panama*	36.2	85.3	84.5	92.4	68.0	80.1	77.7
France	36.2	84.4	83.8	86.6	68.9	76.4	51.2
Romania	36.0	84.7	84.6	88.6	75.9	81.8	60.7
Malaysia	35.6	76.8	74.8	81.7	66.3	72.4	70.5
North Macedonia	35.2	76.1	75.5	81.5	65.6	59.2	65.3
El Salvador	35.2	82.1	80.9	89.2	65.8	72.5	72.8
Morocco	34.6	71.9	71.8	80.1	60.0	49.3	71.6
Philippines	33.8	80.7	81.1	88.8	70.1	71.2	71.4
Indonesia	32.0	81.2	87.8	88.6	66.8	72.2	66.4
Jamaica*	30.8	81.7	77.0	89.6	73.5	81.6	67.6
Netherlands*	30.6	72.2	55.2	78.4	55.6	72.7	48.6
Moldova	29.3	78.0	81.7	87.0	62.8	75.9	62.6
Albania	27.5	76.6	77.5	88.0	63.5	73.8	71.1
Israel	m	87.8	84.5	86.0	m	m	m
Chinese Taipei	63.6	89.8	85.0	84.1	70.5	77.8	70.2
Macao (China)	49.0	78.3	80.3	79.3	70.4	73.5	58.4
Ukrainian regions (18 of 27)	47.2	85.8	77.5	79.3	57.8	58.2	59.7
Hong Kong (China)*	44.1	78.4	80.9	81.9	68.5	67.9	54.5
Baku (Azerbaijan)	42.9	75.5	80.2	85.1	64.4	58.2	59.2
Cyprus	41.2	71.1	76.6	78.6	63.5	67.2	59.5
Palestinian Authority	36.1	74.9	79.6	81.8	56.9	47.8	64.6
Kosovo	30.7	74.6	76.5	85.1	60.6	70.8	67.5

* Caution is required when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4). *Countries and economies are ranked in descending order of the percentage of students who reported "My creativity is something about me that I can change".* Source: OECD, PISA 2022 Database, Tables III.B1.5.1, III.B1.5.4, III.B1.5.11, III.B1.5.19, III.B1.5.23, III.B1.5.29 and III.B1.5.33. The StatLink URL of this table is available below Snapshot Table III.6

Table III.6. Snapshot of school environment conductive to creative thinking

Countries/economies with values **above** the OECD average
Countries/economies with values **not significantly different** from the OECD average
Countries/economies with values **below** the OECD average

	Pedagogies encouraging creative thinking				Weekly participation in classes/activities at school			
	Percentage of students who agreed:				Percentage of students who reported weekly participation in:			
	My teachers encourage me to come up with original answers	My teachers give me enough time to come up with creative solutions on assignements	My teachers value student creativity	At school, I am given a chance to express my ideas	Art (e.g. painting, drawing)	Music (e.g. choir, band)	Computer programming	Creative writing
	%	%	%	%	%	%	%	%
OECD average	63.7	62.5	70.1	69.3	27.4	21.7	17.2	16.3
El Salvador	82.9	79.2	84.3	83.0	24.7	21.9	25.7	27.1
Peru	82.6	79.5	87.1	83.2	47.0	24.5	20.2	33.8
Albania	82.1	79.2	80.3	84.9	38.1	37.0	38.5	40.9
Philippines	81.2	83.0	86.2	83.4	34.5	32.8	29.7	37.7
Kazakhstan	80.5	81.2	83.8	85.0	32.7	27.1	33.7	34.4
Colombia	80.0	78.3	83.9	83.5	45.1	27.0	30.2	35.0
Uzbekistan	79.7	74.2	76.9	82.6	32.9	33.5	38.9	34.9
Singapore	79.6	76.5	79.9	80.6	14.9	18.0	11.9	15.4
Brunei Darussalam	78.9	76.5	85.0	71.7	22.1	6.0	16.2	24.6
United Arab Emirates	78.0	72.9	77.1	75.9	31.0	23.4	35.2	31.9
Jamaica*	78.0	72.5	84.1	74.7	27.6	20.6	23.4	34.5
Qatar	77.8	69.8	75.0	72.6	29.3	21.1	29.7	29.6
Indonesia	77.6	86.4	89.8	88.0	31.3	27.0	31.4	29.3
Costa Rica	77.2	77.1	83.8	80.3	32.6	31.1	26.4	19.6
Australia*	76.9	69.4	74.6	74.1	25.4	19.5	12.6	23.1
Saudi Arabia	76.3	70.5	76.5	74.3	19.5	17.3	26.6	21.9
Portugal	76.1	70.9	79.6	79.0	10.4	7.0	7.4	7.3
Chile	75.7	74.2	82.0	76.1	35.4	30.3	15.9	22.0
Mexico	75.5	76.7	82.1	80.7	24.0	15.3	19.6	21.8
Dominican Republic	75.2	71.2	75.3	75.8	36.5	28.2	28.0	33.3
Iceland	75.2	68.9	77.6	75.6	23.6	18.9	8.9	18.6
Ireland*	75.1	69.8	75.1	71.4	33.3	25.9	19.8	23.5
Canada*	74.7	71.3	75.2	77.0	28.1	19.1	14.7	22.9
Brazil	74.4	63.3	76.2	70.8	38.8	18.7	20.5	39.3
Georgia	74.1	70.9	77.5	78.5	22.6	22.1	20.1	23.1
Panama*	74.0	69.5	79.1	74.2	32.1	26.7	23.9	27.7
Romania	73.6	62.4	76.6	74.0	29.9	24.9	29.3	21.2
New Zealand*	73.0	67.5	73.9	73.2	25.2	18.5	13.7	20.8
Malaysia	72.7	77.2	85.4	75.7	28.5	15.3	20.4	23.1
North Macedonia	72.1	67.1	75.3	75.4	40.1	36.8	35.6	35.5
Moldova	70.9	69.7	78.9	77.8	18.1	18.4	22.4	21.6
United Kingdom*	70.6	61.9	66.0	66.5	24.0	15.3	14.0	21.4
Jordan	70.4	62.9	67.8	71.0	29.7	23.4	28.3	29.1
Croatia	69.3	60.8	75.5	71.6	16.8	15.4	37.5	13.9
Morocco	68.9	54.7	65.5	68.4	17.3	20.3	28.5	21.2
Argentina	68.7	65.7	73.9	76.7	23.0	16.8	27.7	20.1
Norway	68.5	55.2	66.6	61.8	32.6	24.5	12.1	19.0

Table III.6. Snapshot of school environment conductive to creative thinking

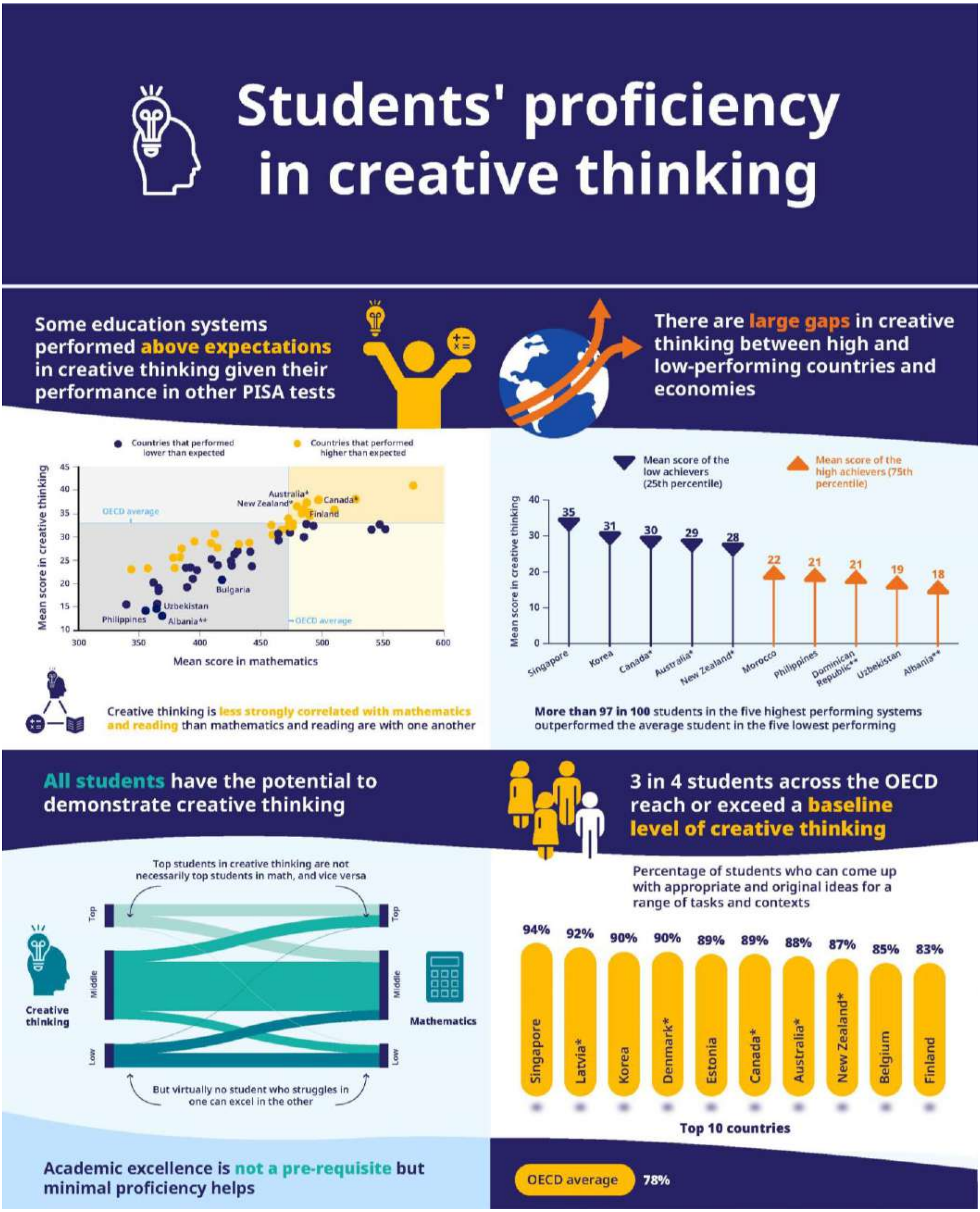
(light blue)	Countries/economies with values **above** the OECD average
(white)	Countries/economies with values **not significantly different** from the OECD average
(grey)	Countries/economies with values **below** the OECD average

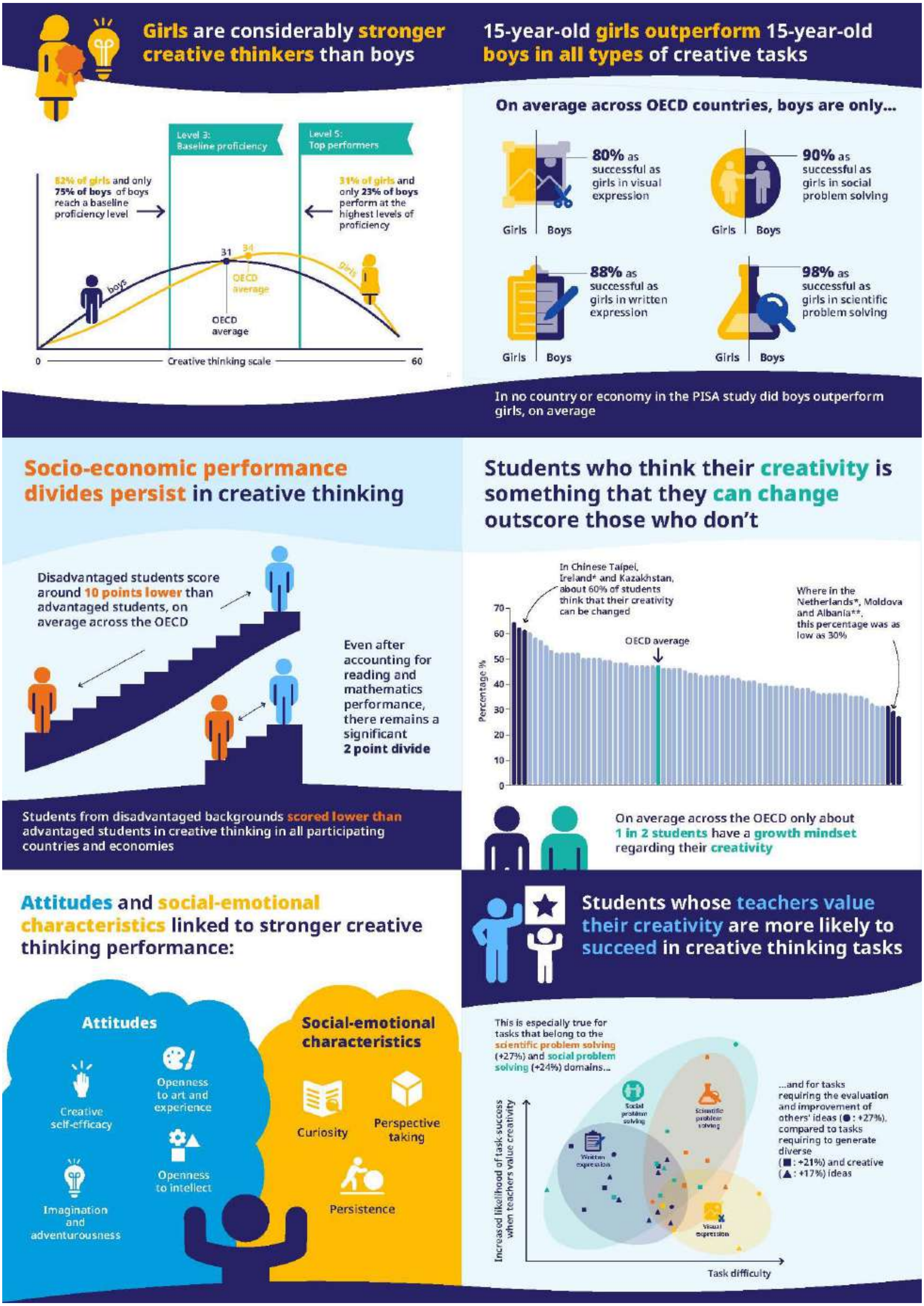
	Pedagogies encouraging creative thinking				Weekly participation in classes/activities at school			
	Percentage of students who agreed:				Percentage of students who reported weekly participation in:			
	My teachers encourage me to come up with original answers	My teachers give me enough time to come up with creative solutions on assignements	My teachers value student creativity	At school, I am given a chance to express my ideas	Art (e.g. painting, drawing)	Music (e.g. choir, band)	Computer programming	Creative writing
	%	%	%	%	%	%	%	%
Malta	68.4	60.7	68.0	66.3	17.3	9.7	20.4	25.1
Thailand	68.1	74.1	79.3	72.1	33.9	30.1	26.4	31.4
Uruguay	67.3	65.9	74.2	77.6	41.6	20.3	19.5	28.9
Denmark*	67.0	68.9	76.7	68.7	9.5	9.4	8.6	10.3
Hungary	66.5	57.8	72.6	59.7	28.5	23.9	20.9	12.8
Bulgaria	66.4	60.3	68.0	67.0	25.5	22.9	26.8	20.2
Türkiye	66.1	63.5	66.1	71.2	29.2	24.8	21.4	12.4
Montenegro	65.7	59.7	69.9	73.6	21.5	18.7	21.4	18.9
Slovenia	64.4	56.9	70.4	69.4	33.7	23.2	22.1	11.8
Slovak Republic	63.4	60.3	72.6	69.1	23.5	17.4	15.9	18.5
Serbia	63.1	59.8	71.9	68.3	21.6	18.3	21.1	14.3
Korea	62.2	72.8	72.0	78.8	59.7	54.8	29.3	27.1
Finland	61.4	67.2	76.5	72.4	31.9	21.9	14.2	19.3
Estonia	61.1	63.3	72.4	70.8	53.0	52.6	13.8	21.2
Lithuania	60.4	65.0	75.0	70.8	12.8	17.8	10.4	8.6
Mongolia	59.8	62.6	64.7	73.3	26.3	22.4	25.2	29.6
Israel	58.1	53.2	58.4	63.8	13.0	11.1	22.1	11.8
Spain	57.9	56.2	61.5	70.3	21.5	16.4	22.9	10.0
Netherlands*	57.3	61.0	74.8	65.0	32.8	12.2	10.9	12.9
Italy	56.8	54.4	63.1	73.3	10.8	7.4	13.0	8.2
Switzerland	56.5	62.0	64.9	64.1	42.2	33.1	21.1	16.7
Latvia*	56.2	60.5	70.8	69.1	29.5	24.8	11.8	16.5
Belgium	55.8	58.7	63.1	64.3	15.7	13.9	11.8	8.8
Greece	52.7	48.4	49.3	61.2	13.8	13.1	27.4	19.2
France	50.7	53.6	50.8	61.3	15.4	9.4	12.3	8.9
Germany	50.2	53.2	59.0	52.1	48.7	38.5	24.3	15.1
Czechia	50.1	49.2	68.4	61.7	14.1	13.7	8.6	6.5
Poland	46.9	43.7	64.1	64.3	12.5	9.1	12.6	6.5
Austria	45.7	54.0	60.3	55.4	39.8	35.5	34.5	16.7
Baku (Azerbaijan)	76.8	73.0	75.1	78.8	34.0	34.7	28.5	36.3
Hong Kong (China)*	74.3	74.5	77.9	80.3	29.2	32.7	15.6	16.2
Macao (China)	74.2	71.0	75.8	76.0	55.1	58.0	38.4	24.6
Palestinian Authority	74.1	66.7	71.9	71.3	37.2	22.6	35.3	31.4
Chinese Taipei	72.8	75.4	78.3	84.4	43.8	52.8	37.5	22.2
Kosovo	69.6	67.1	72.6	76.5	31.2	29.1	28.1	30.5
Ukrainian regions (18 of 27)	65.9	68.6	81.5	79.8	21.2	17.7	24.6	18.7
Cyprus	57.5	50.5	62.6	58.5	34.8	30.0	31.7	27.4

Note: * Caution is required when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).
Countries and economies are ranked in descending order of the percentage of students who reported their teachers encourage them to come up with original answers.
Source: OECD, PISA 2022 Database, Tables III.B1.6.1 and III.B1.6.6.

StatLink https://stat.link/wo63xr

Infographic 1. Creative thinking assessment results




Girls are considerably stronger creative thinkers than boys
Level 3: Baseline proficiency
Level 5: Top performers
82% of girls and only 75% of boys of boys reach a baseline proficiency level
31% of girls and only 23% of boys perform at the highest levels of proficiency
31
34
boys
girls
OECD average
OECD average
0
Creative thinking scale
60
15-year-old girls outperform 15-year-old boys in all types of creative tasks
On average across OECD countries, boys are only...
80% as successful as girls in visual expression
90% as successful as girls in social problem solving
88% as successful as girls in written expression
98% as successful as girls in scientific problem solving
Girls
Boys
In no country or economy in the PISA study did boys outperform girls, on average
Socio-economic performance divides persist in creative thinking
Disadvantaged students score around 10 points lower than advantaged students, on average across the OECD
Even after accounting for reading and mathematics performance, there remains a significant 2 point divide
Students from disadvantaged backgrounds scored lower than advantaged students in creative thinking in all participating countries and economies
Students who think their creativity is something that they can change outscore those who don't
In Chinese Taipei, Ireland* and Kazakhstan, about 60% of students think that their creativity can be changed
Where in the Netherlands*, Moldova and Albania**, this percentage was as low as 30%
OECD average
Percentage %
70
60
50
40
30
20
10
0
On average across the OECD only about 1 in 2 students have a growth mindset regarding their creativity
Attitudes and social-emotional characteristics linked to stronger creative thinking performance:
Attitudes
Creative self-efficacy
Openness to art and experience
Openness to intellect
Imagination and adventurousness
Social-emotional characteristics
Curiosity
Perspective taking
Persistence
Students whose teachers value their creativity are more likely to succeed in creative thinking tasks
This is especially true for tasks that belong to the scientific problem solving (+27%) and social problem solving (+24%) domains...
...and for tasks requiring the evaluation and improvement of others' ideas (●: +27%), compared to tasks requiring to generate diverse (■: +21%) and creative (▲: +17%) ideas
Social problem solving
Scientific problem solving
Written expression
Visual expression
Increased likelihood of task success when teachers value creativity
Task difficulty

What is PISA?

OECD's Programme for International Student Assessment (PISA)

What should citizens know and be able to do? In response to that question and to the need for internationally comparable evidence on student performance, the Organisation for Economic Co-operation and Development (OECD) launched the Programme for International Student Assessment (PISA) in 1997 and the first assessment was conducted in 2000.

PISA is a triennial survey of 15-year-old students around the world that assesses the extent to which they have acquired key knowledge and skills essential for full participation in social and economic life. PISA assessments do not just ascertain whether students near the end of their compulsory education can reproduce what they have learned; they also examine how well students can extrapolate from what they have learned and apply their knowledge in unfamiliar settings, both in and outside of school.

While the eighth assessment was originally planned for 2021, the PISA Governing Board postponed the assessment to 2022 because of the many difficulties education systems faced due to the COVID-19 pandemic.

What is unique about PISA?

PISA is unique because of its:

- **policy orientation**, which links data on student learning outcomes with data on students' backgrounds and attitudes towards learning, and with key aspects that shape their learning, in and outside of school; by doing so, PISA can highlight differences in performance and identify the characteristics of students, schools and education systems that perform well
- **innovative concept of student competency**, which refers to students' capacity to apply their knowledge and skills in key areas, and to analyse, reason and communicate effectively as they identify, interpret and solve problems in a variety of situations
- **relevance to lifelong learning**, as PISA asks students to report on their motivation to learn, their beliefs about themselves, and their learning strategies
- **regularity**, which enables countries to monitor their progress in meeting key learning objectives
- **breadth of coverage**, which, in PISA 2022, encompassed 37 OECD countries and 44 partner countries and economies.

Which countries and economies participate in PISA?

PISA is used as an assessment tool in many regions around the world. It was implemented in 43 countries and economies in the first assessment (32 in 2000 and 11 in 2002), 41 in the second assessment (2003), 57 in the third assessment (2006), 75 in the fourth assessment (65 in 2009 and 10 in 2010), 65 in the fifth assessment (2012), 72 in the sixth assessment (2015) and 79 in the seventh assessment (2018). In 2022, 81 countries and economies participated in PISA.

Figure III.1. Map of PISA countries and economies

OECD member countries in PISA 2022

Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, United Kingdom, United States

Partner countries and economies in PISA 2022

Albania, Argentina, Baku (Azerbaijan), Brazil, Brunei Darussalam, Bulgaria, Cambodia, Croatia, Cyprus, Dominican Republic, El Salvador, Georgia, Guatemala, Hong Kong (China), Indonesia, Jamaica, Jordan, Kazakhstan, Kosovo, Macao (China), Malaysia, Malta, Republic of Moldova, Mongolia, Montenegro, Morocco, North Macedonia, Palestinian Authority, Panama, Paraguay, Peru, Philippines, Qatar, Romania, Saudi Arabia, Serbia, Singapore, Chinese Taipei, Thailand, Ukraine, United Arab Emirates, Uruguay, Uzbekistan, Viet Nam

Countries and economies in previous cycles

Algeria, Azerbaijan, Beijing (China), Belarus, Bosnia and Herzegovina, Guangdong (China), Himachal Pradesh (India), Jiangsu (China), Kyrgyzstan, Lebanon, Liechtenstein, Luxembourg, Mauritius, Miranda (Venezuela), Russian Federation, Shanghai (China), Tamil Nadu (India), Trinidad and Tobago, Tunisia, Zhejiang (China)

First-time participants include Cambodia, El Salvador, Guatemala, Jamaica, Mongolia, the Palestinian Authority, Paraguay and Uzbekistan, while Cambodia, Guatemala and Paraguay participated in the PISA for Development programme. Chinese provinces/municipalities (Beijing, Shanghai, Jiangsu and Zhejiang) and Lebanon are participants in PISA 2022 but were unable to collect data because schools were closed during the intended data collection period.

Key features of PISA 2022

The content

The PISA 2022 survey focused on mathematics, with reading, science and creative thinking as minor areas of assessment. In each round of PISA, one subject is tested in detail, taking up nearly half of the total testing time. The main subject in 2022 was mathematics, as it was in 2012 and 2003. Reading was the main subject in 2000, 2009 and 2018, science was the main subject in 2006 and 2015.

With this alternating schedule, a thorough analysis of achievement in each of the three core subjects is presented every nine (or 10) years; and an analysis of trends is offered every three (or four) years. As this cycle was postponed from 2021 to 2022 due to the COVID-19 pandemic, this cycle offers results one year later than previous cycles.

Creative thinking was assessed as an innovative domain for the first time in PISA 2022.

The *PISA 2022 Assessment and Analytical Framework* (OECD, 2023[1]) presents definitions and more detailed descriptions of the subjects assessed in PISA 2022:

- Mathematics is defined as students' capacity to reason mathematically and to formulate, employ and interpret mathematics to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts and tools to describe, explain and predict phenomena. It helps individuals make well-founded judgements and decisions, and become constructive, engaged and reflective 21st-century citizens.
- Reading is defined as students' capacity to understand, use, evaluate, reflect on and engage with texts in order to achieve one's goals, develop one's knowledge and potential, and participate in society.
- Science literacy is defined as students' ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires the competencies to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically.
- Creative thinking is defined as students' ability to engage productively in the generation, evaluation and improvement of ideas that can result in original and effective solutions, advances in knowledge and impactful expressions of imagination.

PISA 2022 also included an assessment of young people's financial literacy, which was optional for countries and economies.

The students

Some 690 000 students took the assessment in 2022, representing about 29 million 15-year-olds in the schools of the 81 countries and economies.

PISA students are aged between 15 years 3 months and 16 years 2 months at the time of the assessment, and they have completed at least 6 years of formal schooling. Using this age across countries and over time allows PISA to consistently compare the knowledge and skills of individuals born in the same year who are still in school at age 15, despite the diversity of their education histories in and outside of school. They can be enrolled in any type of institution, participate in full-time or part-time education, in academic or vocational programmes, and attend public or private schools or foreign schools within the country.

The population of PISA-participating students is defined by the PISA Technical Standards as are the students who are excluded from participating (see Annex A2). The overall exclusion rate within a country is required to be below 5% to ensure that, under reasonable assumptions, any distortions in national mean scores would remain within plus or minus five score points, i.e. typically within the order of magnitude of two standard errors of sampling. Exclusion could take place either through the schools that participated or the students who participated within schools. There are several reasons why a school or a student could be excluded from PISA. Schools might be excluded because they are situated in remote regions and are inaccessible, because they are very small, or because of organisational or operational factors that precluded participation. Students might be excluded because of intellectual disability or limited proficiency in the language of the assessment.

The assessment

As was done in 2015 and 2018, computer-based tests were used in most countries and economies in PISA 2022, with assessments lasting a total of two hours for each student. In mathematics and reading, a multi-stage adaptive approach was applied in computer-based tests whereby students were assigned a block of test items based on their performance in preceding blocks.

Test items were a mixture of multiple-choice questions and questions requiring students to construct their own responses. The items were organised in groups based on a passage setting out a real-life situation. More than 15 hours of test items for reading, mathematics, science and creative thinking were covered, with different students taking different combinations of test items.

There were six different kinds of test forms representing various combinations of two of the four domains (i.e. the three core domains, plus the innovative domain). Typically, within each country/economy, 94% of students received test forms covering 60 minutes of mathematics as the major domain, and another 60 minutes of one of the three minor or innovative domains (reading, science or creative thinking). In addition, 6% of students received test forms composed of two minor domains. Each test form was completed by enough students to allow for estimations of proficiency and psychometric analyses of all items by students in each country/economy and in relevant subgroups within a country/economy, such as boys and girls, or students from different social and economic backgrounds.

In addition, PISA 2022 retained a paper-based version of the assessment that included only trend items that had been used in prior paper-based assessments. This paper-based assessment was implemented in four countries: Cambodia, Guatemala, Paraguay and Viet Nam.

The assessment of financial literacy was offered again in PISA 2022 as an optional computer-based test. It was based on a revised framework based on the PISA 2022 updated framework. The cognitive instruments included trend items and a set of new interactive items that were developed specifically for PISA 2022.

The questionnaires

Students answered a background questionnaire, which took about 35 minutes to complete. The questionnaire sought information about the students' attitudes, dispositions and beliefs, their homes, and their school and learning experiences. School principals completed a questionnaire that covered school management and organisation, and the learning environment. Both students and schools responded to items in the Global Crises Module in their respective questionnaires. These items aimed to elicit their perspectives on how learning was organised when schools were closed because of the COVID-19 pandemic.

Some countries/economies also distributed additional questionnaires to elicit more information. These included: a questionnaire for teachers asking about themselves and their teaching practices; and a questionnaire for parents asking them to provide information about their perceptions of and involvement in their child's school and learning.

Countries/economies could also choose to distribute two other optional questionnaires for students: a questionnaire about students' familiarity with computers and a questionnaire about students' well-being. A financial literacy questionnaire was also distributed to the students in the countries/economies that conducted the optional financial literacy assessment.

Where can you find the results?

The initial PISA 2022 results are released in five volumes:

- **Volume I: The State of Learning and Equity in Education** (OECD, 2023[2]) presents two of the main education outcomes: performance and equity. The volume examines countries' and economies' performance in mathematics, reading and science and how performance has changed over time. In addition, equity in education is analysed from the perspectives of inclusion and fairness, focusing on students' gender, socio-economic status and immigrant background.
- **Volume II: Learning During – and From – Disruption** (OECD, 2023[3]) examines various student-, school-, and system-level characteristics, and analyses how these are related to student outcomes, such as performance, equity and student well-being. The volume also presents data on how learning was organised when schools were closed because of COVID-19. These results can assist countries in building resilience in their education systems, schools and students so they are all better able to withstand disruptions in teaching and learning.
- **Volume III: Creative Minds, Creative Schools** (OECD, 2024[4]) is on creative thinking. This volume examines students' capacity to generate original and diverse ideas in the 66 countries and economies that participated in the innovative domain assessment for the PISA 2022 cycle. It explores how student performance and attitudes associated with creative thinking vary across and within countries, and with different student- and school-level characteristics. The volume also offers an insight into students' participation in creative activities, how opportunities to engage in creative thinking vary across schools and socio-demographic factors, and how these are associated with different student outcomes.
- **Volume IV: How Financially Literate Are Students?** (OECD, forthcoming[5]) is on financial literacy. This volume examines 15-year-old students' understanding about money matters in the 23 countries and economies that participated in this optional assessment. The volume explores how the financial literacy of 15-year-old students is associated with their competencies in other subjects and how it varies across socio-demographic factors. It also offers an overview of students' experiences with money, of their financial behavior and attitudes, and of exposure to financial literacy in school.
- **Volume V** (OECD, forthcoming[6]) on students' readiness for lifelong learning. This volume presents key aspects of students' preparedness to continue learning throughout their lives. These include students' attitudes towards mathematics, their social and emotional skills, and their aspirations for future education and a career.

References

OECD (2024), *PISA 2022 Results (Volume III): Creative Minds, Creative Schools*. [4]

OECD (2023), *PISA 2022 Assessment and Analytical Framework*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/dfe0bf9c-en. [1]

OECD (2023), *PISA 2022 Results (Volume I): The State of Learning and Equity in Education*. [2]

OECD (2023), *PISA 2022 Results (Volume II): Learning During – and From – Disruption*. [3]

OECD (forthcoming), *PISA 2022 Results (Volume IV): How financially literate are students?*. [5]

OECD (forthcoming), *PISA 2022 Results (Volume V)*. [6]

1 Measuring creative thinking

This chapter summarises the conceptual foundations of the PISA 2022 Creative Thinking assessment and presents a selection of released items from the test. The chapter also describes how well students around the world demonstrate creative thinking at different levels of proficiency.

For Australia*, Canada*, Denmark*, Hong Kong (China)*, Jamaica*, Latvia*, the Netherlands*, New Zealand* and Panama* caution is advised when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).

For Albania** and the Dominican Republic**, caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

"Creativity is seeing what others see and thinking what no one else ever thought."

Albert Einstein

For the first time, in its 2022 cycle, PISA has measured the creative thinking skills of 15-year-olds in 64 countries and economies. This chapter first presents the rationale for assessing creative thinking in PISA, and then describes how the creative thinking construct is defined and measured in the PISA 2022 test. The chapter then presents a selection of released items from the test to illustrate how students were asked to demonstrate creative thinking across different domain contexts. Finally, the chapter describes creative thinking at different levels of proficiency and summarises how the creative thinking scale was constructed to assess and describe students' performance in the test.

Why measure creative thinking?

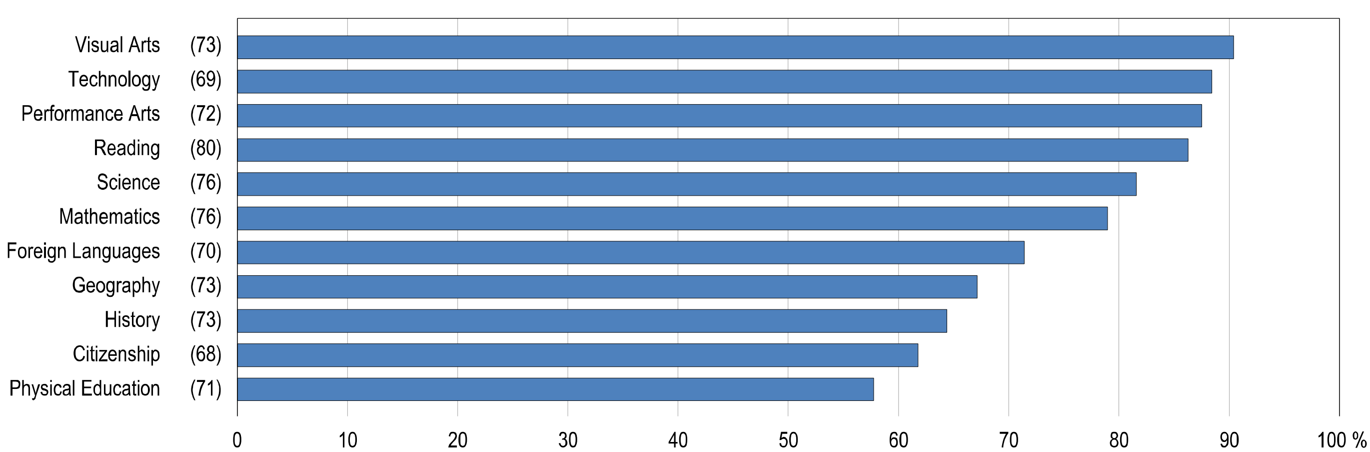
Creativity has driven innovation in human culture and society for millennia – from the sciences and technology, to philosophy, the arts and the humanities. One fundamental goal of education is to equip individuals with the competencies they need to succeed in life and society, for both their own and collective well-being (OECD, 2018[1]). Creativity, creative thinking and innovation are amongst these important competencies.[1]

Creative thinking helps prepare young people to adapt to a rapidly changing world that demands flexible and innovative workers. Beyond preparing students for the labour market, creative thinking in education contributes to students' holistic development – it supports learning, problem solving and metacognitive skills through exploration and discovery, helping students to interpret information in personally meaningful ways. It has also been found to support a range of other important aspects of students' development and achievement.[2]

The importance of developing creative thinking in education is reflected in national curricula worldwide. Nearly all PISA participating countries or economies with data available reported creativity as an intended student outcome in secondary education (Figure III.1.1).[3]

Figure III.1.1. Creativity in curricula worldwide

Percentage of countries/economies in which various subject areas refer to creativity in secondary education curricula



Notes: For each subject, the share of countries/economies is based on the number that reported the subject containing a reference to creative thinking (or related terms) over the number that reported including that subject within their relevant curriculum or learning standards (see N reported in brackets).
Where it was not possible to establish whether a subject referred to creativity, responses were counted as missing responses and excluded from the total response count (N).
Secondary education refers to ISCED Levels 2 and 3. In some jurisdictions, the curriculum or learning standards for primary education (ISCED Level 1) and lower secondary education (ISCED Level 2) are integrated; in these cases, secondary education refers only to upper secondary education (ISCED Level 3).
Source: OECD (2023[2]), *Supporting Students to Think Creatively: What Education Policy Can Do*. The StatLink URL of this figure is available at the end of the chapter.

How PISA 2022 defines creative thinking

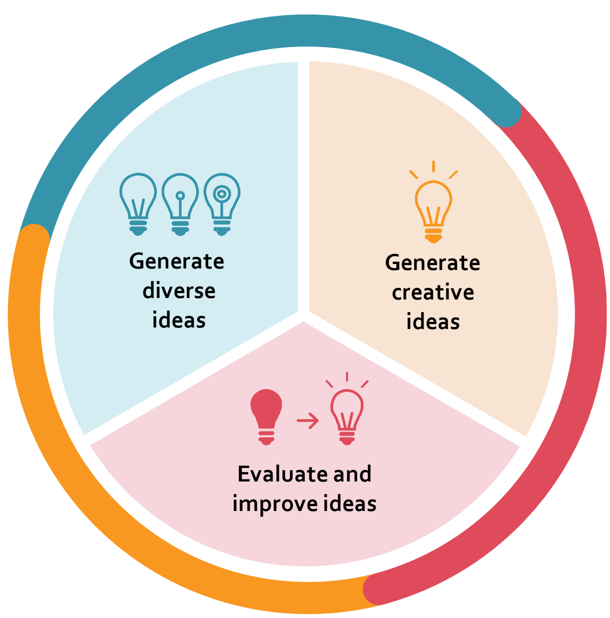
In its 2022 cycle, PISA defines creative thinking as "the competence to engage productively in the generation, evaluation and improvement of ideas that can result in original and effective solutions, advances in knowledge and impactful expressions of imagination". It focuses on the cognitive processes required to engage in creative work and is aligned with the concept of "little-c" creativity – in other words, a malleable capacity that can be developed through practice and that can be reasonably demonstrated in everyday contexts (see Box III.1.1).

Box III.1.1. "Big-C" vs. "little-c" creativity

Creativity can manifest in different ways, but research generally distinguishes between "big-C" and "little-c" creativity (Csikszentmihalyi, 2013[3]; Simonton, 2013[4]). "Big-C" creativity is associated with intellectual or technological breakthroughs or artistic or literary masterpieces that require deep expertise in a given context. In contrast, all people can demonstrate "little-c" (or "everyday") creativity by engaging in creative thinking. This is the type of creativity people manifest when, for example, they arrange photos for display, combine leftovers to make a tasty meal, or find solutions to day-to-day problems. "Little-c" creativity can be developed through practice and honed through education (Kaufman and Beghetto, 2009[5]).

This definition of creative thinking includes both divergent cognitive processes (i.e. the ability to generate diverse ideas and creative ideas) and convergent cognitive processes (i.e. the ability to evaluate ideas and identify improvements to those ideas). For measurement purposes in PISA 2022, the construct of creative thinking consisted of three ideation processes (see Figure III.1.2 and Box III.1.2).

Figure III.1.2. The PISA 2022 competency model for creative thinking



Source: OECD (2022[6]), *Thinking Outside the Box: The PISA 2022 Creative Thinking Assessment*.

Box III.1.2. The three ideation processes involved in creative thinking in PISA 2022

In PISA 2022, creative thinking was premised on three ideation processes (Figure III.1.2). These ideation processes reflect the PISA definition and encompass the cognitive skills that are relevant to creative thinking in the classroom (see Annex A1 for a more detailed description). The distribution of test items across the three ideation processes is as follows: 12 items correspond to “generate diverse ideas”, 11 items correspond to “generate creative ideas”, and 9 items correspond to “evaluate and improve ideas”.

Generate diverse ideas

This ideation process refers to a student’s capacity to think flexibly by generating ideas that are different to each other. In the context of measuring creative thinking ideation skills, both ideational fluency (i.e. the total number of ideas produced) and ideational flexibility (i.e. how fundamentally different ideas are) are important factors for estimating creative potential (Guilford, 1956[7]; Runco and Acar, 2012[8]).

Generate creative ideas

Creative ideas are usually defined as being both novel and useful. Expecting 15-year-olds to think of unique and novel ideas would be neither feasible nor appropriate in the context of PISA; however, originality is a useful proxy for measuring the extent to which students can think outside of the box. Defined by Guildford (1950[9]) as “statistical infrequency”, originality encompasses the qualities of newness, remoteness, novelty or unusualness, and generally refers to deviance from patterns that are observed within a population. In the PISA assessment, originality is measured in relation to the responses of other students who complete the same task – if relatively few other students suggest the same idea, then a response is considered original.

Evaluate and improve ideas

This ideation process refers to a student’s capacity to evaluate limitations in ideas and improve their originality. Evaluative processes help to identify and remediate deficiencies in initial ideas as well as ensure that ideas or solutions are appropriate, adequate, efficient and effective (Cropley, 2006[10]). They often lead to further iterations of idea generation that can ultimately improve creative outcomes.

The PISA definition of creative thinking focuses on those ideation processes that can be engaged in different learning and problem-solving contexts. These include learning contexts that require imagination and expression, such as creative writing or the visual and performance arts, as well as those in which generating and improving upon ideas is functional to investigating problems or phenomena, or to designing innovative solutions.

Sample items

Students who took the creative thinking test in PISA 2022 spent one hour on creative thinking items, with the remaining hour of PISA testing time assigned to mathematics, reading or scientific literacy items. Creative thinking items were organised into units based on a common stimulus. Each unit varied according to the ideation process involved, the unit length, the number of items in the unit, and the domain context (see Box III.1.3).

Selected items from 9 of the 18 creative thinking units developed for the PISA 2022 test are described below. At least one unit from each domain context is presented. For each unit, a brief description of the unit context and scenario is provided, followed by a screenshot and description of the sample item(s) from that unit. For some items, genuine student responses are also presented, as well as a description of the item-specific coding criteria. For more detailed information on the scoring processes and the general approach to awarding full or partial credit across items, see Annex A1. Information on the empirical difficulty of select items presented here, at different credit levels, is also included in Table III.1.2 towards the end of this chapter. For more information on the released items, see also Annex C.

Box III.1.3. The four domain contexts in the PISA 2022 Creative Thinking assessment

Researchers now recognise that, to some extent, the internal resources needed to engage in creative work differ by domain (Baer, 2011[11]; Baer and Kaufman, 2005[12]). Situating creative thinking tasks across different domain contexts has several advantages in the context of the PISA assessment: it contributes to the generalisability of claims about overall performance on the test; it allows variation in student performance by domain to be analysed (see Chapter 4); it acknowledges that cultural preferences may exist for certain forms of creative engagement; and it acknowledges that creative work is supported by some degree of domain readiness.

Given the age of PISA test takers and the amount of available testing time, tasks in the PISA 2022 creative thinking test were situated in four different domain contexts:

- **written expression**, which involves communicating ideas and imagination through written language;
- **visual expression**, which involves communicating ideas and imagination through a range of different media;
- **social problem solving**, which involves understanding different perspectives, addressing the needs of others, and finding innovative and functional solutions for the parties involved; and
- **scientific problem solving**, which involves generating new ideas, designing experiments to probe hypotheses, and developing new methods or inventions to solve problems.

The distribution of items in the test across the four domain contexts is as follows: 12 items in written expression; 4 items in visual expression; 10 items in social problem solving; and 6 items in scientific problem solving (see Table III.4.1 in Chapter 4).

Written expression

In the PISA 2022 Creative Thinking test, students were asked to express their imagination in a variety of written formats. For example, students captioned an image, proposed ideas for a short story, or wrote short dialogues between characters in a movie or comic book.

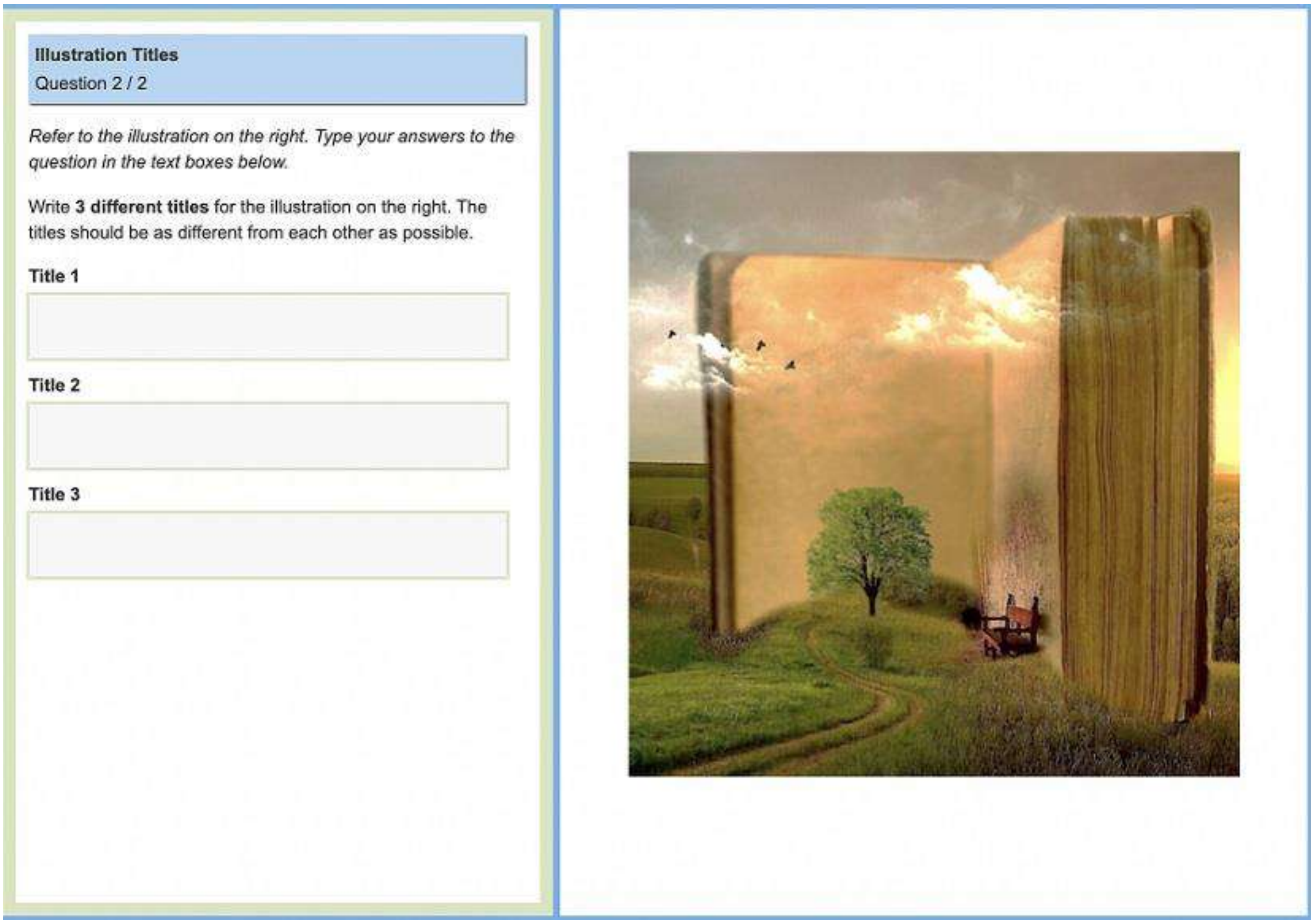
Sample Unit 1: Illustration Titles

The unit *Illustration Titles* included two items. In the two items, students were asked to come up with original and diverse titles, respectively, for abstract illustrations.

Illustration Titles: Item 2 (Generate diverse ideas)

The second item in the *Illustration Titles* unit asked students to write three different titles for an abstract illustration of an oversized book embedded in nature (Figure III.1.3). To achieve full credit on the item, the ideas must all be appropriate and sufficiently different from one another. Box III.1.4 provides coded examples of genuine student responses and describes how ideas for this item would be considered "sufficiently different".

Figure III.1.3. *Illustration Titles*: Item 2

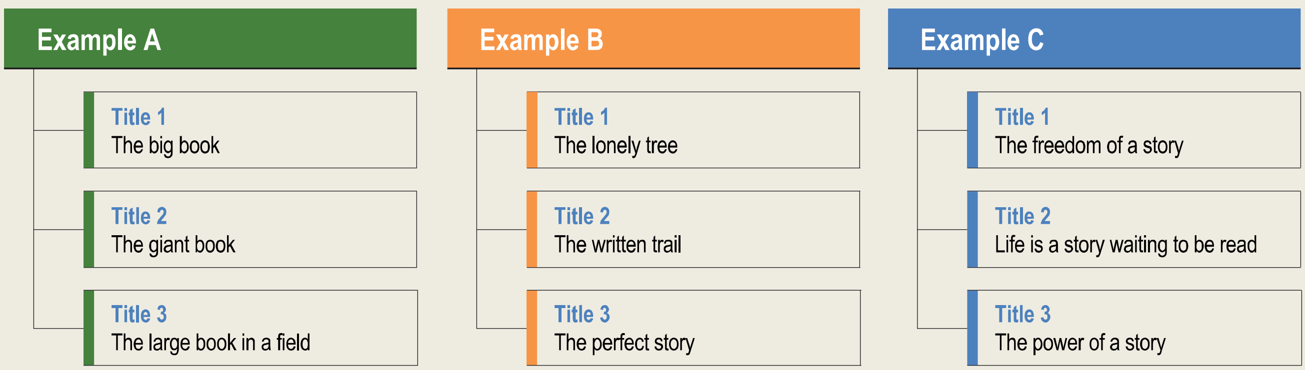


Box III.1.4. *Illustration Titles*: Item-specific coding criteria and example responses

Item 2 (Suggest three different illustration titles)

Figure III.1.4 provides three example student responses for Item 2 of the *Illustration Titles* unit, in which students were asked to suggest three different titles for a given illustration (Figure III.1.3). Scorers must decide whether to award responses no credit, partial credit or full credit, depending on whether the three ideas are sufficiently different from each other.

Figure III.1.4. Coded examples for item 2 in *Illustration Titles*



In Example Response A, all three ideas provide a literal description of the illustration and synonyms describe the same idea (the size of the book); this response did not demonstrate skill in generating diverse ideas and was awarded no credit. In Example Response B, the foci of all three ideas reference a different element of the illustration (the book, the trail and the tree). The titles each include adjectives with distinct meanings (perfect, written and lonely) to further differentiate their meaning from each other. This response was awarded full credit. Example Response C includes two ideas that are structured identically (Title 1 and 3) and that focus on an abstract attribute of a story (freedom and power); although the attributes change, they both focus solely and explicitly on the book element of the illustration. The second title also references a story but focuses on the idea of life as a story. The structure of the title is significantly different, and it also implicitly connects to other elements of the illustration (e.g. nature or the path). Example Response C was awarded partial credit for including three appropriate ideas, but only two different ideas.

Sample Unit 2: Robot Story

In the unit *Robot Story*, students were asked to think of ideas for the plot and dialogue of a short film about an intelligent robot ("Rob") and a human character ("Leo"). The unit included three items.

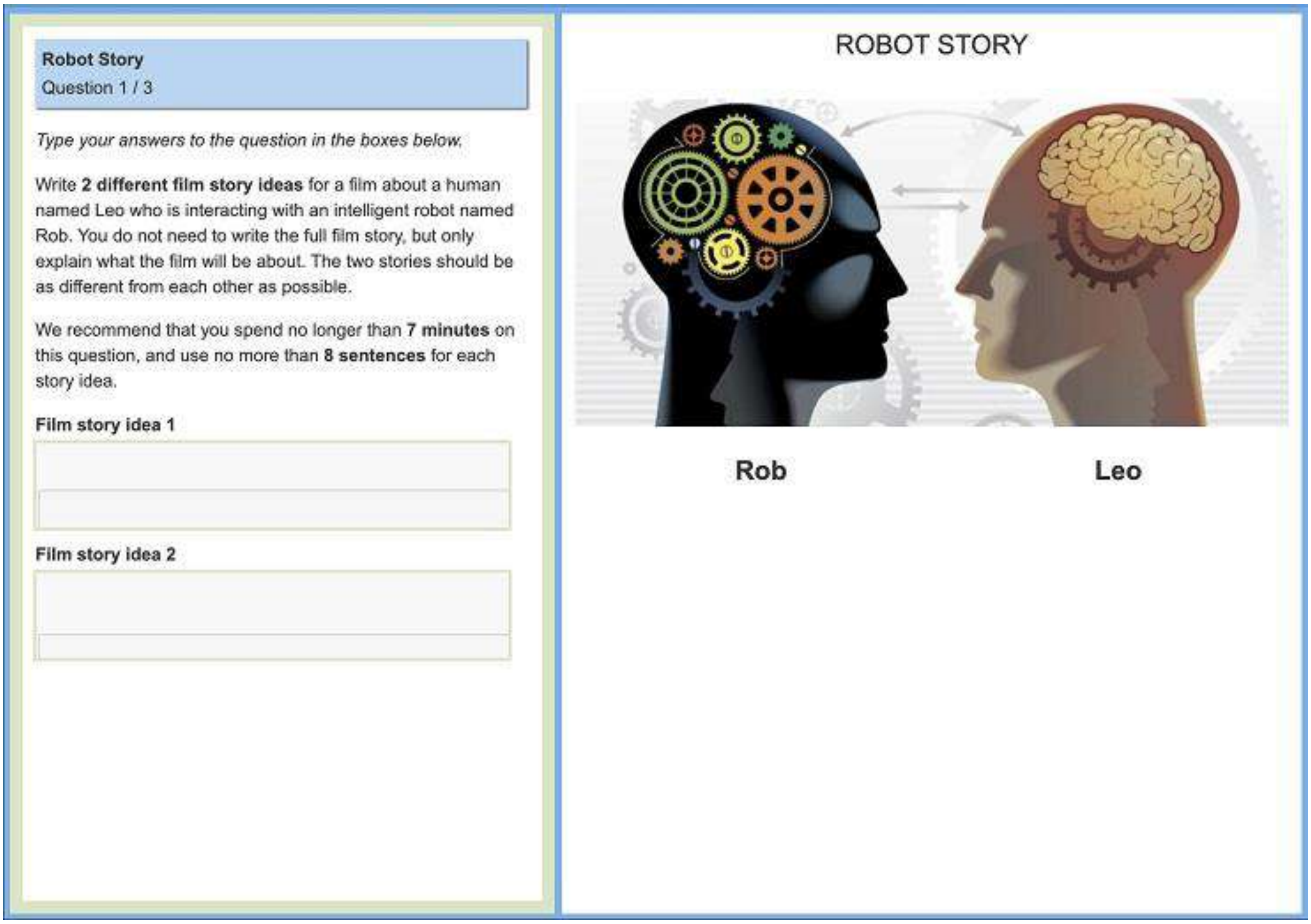
Robot Story: Item 1 (Generate diverse ideas)

The first item of the *Robot Story* unit asked students to write two different story ideas for the film based on a short prompt (see Figure III.1.5). To achieve full credit, students must provide two appropriate ideas that are different from each other. The scoring process is similar to the one described in Box III.1.4. There is no partial credit available for this item as students must provide only two different ideas.

The item-specific criteria outline examples of distinct plot developments: for example, the story might focus on how the robot "Rob" was created; a friendship between the two characters; or the human "Leo" becoming a robot. Stories with similar plots could also achieve full credit if the student sufficiently changed the focus or representation of ideas.

For example, the narration of the story might occur from two different perspectives or very different settings or contexts.

Figure III.1.5. *Robot Story*: Item 1



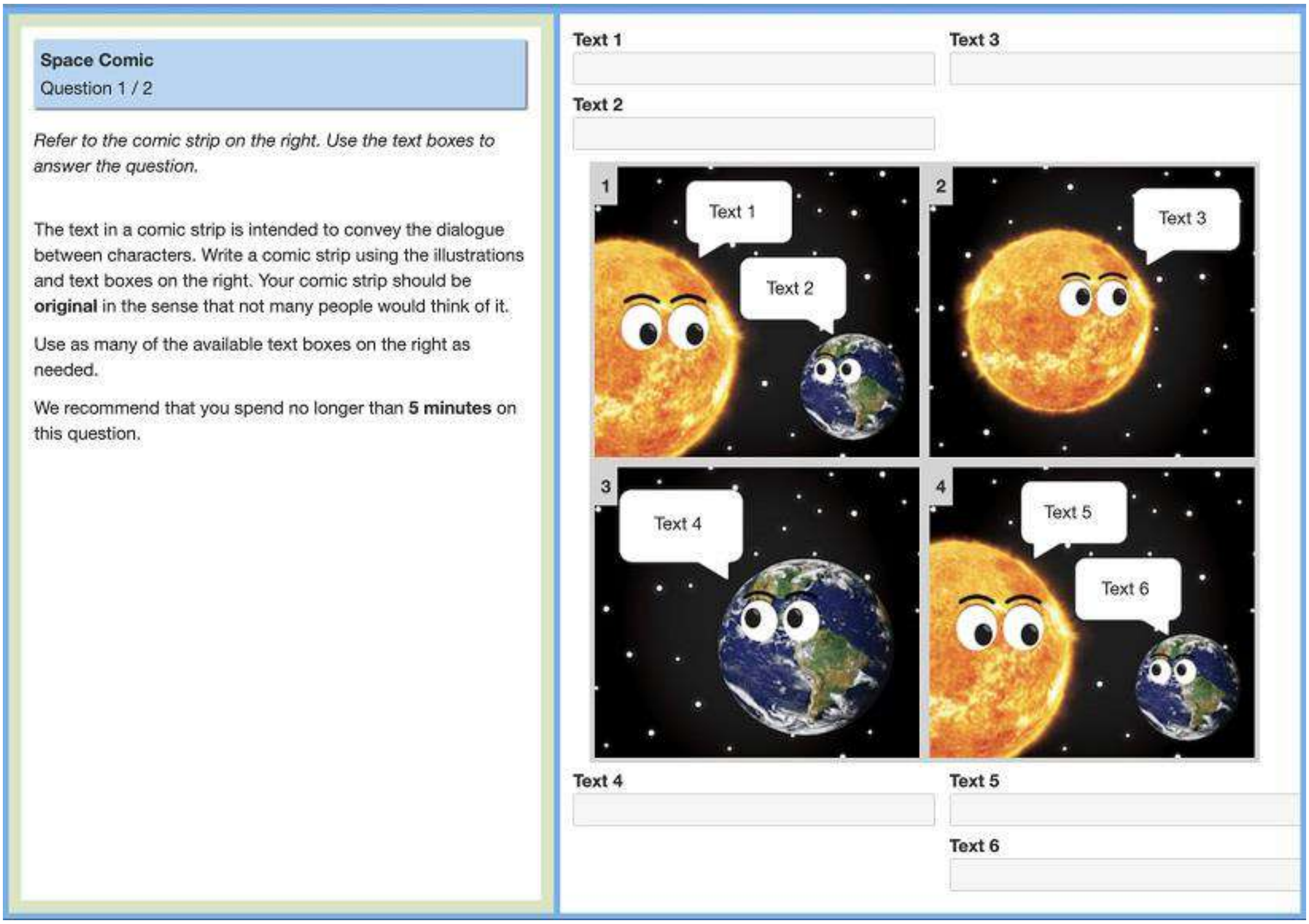
Sample Unit 3: Space Comic

There were two items in the unit *Space Comic*. Students had to write a dialogue and suggest titles for a comic strip that shows the Sun and the Earth in conversation with each other.

Space Comic: Item 1 (Generate creative ideas)

The first item of the *Space Comic* unit asked students to write an original dialogue between the Sun and the Earth (Figure III.1.6). The comic strip includes six empty dialogue boxes in a fixed order that students must fill in. To achieve full credit, students must compose a dialogue with an original theme; conventional (i.e. non-original) themes for this item and example coded responses are described in Box III.1.5. Responses corresponding to conventional themes were awarded partial credit, unless combined with an innovative approach or implementation.

Figure III.1.6. *Space Comic*: Item 1



Box III.1.5. *Space Comic*: Item-specific coding criteria and example responses

Item 1 (Create an original dialogue)

Figure III.1.7 provides examples of three student responses to the first item in the *Comic Strip* unit Figure III.1.6). Scorers must decide whether to award no credit, partial credit or full credit for the response depending on whether the dialogue is original.

The item-specific coding criteria describe two conventional themes for this unit:

- **Conventional Theme 1:** Dialogue focusing on heat, temperature, weather or seasons (excluding a focus on environmental degradation or global warming);
- **Conventional Theme 2:** Dialogue focusing on environmental degradation or global warming.

In contrast, original themes included (but were not limited to) the Earth's ability to sustain life, observable or physical aspects of the Earth/Sun (e.g. colour, size, etc.), conversations about love or friendship, or about (other) celestial bodies.

Figure III.1.7. Coded examples for Item 1 in *Space Comic*

Example A	Example B	Example C
How are you feeling today	Earth will you marry me?	Welcome back, Earth
I am hot and it is getting worse	What!?!	Hi! I'm so excited for summer
I am also getting hotter and hotter	We've been together since the dawn of time	Summer is my favourite season too
This is not good	That's just because of gravity	I might have to get some sunglasses
No it isn't	But I love you	Well that's rude! Don't you want to see me?
Good luck	Sorry bro. Just gravity	Yeah, but I'll go blind after a whole summer without them

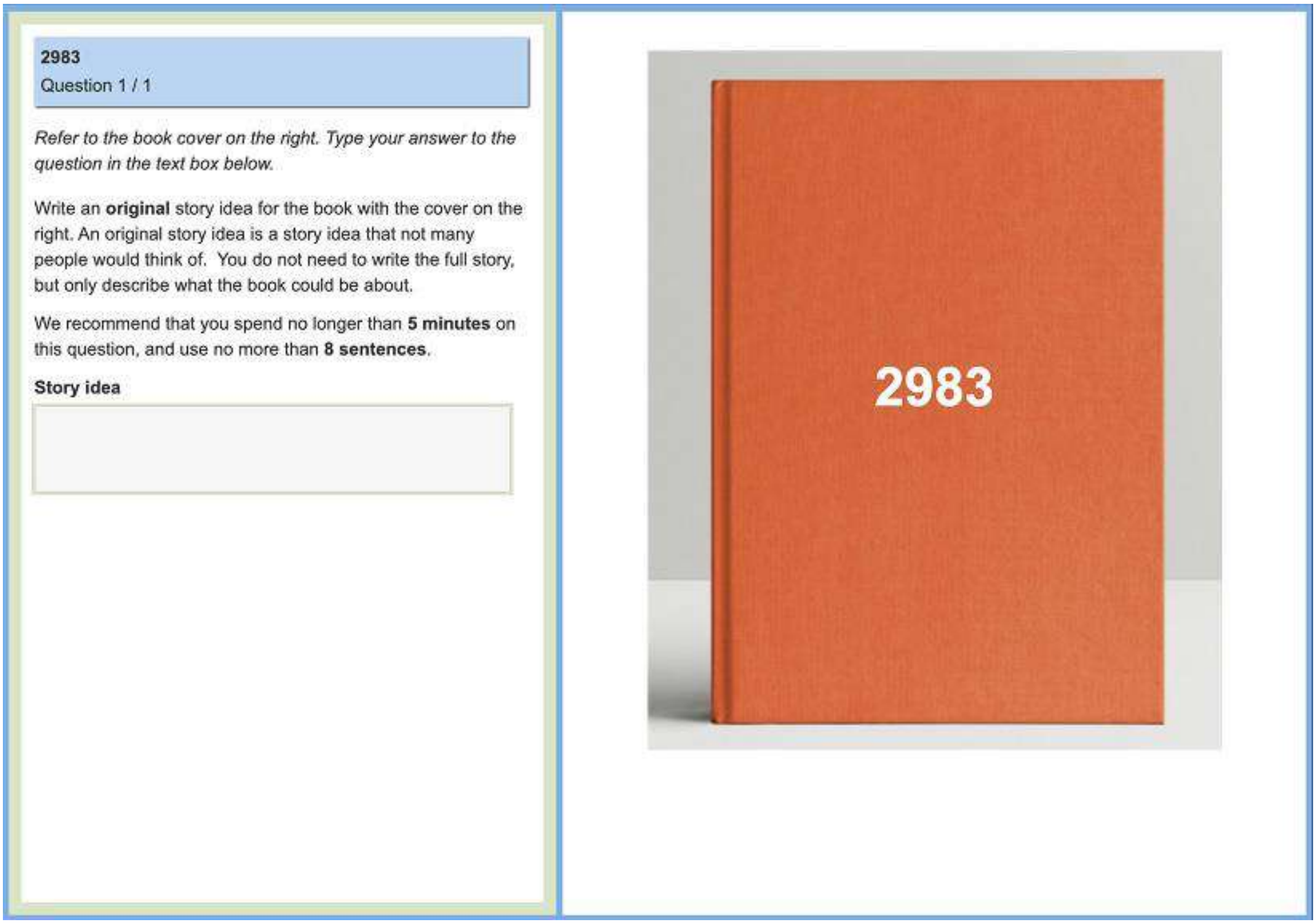
The dialogue in Example Response A focuses on the topic of heat. This response was awarded partial credit because it corresponded to Conventional Theme 1 but did not further develop the theme in an innovative or unconventional way. In Example Response B, the student focuses on the relationship between the Earth and Sun and references their gravitational attraction. This idea was awarded full credit as it corresponded to an original theme. Example Response C focused on seasons (also Conventional Theme 1) but introduced original details about the Sun's brightness and developed the dialogue in a humorous way; the response was thus awarded full credit.

Sample Unit 4: 2983

The unit *2983* is a single-item unit in which students were asked to think of an original story idea for a book titled "2983" (Figure III.1.8). The item is classified as a "Generate creative ideas" item. Students must associate the number 2983 to a relevant detail in their story idea.

The scoring process is similar to that described in Box III.1.5 for Item 1 of the *Space Comic* unit. To achieve full credit, the response must correspond to an original theme. Conventional (i.e. non-original) themes included: stories about the future of humanity set in the year 2983; or stories in which the number 2983 identifies a person, a place or an object. Responses that corresponded with conventional themes were awarded partial credit unless combined with an innovative approach or implementation. For example, an unconventional reference to the number 2983 in the story was its use as a code for unlocking a device.

Figure III.1.8. *2983*: Item



Visual expression

In the PISA creative thinking test, students created visual compositions from a library of images and shapes using a simple graphic tool. Students were able to resize, rotate and change the colour of shape elements. Students created visual designs for a variety of purposes, such as logos or posters for an event or designs for merchandise.

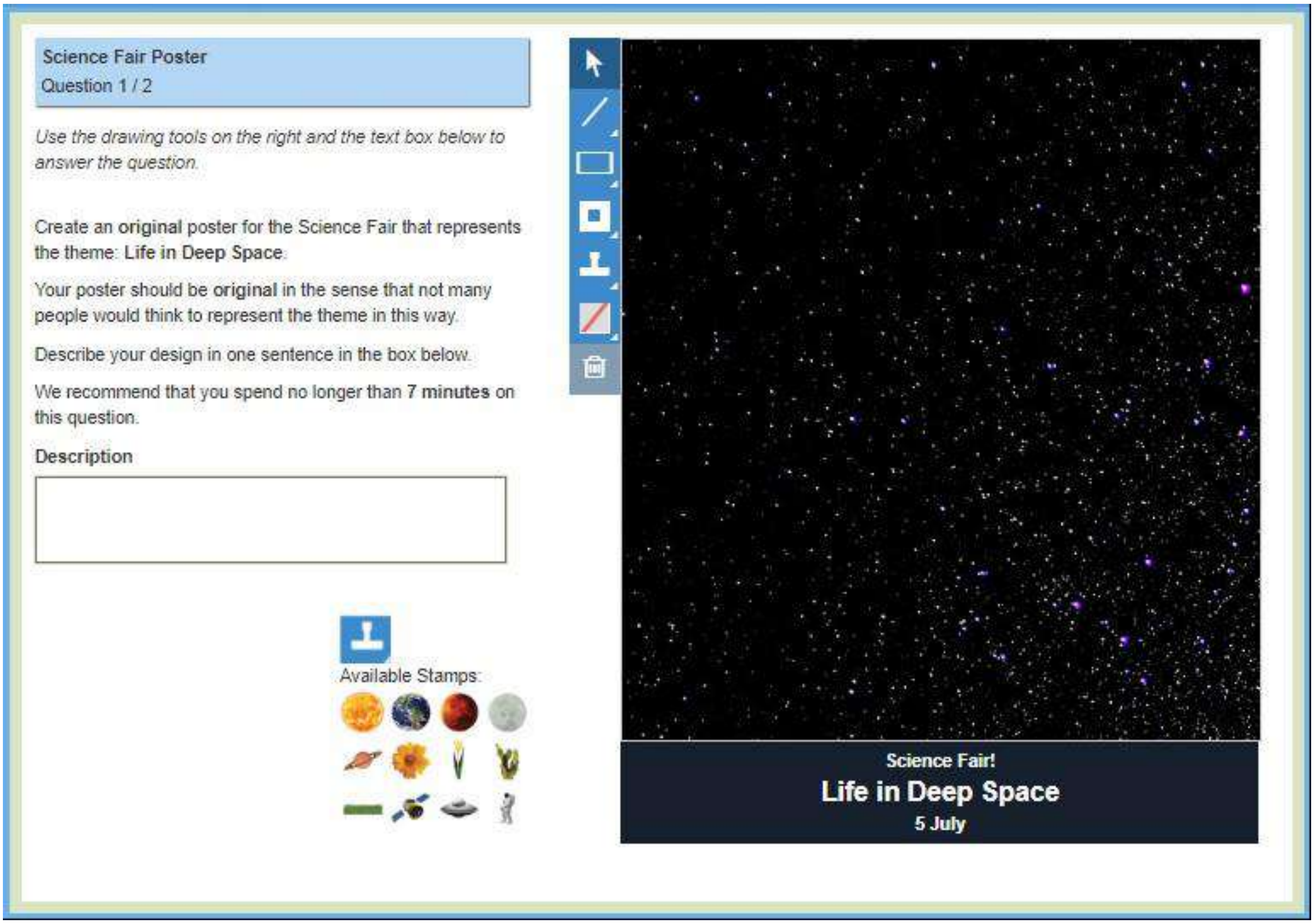
Sample Unit 5: Science Fair Poster

In the unit *Science Fair Poster*, students designed and improved posters for their school's upcoming science fair. Students used a simple drawing tool that includes different shapes, colours and stamps to complete both items in the unit.

Science Fair Poster: Item 1 (Generate creative ideas)

The first item in the *Science Fair Poster* unit asked students to create an original poster for the science fair that represents the theme "Life in Deep Space" (Figure III.1.9). To achieve full credit, students must create a poster with an original theme. Box III.1.6 describes the conventional (i.e. non-original) themes for this item as well as coded example responses; responses that corresponded to conventional themes were awarded partial credit, unless combined with an innovative approach or implementation.

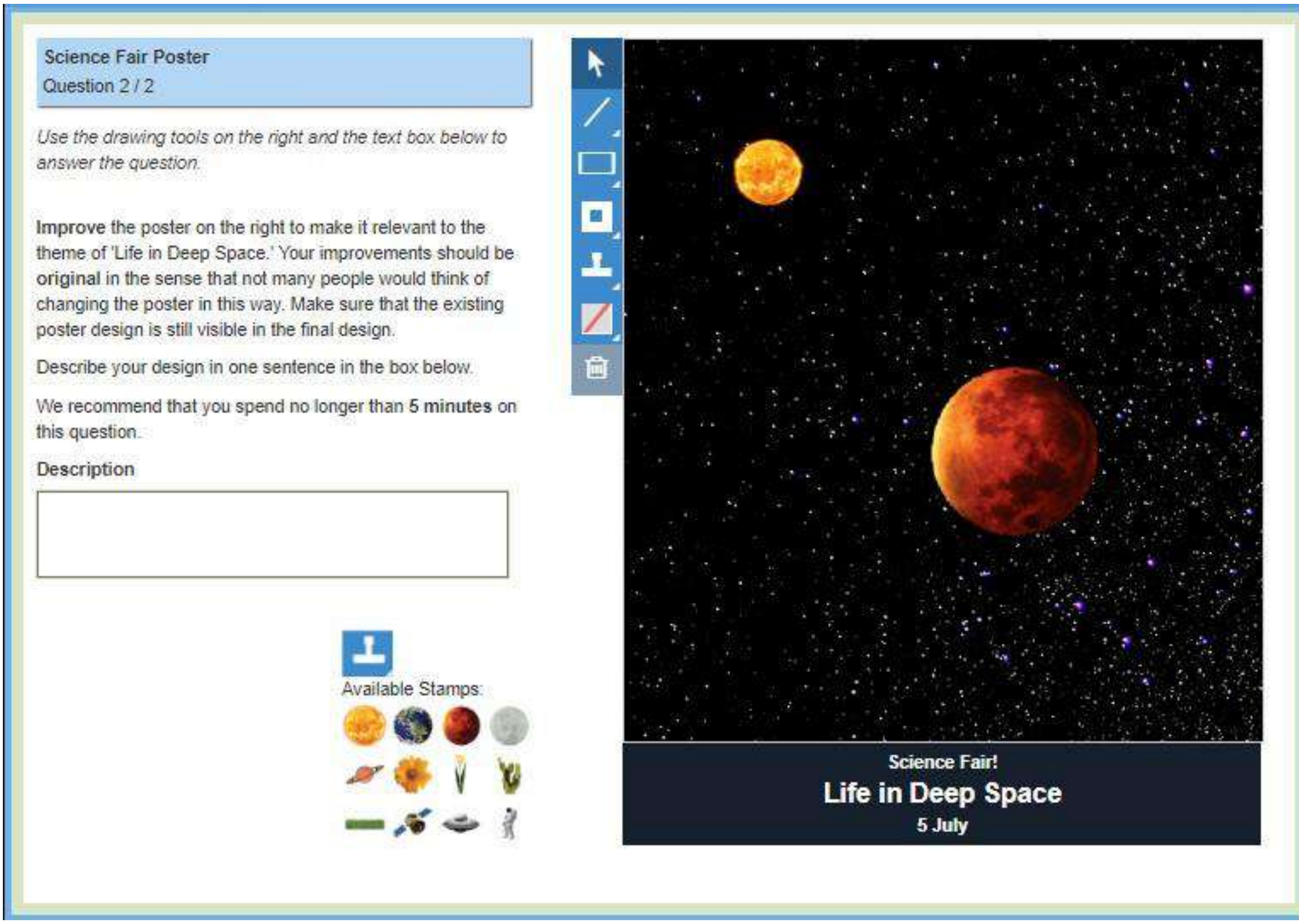
Figure III.1.9. *Science Fair Poster*: Item 1



Science Fair Poster: Item 2 (Evaluate and improve ideas)

The second item in the *Science Fair Poster* unit provides students with a simple poster design (the Sun and one planet) and asks them to improve it by connecting it to the topic of “Life in Deep Space” in an original way (Figure III.1.10). The coding process for this item is similar to that of Item 1: to achieve full credit, students must modify the poster with an original idea. Modifications that corresponded to conventional (i.e. non-original) theme ideas were awarded partial credit, unless combined with an innovative approach or implementation (see Box III.1.6 for coded examples of student responses).

Figure III.1.10. *Science Fair Poster*: Item 2



Box III.1.6. *Science Fair Poster*: Item-specific coding criteria and example responses

Item 1 (Design an original poster)

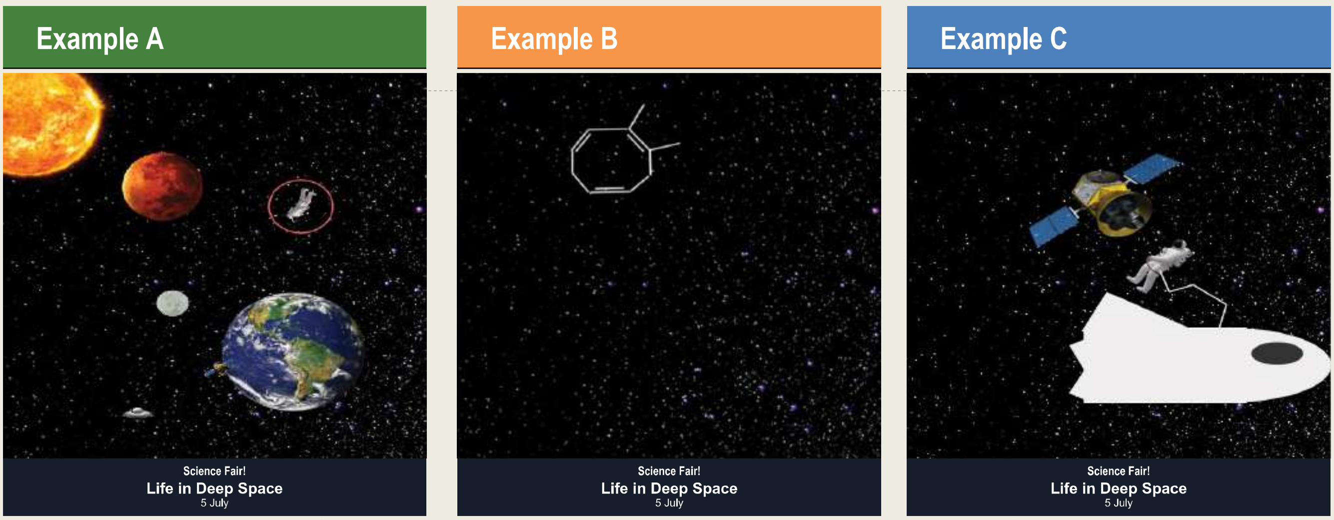
The item-specific coding criteria for Item 1 in the *Science Fair Poster* unit describes two conventional themes. These themes refer to students' dominant representation of the idea of "Life in Deep Space":

- **Conventional Theme 1:** The Earth;
- **Conventional Theme 2:** Elements related to human space exploration (e.g. astronauts, spacecraft, satellites).

Original themes included (but were not limited to) the use of text or script elements to communicate the theme, the inclusion of animate figures (e.g. humans or aliens) other than astronauts, and scientific models or notations related to life (e.g. molecules).

Figure III.1.11 provides examples of coded student responses for this item. Example Response A represents the idea of "Life in Deep Space" through two stickers: an astronaut and a spacecraft. Since the elements of the poster correspond to Conventional Theme 2, the response is awarded partial credit. Example Response B displays a molecule, created through combining shapes, and which the student has clarified to be a carbon molecule in the poster description (carbon is the most common element to all known life on Earth). The response connects to the science fair and does not correspond to one of the two conventional themes; it is thus considered original and awarded full credit. Like Example Response A, Example Response C also represents "Life in Deep Space" through an astronaut and spaceship. However, in Example Response C, the student used different shapes to create a spaceship (rather than using the sticker) and has attached the astronaut to the spaceship as if conducting a moonwalk. This is an innovative implementation of Conventional Theme 2 and is thus awarded full credit.

Figure III.1.11. Coded examples for Item 1 in *Science Fair Poster*



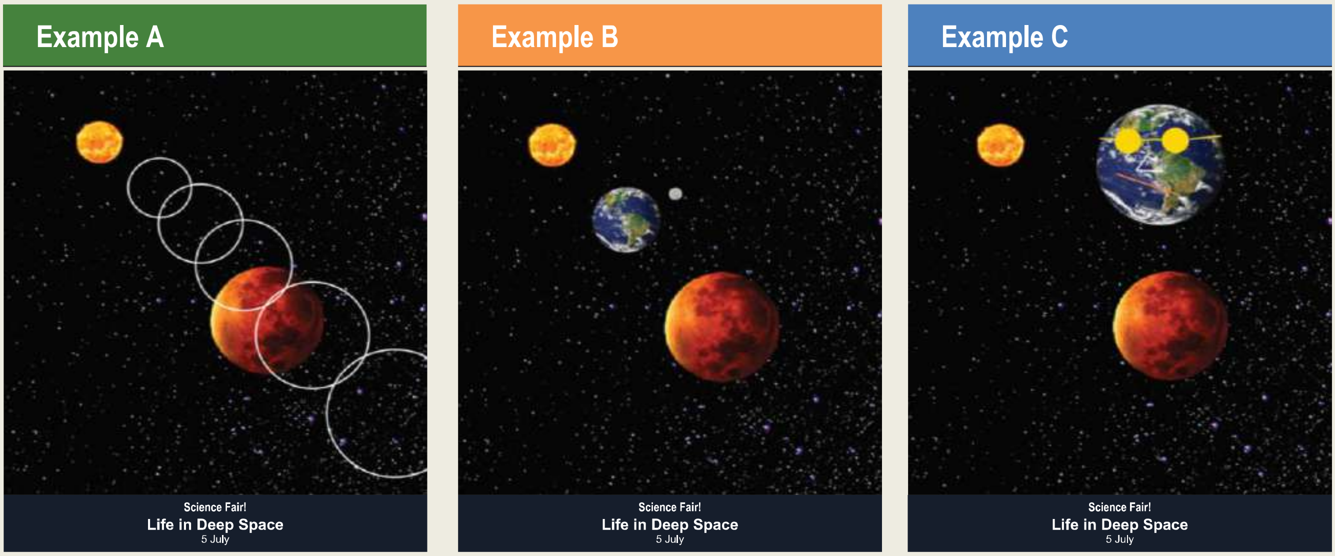
Item 2 (Modify a poster in an original way)

For Item 2 of the *Science Fair Poster*, the item-specific coding criteria describe three conventional themes. These themes refer to elements that students must add to connect the existing poster to the idea of "Life in Deep Space". In addition to the two conventional themes that constituted the coding criteria for Item 1 (the Earth, and human space exploration), the item-specific coding criteria for Item 2 included a third conventional theme:

- **Conventional Theme 3:** The use of plants or flora as the dominant representation of life.

Figure III.1.12 provides examples of coded student responses for Item 2. Example Response A does not connect to the Science Fair: concentric circle shapes have been added but with no clear association to the theme of "Life in Deep Space" (nor is there any clarification in the description provided by the student). The response does not achieve any credit. In Example Response B, two simple stickers of the Earth and the moon have been added. The response is awarded partial credit as it corresponds to Conventional Theme 1. While Example Response C also uses the Earth sticker to connect the poster to "Life in Deep Space", the student also uses shapes to modify the Earth and add animate details to its surface (sunglasses and a mouth). The response integrates an innovative approach and thus receives full credit.

Figure III.1.12. Coded examples for Item 2 in *Science Fair Poster*



Social problem solving

Social problem solving can range from the small-scale, personal and interpersonal problems of individuals to wider school, community or even global problems. In the PISA creative thinking test, students suggested solutions for open problems that focused on issues affecting different groups within society (e.g. wheelchair users) or affecting society at large (e.g. the collection and use of waste materials).

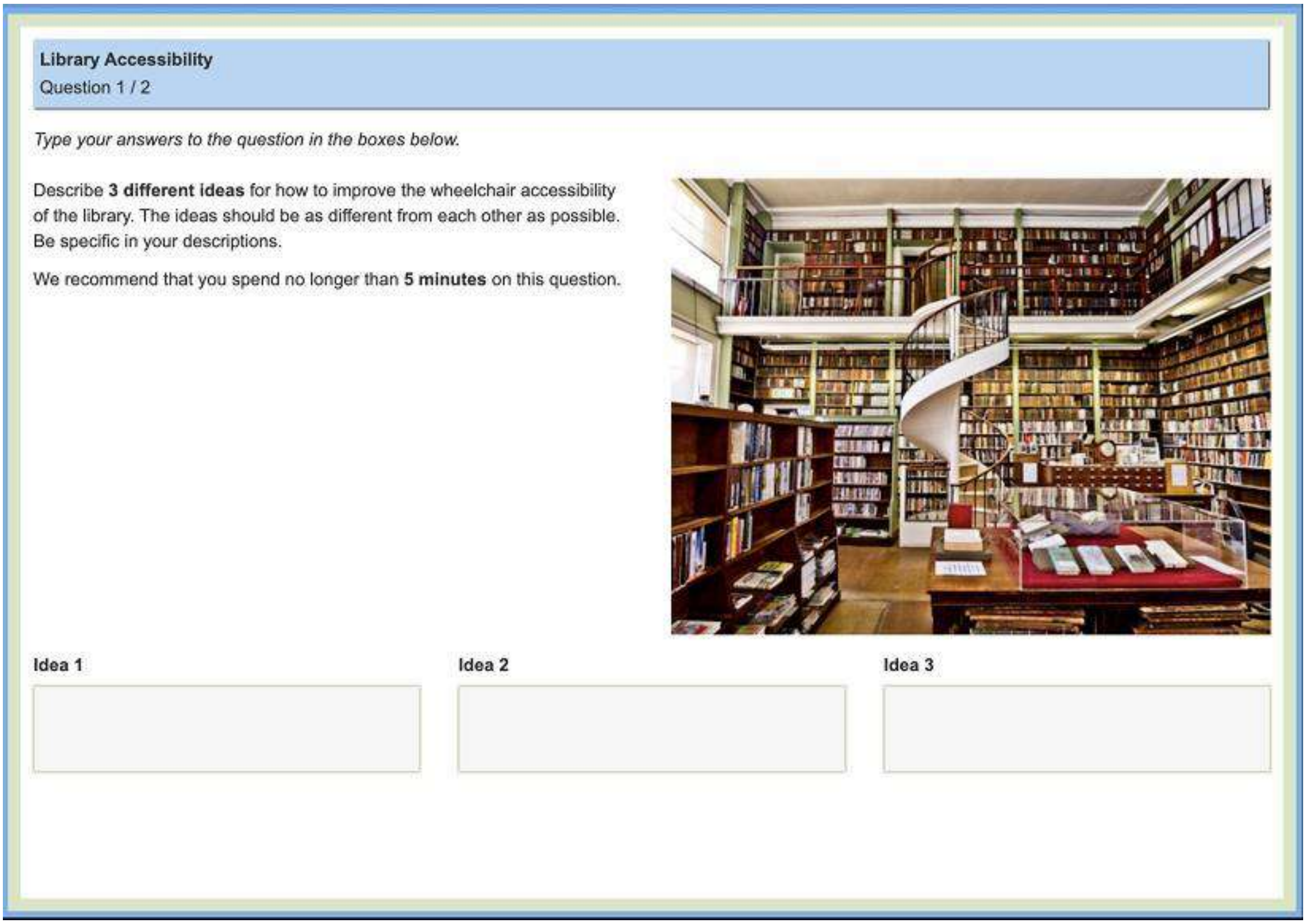
Sample Unit 6: Library Accessibility

In the unit *Library Accessibility*, students were asked to consider creative ways to address the accessibility of a library for wheelchair users (a community problem). The unit involved two items.

Library Accessibility: Item 1 (Generate diverse ideas)

The first item of the unit *Library Accessibility* asks students to think of three different ideas for improving the wheelchair accessibility of a library (Figure III.1.13). The coding guide provided scorers with a non-exhaustive list of idea categories and sub-categories to classify whether ideas are fundamentally different from one another (see Box III.1.7). To achieve full credit, students had to provide three appropriate ideas that are sufficiently different; if students provided only two different ideas, then their response achieved partial credit.

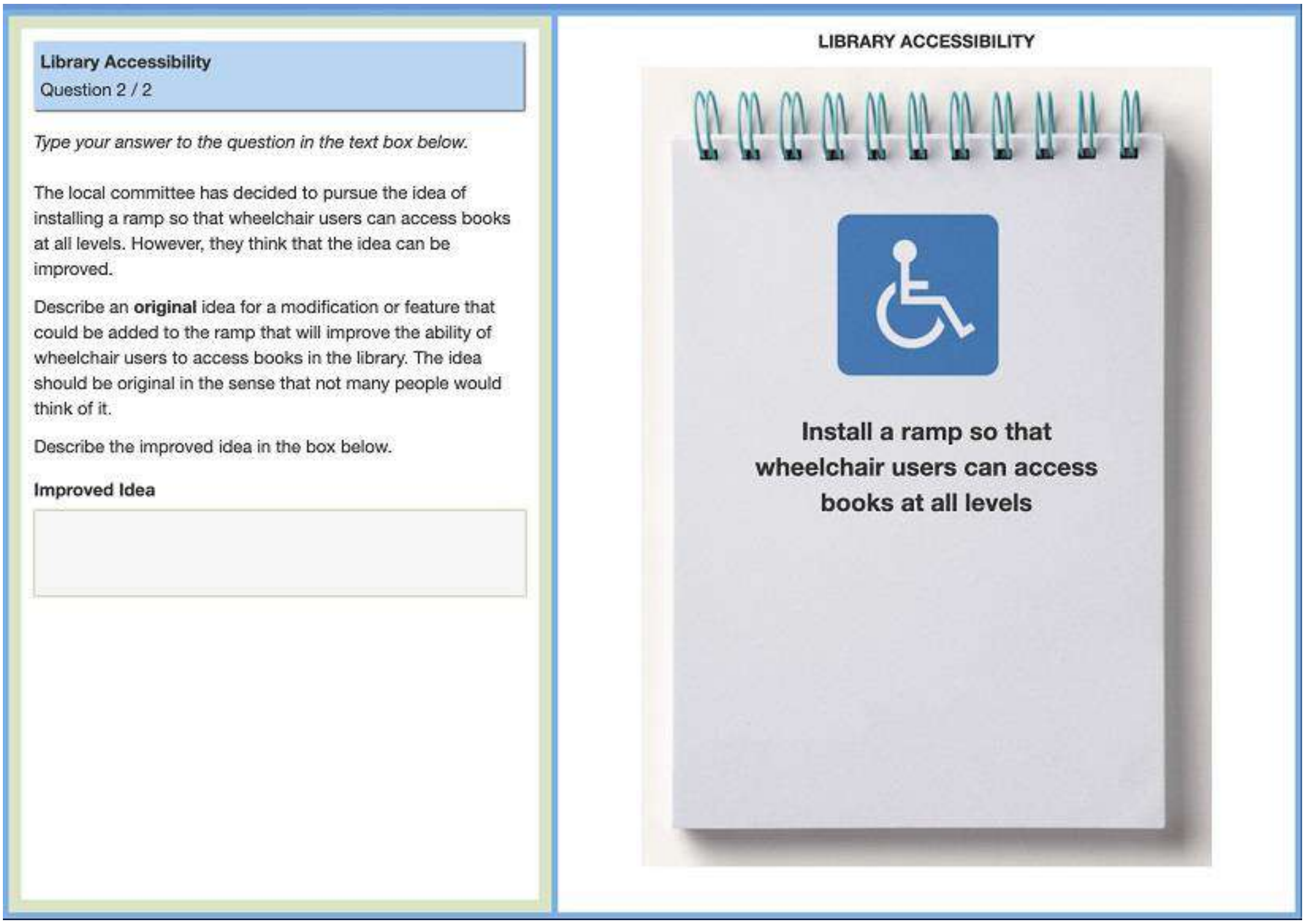
Figure III.1.13. *Library Accessibility*: Item 1



Library Accessibility: Item 2 (Evaluate and improve ideas)

In the second item of the unit *Library Accessibility*, students were presented with an idea to install ramps in the library. They were asked to suggest an original modification or feature for the ramp that would further enhance the ability of wheelchair users to access books in the library (Figure III.1.14). To achieve full credit, the response had to correspond to an original improvement theme. Responses that corresponded with conventional themes were awarded partial credit, unless combined with an innovative approach or implementation. Box III.1.7 describes the conventional themes for this item, as well as coded example responses.

Figure III.1.14. *Library Accessibility*: Item 2



Box III.1.7. *Library Accessibility*: Item-specific coding criteria and example responses

Item 1 (Suggest three ideas to address the accessibility of a library building)

In general, for the social problem-solving and scientific problem-solving items, the coding guide provided scorers with guidelines for determining whether student ideas were "sufficiently different". As items in the two problem-solving domains had a more constrained solution space than items in the written or visual expression, it was possible to provide scorers with a non-exhaustive list of idea category and sub-category groupings. Typically, category groupings differentiated ideas by their main approach or focus while the sub-categories differentiated ideas within the same larger category by their means of implementation.

The item-specific criteria for Item 1 in the *Library Accessibility* unit described the following categories of ideas (sub-categories in parentheses):

- **Category 1** – Physical modifications to the library (e.g. integrating ramps, elevators, etc.);
- **Category 2** – Providing human assistance to wheelchair users (e.g. staff or volunteers deliver library materials or bring customers to the materials);
- **Category 3** – Providing technological assistance mechanisms (e.g. aid with retrieving materials, guiding customers, or requesting deliveries).

Figure III.1.15. Coded examples for Item 1 in *Library Accessibility*

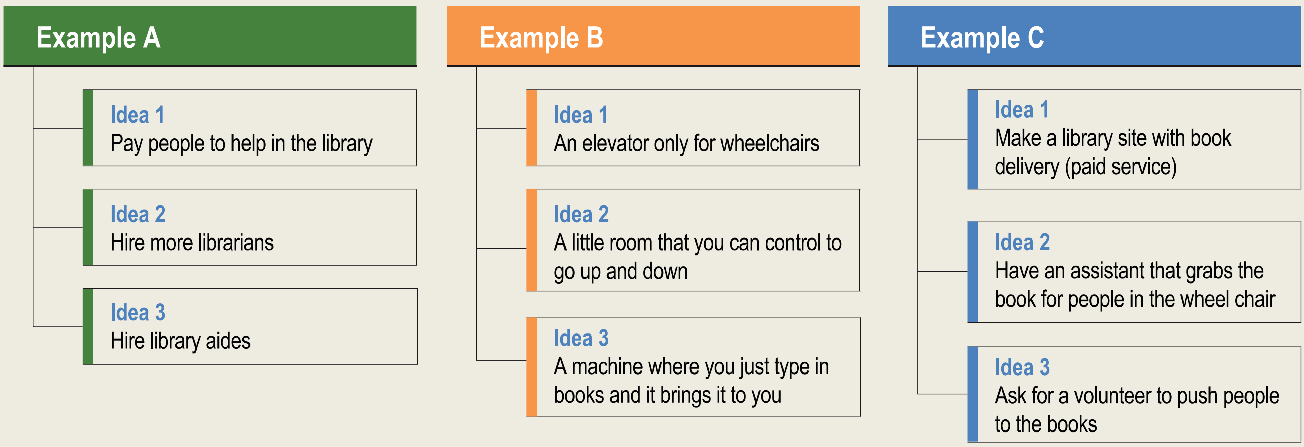


Figure III.1.15 shows three example responses for this item. All three ideas in Example Response A suggest hiring more staff for the library (Category 2) without further detail that could be considered evidence of a distinct focus or method of implementation. This response does not demonstrate skill in generating diverse ideas and was awarded no credit. In Example Response B, Ideas 1 and 2 both propose physical modifications to the library building (Category 1), effectively installing an elevator in both cases. The third idea of the response refers to integrating some technological assistance mechanisms (Category 3) and therefore displays a different focus. With two similar ideas and a third different idea, the response was awarded partial credit. In Example C, while all three ideas focus on providing human assistance (Category 2), each idea proposes a different method of implementation to assist the wheelchair users. They therefore correspond to different sub-categories and the response was awarded full credit.

Item 2 (Suggest an original modification to an existing solution)

The item-specific coding criteria for Item 2 in the *Library Accessibility* unit describes two conventional (i.e. non-original) themes. These themes include:

- **Conventional Theme 1:** Automating the ramp using a conveyer belt mechanism;
- **Conventional Theme 2:** Automating the ramp in other ways to move people (e.g. push/pull “on-demand” mechanisms, or mobile ramps).

Original themes included (but were not limited to) modifying the ramp’s gradient, adding a braking mechanism or an anti-slip surface to the floor of the ramp, adding extra lanes or adjusting the width of the ramp, or using the ramp as a bookshelf.

Figure III.1.16 provides examples of coded student responses for this item. Response A clearly corresponds to Theme 1 without adding further detail that could be considered an innovative approach or implementation; it was thus awarded partial credit. In Example Response B, the focus of the idea (adding an anti-slip surface) did not correspond to any of the conventional themes and was awarded full credit. Response C also corresponded to Theme 1 but introduced an original tool (voice automation) to facilitate the automation of the ramp. The response was awarded full credit.

Figure III.1.16. Coded examples for Item 2 in *Library Accessibility*

Example A	Example B	Example C
Install a long electronic ramp that goes to every level so that the wheelchair users don't have to roll their wheels so much as to end up being very tired and not want to go to higher levels.	You can add a thing to the ramp floor that makes it rough so the wheels don't slip.	Instead of them pushing with their hands they simply say where they want to go and the ramp floors move for them and help get them to where they need to be or go.

Sample Unit 7: Save the Bees

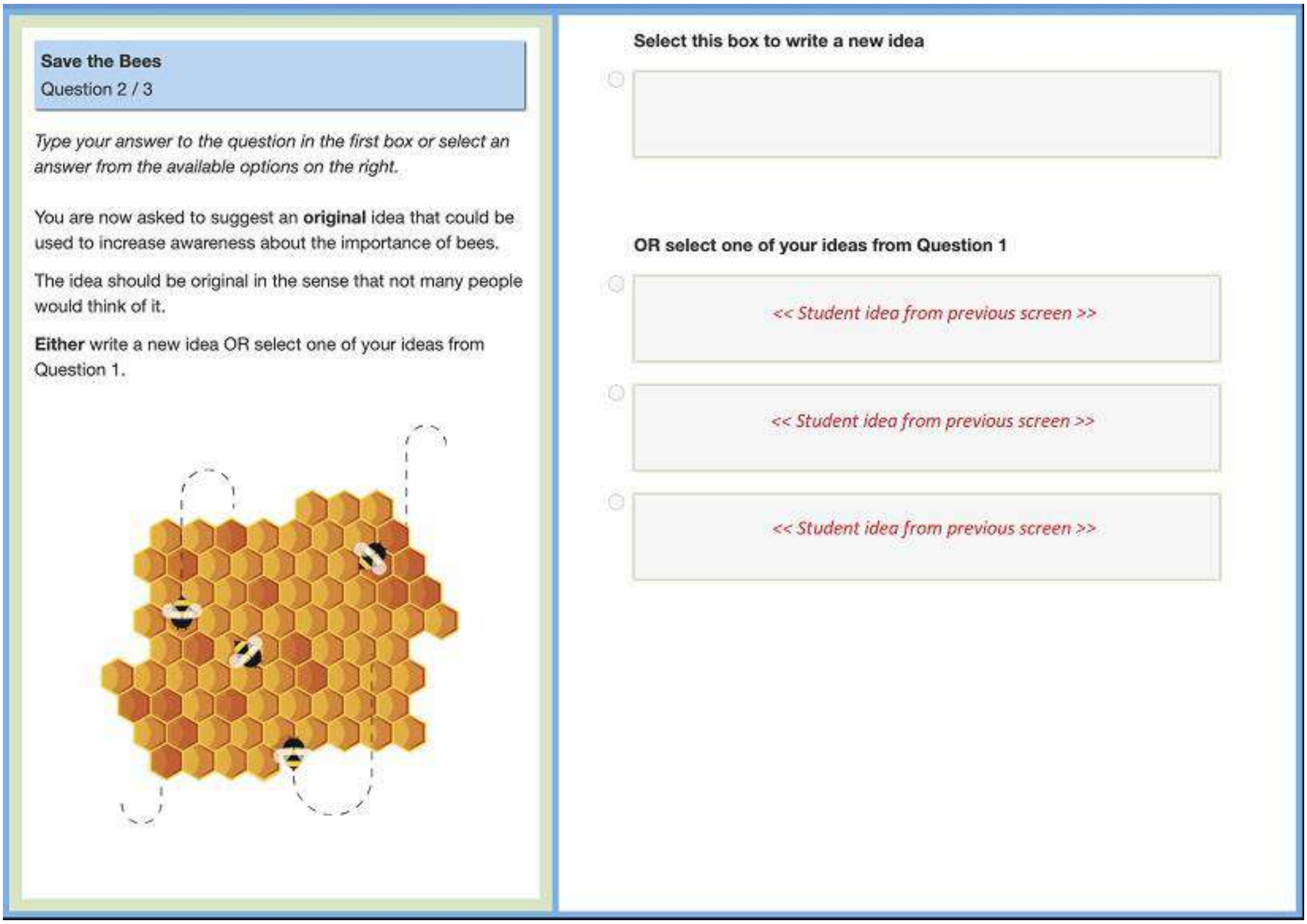
In the unit *Save the Bees*, students were asked to help the "Save the Bees" club at their school conduct an awareness-raising campaign focused on bees' ecological importance. The unit includes three items in total.

Save the Bees: Item 2 (Generate creative ideas)

In the first item of the *Save the Bees* unit, students were asked to suggest three different ideas to raise awareness about the importance of bees; in the second item of the unit, students must suggest one original idea to achieve this goal (Figure III.1.17). Students could provide a completely new idea or choose one of the ideas they provided in the previous item.

Like all "generate creative ideas" items, the response must correspond to an original theme to achieve full credit. Conventional themes for this item included: efforts to amplify the verbal communication of club members, the creation of informative visual materials, or organising the observation of live bees. Responses that corresponded with conventional themes were awarded partial credit unless combined with an innovative approach or implementation.

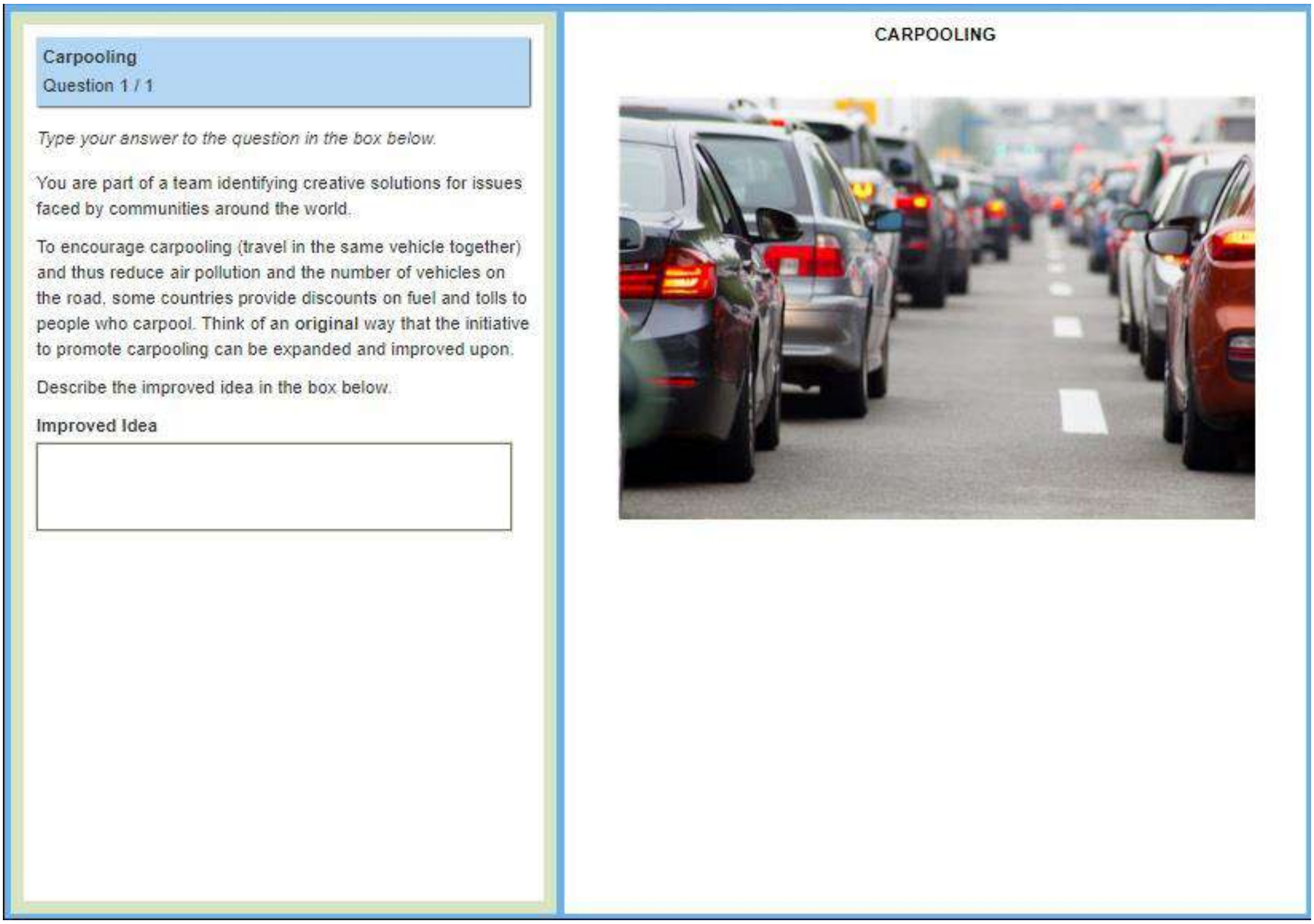
Figure III.1.17. *Save the Bees*: Item 2



Sample Unit 8: Carpooling

The unit *Carpooling* is a single-item unit in which students must think of an original idea to further incentivise carpooling (Figure III.1.18). The item is classified as an "evaluate and improve ideas" item because granting discounts on fuel or tolls are existing incentives that need to be further strengthened. To achieve full credit, the response must correspond to an original idea theme. For this item, there is only one conventional (i.e. non-original) theme: introducing additional financial incentives, for example making the shared purchase of cars more affordable. Responses that corresponded to the conventional theme were awarded partial credit unless combined with an innovative approach or implementation.

Figure III.1.18. *Carpooling*: Item



Scientific problem solving

In the PISA creative thinking test, students investigated open scientific or engineering problems. Although creative thinking in scientific contexts is related to scientific inquiry, the tasks in this domain context differed fundamentally from the PISA scientific literacy tasks – in the creative thinking test, students were asked to generate multiple ideas or solutions, or an original idea or solution, for an open problem with no pre-defined “correct” response. For example, in a task asking students to think of explanations for a given phenomenon, they would be rewarded for proposing multiple plausible ideas regardless of whether these constituted the right explanation.

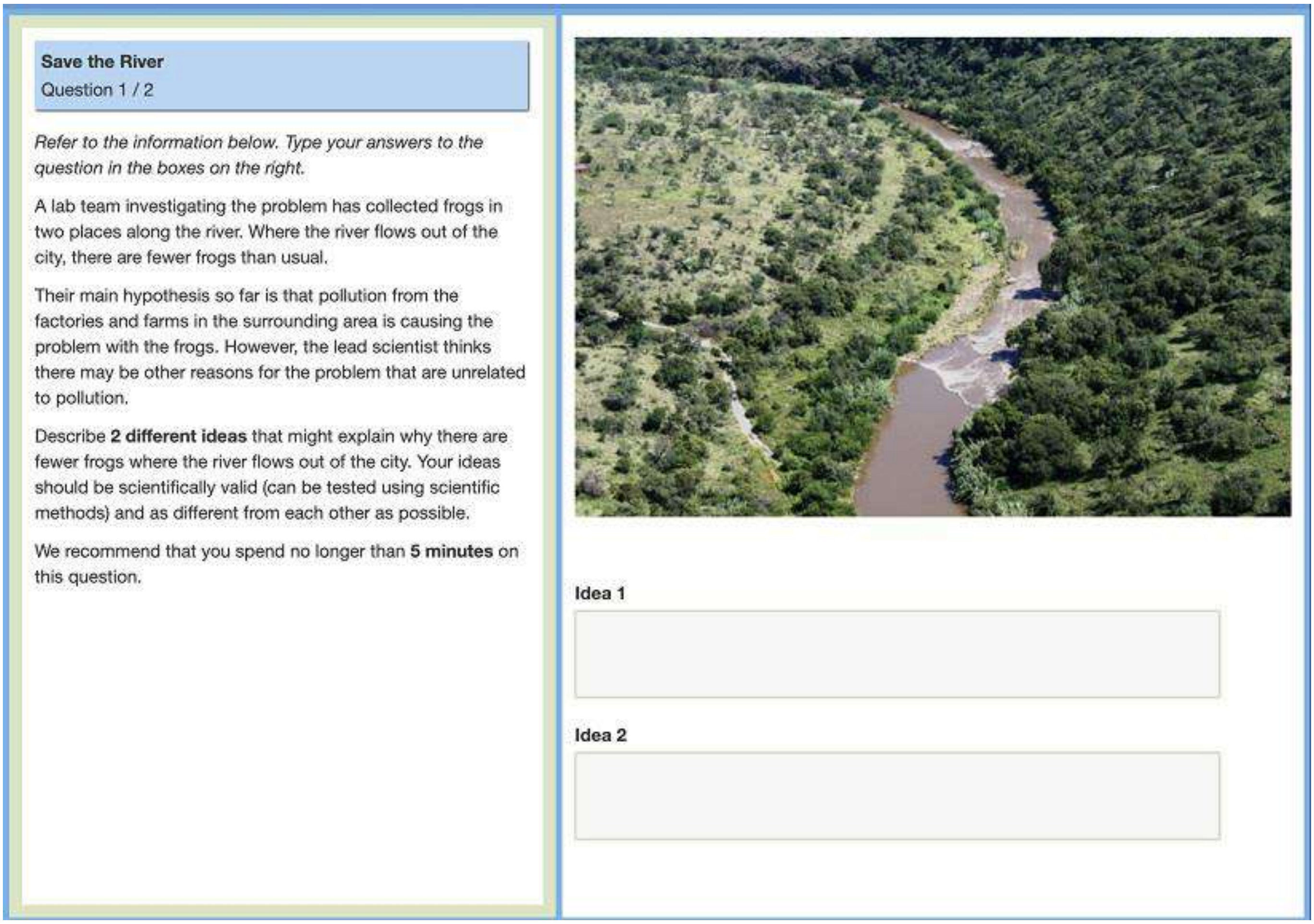
Sample Unit 9: Save the River

In the unit *Save the River*, students were asked to think creatively about a problem related to frogs in a local river. The two items in the unit focus on finding and verifying ideas about the cause of the problem.

Save the River: Item 1 (Generate diverse ideas)

The first item in the *Save the River* unit describes the problem to students – a declining frog population in a part of the river downstream from the city compared to the rest of the river – and asks them to provide two different, testable ideas for possible causes (Figure III.1.19). Students were explicitly instructed to think of causes other than pollution. Students could only achieve full credit or no credit for this item, as it required only two different ideas. The item-specific coding criteria provided several different possible causes of the problem (see Box III.1.8).

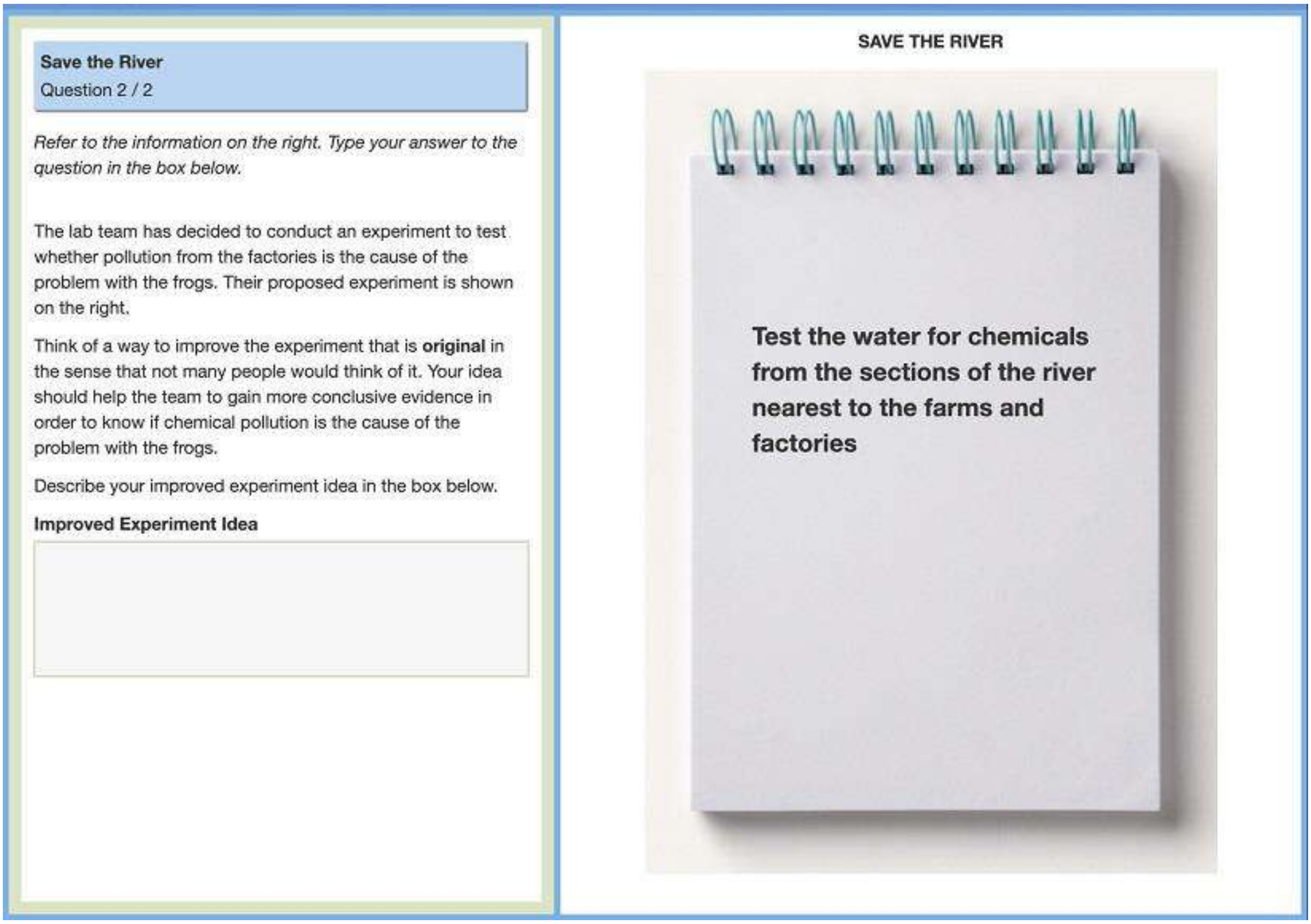
Figure III.1.19. *Save the River*: Item 1



Save the River: Item 2 (Evaluate and improve ideas)

The second item of the *Save the River* unit asks students to improve a proposed experiment aiming to test whether pollution is the cause of the problem with the declining frog population (Figure III.1.20). To achieve full credit, the response must correspond to an original improvement theme; conventional (i.e. non-original) themes and coded examples for this item are described in Box III.1.8. Responses that corresponded with conventional themes were awarded partial credit, unless combined with an innovative approach or implementation.

Figure III.1.20. *Save the River*: Item 2



Box III.1.8. *Save the River*: Item-specific coding criteria and example responses

Item 1 (Suggest two different ideas unrelated to pollution)

The item-specific coding criteria for Item 1 of the *Save the River* unit provides coders with guidelines on "sufficiently different" ideas. Ideas are classed into different categories and sub-categories based on their main focus and method of implementation. Among the possible different categories of ideas are:

- **Category 1** - Changes to the water habitat (e.g. colder or warmer temperature, changes in oxygen or mineral levels, etc.);
- **Category 2** – Changes to the surrounding fauna (e.g. a localised predator, lack of food);
- **Category 3** – Changes to the local flora (e.g. a new invasive plant species, or absence of important flora);
- **Category 4** – Changes to the frogs themselves (e.g. infection, disease, or mutation);
- **Category 5** – Changes to the behaviour or activities of humans in the area (e.g. noise, ground vibrations, or humans capturing frogs).

This list of idea categories and sub-categories is not exhaustive, but intended to provide coders with informative guidelines to help determine whether the two ideas proposed by students are "sufficiently different".

Item 2 (Suggest an original way to improve the experiment)

The item-specific coding criteria for Item 2 describes three conventional (i.e. non-original) themes for improving the given experiment idea (Figure III.1.20). These are:

- **Conventional Theme 1:** Providing more specific information about ways to test the water for chemicals or pollution;
- **Conventional Theme 2:** Testing the frogs for chemicals;
- **Conventional Theme 3:** Including a control measure in the experiment (e.g. comparing results to an unaffected group of frogs).

Original themes included (but were not limited to) conducting additional tests to rule out changes or anomalies in the frogs, to rule out environmental changes or anomalies, or to focus enquiries on identifying the chemicals that farms or factories are emitting.

Figure III.1.21 provides examples of coded student responses for this item. Response A suggests testing water from a different source as a type of control measure. It corresponds to Conventional Theme 3 without including any further information about how to test the water that could be considered evidence of an innovative approach or implementation. The response was thus awarded partial credit. Response B refers to also investigating the presence of invasive species that might be an alternative cause of the problem. It is an example of an original experiment improvement and was awarded full credit.

Figure III.1.21. Coded examples for Item 2 in *Save the River*

Example A	Example B
The experiment can be improved by comparing the analyzed water with water from other rivers and drawing conclusions.	Check the envionment for invasive species that are crowding out the frogs.

Reporting student proficiency in creative thinking

Like all PISA scales, student scores on the creative thinking test are summarised according to a unidimensional scale that estimates their overall creative thinking proficiency. However, the creative thinking scale for PISA 2022 has been constructed differently: this scale has been constructed as a bounded scale between 0 and 60 score points. The maximum sum-score of 60 points represents the total number of points available in a hypothetical test containing all 32 items within the creative thinking test-item pool. Student scores on the creative thinking scale can therefore be interpreted in terms of their estimated score (i.e. the sum of their partial and full credit responses) if they were to sit a test containing all 32 items in the test-item pool.

This two-digit scale addresses the relatively lower measurement precision of the creative thinking test compared to the PISA assessments of mathematics, reading and science, given the smaller number of items in the creative thinking test-item pool. A 1-point change in the creative thinking scale signals about 10% of a standard deviation of proficiency. This approach to scaling the PISA creative thinking data also means that results will be more sensitive to performance differences where there is more information available about students' performance in the test. For more information on the construction of the creative thinking scale and its supporting rationale, see Annex A3 or Chapter 18 of the *PISA 2022 Technical Report* (OECD, 2023[13]).

Creative thinking proficiency levels

To help interpret what student scores mean on the creative thinking scale in substantive terms, the scale is divided into seven proficiency levels. Six levels are described based on the skills needed to successfully complete the tasks that are located within them; the seventh level refers to students who perform below Level 1. Level 1 is the lowest described level and Level 6 corresponds to the highest described level of creative thinking skills.

Table III.1.1 describes the six proficiency levels in detail and shows the OECD average percentage of students at or above each proficiency level.[4]

Mapping of select sample items to the creative thinking proficiency levels

The difficulty of each item in the PISA assessment, at both partial credit (where available) and full credit, can be located on the same scale as the proficiency levels (OECD, 2023[14]). This mapping of items to a value on the scale is based on response probabilities.[5] The sample items described earlier in this chapter provide information about students across the entire range of the creative thinking scale. A selection of these sample items, at different credit thresholds (partial or full credit), have been mapped to each of the six described proficiency levels of creative thinking. Table III.1.2 presents this mapping, along with a brief description of the nature of the task at a given credit threshold and its drivers of difficulty (see Annex C for the technical information on each of the released items).

While the difficulty of the creative thinking items is established empirically based on response probability data at the international level, a combination of factors is likely to affect the difficulty of tasks in the creative thinking test. These include the familiarity of the item content to students, the task demands (e.g. generate two or three ideas), the task constraints (e.g. how open or closed the "solution space" is), the response type (e.g. a single word answer or an elaborated story idea), and the item-specific coding criteria (e.g. how many themes are designated as "conventional", or the scope of each theme/category). In general, tasks that require shorter response types and that focus on more familiar task contexts with an open solution space (i.e. with many possibilities and few appropriateness constraints) tend to be easier for students to demonstrate creative thinking.

Table III.1.1. Description of the six levels of proficiency in creative thinking

Level	Lower score limit	Percentage of students able to perform tasks at each level (OECD average)	Characteristics of tasks
6	48	8.9%	At Level 6, students can productively engage in creative idea generation, generating both original and diverse ideas for a wide range of expressive and problem-solving tasks including those in more complex, abstract and unfamiliar contexts. With respect to students at Level 5, students at this level can identify weaknesses in existing solutions to social or scientific problems, including those that are in less familiar contexts, and build on this understanding to suggest original and innovative ways to improve solutions. They can also generate several appropriate solution ideas for complex social and scientific problems that require more specific knowledge of the domain context and that have a more restricted range of solutions. For expressive tasks, students at Level 6 can create and improve more abstract visual designs, combining visual elements and representations in unexpected ways and conveying an original interpretation or iteration of an existing representation.
5	41	27.0%	At Level 5, students can productively engage in creative idea generation, generating both original and diverse ideas for a range of expressive and problem-solving tasks. Students at Level 5 can think of several qualitatively different ways to express their imagination and to address familiar social and scientific problems. They can make several different idea associations, considering different interpretations and perspectives on the same issue or stimulus. For both simple and more abstract written expression tasks, they can use their imagination to create original written outputs that make unconventional associations between ideas or that add atypical details to elaborate creatively on common themes. With respect to students at Level 4, students can create original visual outputs that combine elements in an unusual or unexpected way for open visual design tasks. Students at this level can also generate unconventional solution ideas that integrate innovative approaches in familiar social, and sometimes scientific, problem contexts. This includes when tasked to iterate on and improve an existing solution idea in more open, familiar problem contexts.
4	32	53.7%	At Level 4, students can productively engage in idea generation across a range of expressive and problem-solving tasks. Students at Level 4 can also generate original and diverse ideas for simple tasks in more familiar domain contexts. With respect to students at Level 3, students at this level can generate an appropriate idea for most types of idea generation task, including more complex or unfamiliar problem-solving tasks and tasks in a scientific context. They can also build on others' ideas for solutions in social and scientific contexts, although they tend to provide an obvious or common iteration with respect to their peers. Students at Level 4 can generate their own original ideas in written expression tasks and sometimes when iterating on others' ideas. They can express their imagination in unexpected ways, making unconventional idea associations between elements of the stimulus and their written output, or they can add atypical details to elaborate creatively on more common ideas. Students at this level can often suggest two or three qualitatively different ideas in open written expression and social problem contexts, but are less successful in more complex or constrained social and scientific problem contexts.
3	23	78.3%	At Level 3, students can generate one or several appropriate ideas for simple to moderately complex eaxpressive and problem-solving tasks, including extended written ideas that require them to engage and express their imagination and coherently build upon others' ideas. Students at this level thus show a greater level of engagement with creative tasks than students at Level 1 or Level 2. Students at Level 3 still typically suggest ideas that rely on obvious idea associations or common themes with respect to their peers, but they begin to demonstrate the ability to generate original solutions for familiar, everyday problems with a social focus. They may suggest solution ideas that not many other students think of or add an innovative or different twist to more conventional solution ideas.
2	15	93.1%	At Level 2, students can generate appropriate ideas for simple visual and written expression tasks as well as those that focus on solving familiar, everyday social problems. With respect to students at Level 1, students in Level 2 can develop simple written ideas in the form of longer captions or short dialogues. Students at Level 2 typically suggest ideas that rely on obvious idea associations for expressive tasks or that refer to existing solutions for problems in social problem-solving tasks. Students can generate more than one appropriate idea for some written expression and social problem-solving tasks, but these ideas are not qualitatively different to one another.
1	6	99.6%	At Level 1, students can generate very simple visual designs using isolated shapes or existing visual elements, and in some cases very short written outputs (e.g. a few words), that require them to engage their imagination. In general, students at this level rely on obvious themes or idea associations as the basis for their response and struggle to generate more than one appropriate idea even for very open and simple imagination tasks. These students typically generate simple visual or written outputs with few details that reflect only a minimal level of engagement with the task.

Source: OECD, PISA 2022 Database, Table III.B1.2.2. The StatLink URL of this table is available at the end of the chapter.

Table III.1.2. Mapping of select creative thinking items to the proficiency levels

Level	Lower score limit	Task	Task score	Percentage of students able to perform task (OECD average)	Nature of the task and drivers of difficulty
6	48	**Science Fair Poster** Task 1 (DT200Q01C2) Full credit	53.9	24.5%	Students must visually communicate the theme "Life in Deep Space" by using limited resources (e.g. without using the provided sticker elements) or by combining shape and sticker elements in an unconventional way. Obvious connections to life and space exploration (e.g. the Earth, astronauts, spacecraft) are not considered to be original. The stickers provided correspond only to the conventional themes.
		Library Accessibility Task 2 (DT500Q02C2) Full credit	53.4	20.9%	Students must find a meaningful and original way to improve a familiar solution to an accessibility problem (adding ramps), usually by identifying ways to enhance the context-specific experience (e.g. increasing the efficiency of book search, etc.) or by addressing other potential accessibility problems for wheelchair users. Students must therefore consider the specific needs of a group within society. The task context is also significantly constrained by the existing solution.
5	41	**Save the River** Task 1 (DT690Q01C) Full credit	46.4	39.7%	Students must suggest multiple plausible explanations to explain the decreasing frog population. The task context is relatively constrained given that ideas must coherently reflect the observations described in the task scenario. Both ideas must be appropriate and different to achieve full credit (no partial credit available), and students are instructed not to consider a familiar, and likely conventional, explanation (pollution).
		Public Transport Task 1 (DT630Q01C2) Full credit	45.1	39.3%	Students must suggest incentive measures that may (directly or indirectly) result in changes in the behaviour of people, building on a familiar and direct solution (financial incentives). The task context may be less familiar to student classroom activities, as they must consider the effects of policies on population behaviours.
4	32	**2983** Task 1 (DT370Q01C2) Full credit	37.6	52.6%	Students must find an original way to connect the number 2983 to a detail in their story idea. The task context is relatively open, but several obvious idea associations - stories set in the future year 2983, or where 2983 identifies a specific place, object or person - are considered conventional (unless combined with an innovative approach).
		Save the River Task 2 (DT690Q02C2) Partial credit	36.6	61.8%	Students must suggest a modification to an experiment idea, generally by addressing a flaw or deficiency in the current design. To achieve partial credit, students suggest an appropriate idea that corresponds to a conventional theme (providing directions on how to test the water for chemicals or including a control group in the experiment).
3	23	**Robot Story** Task 1 (DT570Q01C) Full credit	31.1	66.1%	Students must develop different story ideas for developing the relationship between a human and robot character. The task context is relatively open (there are few appropriateness constraints other than making reference to two characters) and only two different ideas are required.
		2983 Task 1 (DT370Q01C2) Partial Credit	27.2	73.7%	Students must connect the number 2983 to a detail in their story idea. The task context is relatively open in that there are no real constraints other than establishing the connection to the number, and this can either be explicit (e.g. 2983 is a key code) or implicit (a person has to discover a numeric key code).
2	15	**Library Accessibility** Task 1 (DT500Q01C) Partial credit	19.0	85.7%	Students must suggest three ideas to address accessibility issues for wheelchairs users. The context is relatively familiar: most students will be aware of at least some existing methods to make locations more accessible. The solution space is also relatively open: ideas differ if they focus on a different approach (e.g. physical modifications vs. human assistance) or if the method of implementation differs (e.g. adding ramps or lowering shelves). To achieve partial credit, students suggest two appropriate and different ideas.
		Space Comic Task 2 (DT240Q01C2) Partial credit	18.5	82.3%	Students must suggest an idea for a comic strip dialogue, completing six dialogue boxes. Unlike most tasks in the creative thinking test, a single or very few words may be appropriate for each box. To achieve partial credit, students suggest a coherent but conventional dialogue between the two comic strip characters with no original details.
1	6	**Science Fair Poster** Task 2 (DT200Q02C2) Partial credit	14.6	88.0%	Students must modify an existing poster design to communicate the theme of "Life in Deep Space". Students can use sticker elements (e.g. astronaut, plants, Earth) or create simple designs using shapes to add details relevant to the theme. To achieve partial credit, students suggest an appropriate but conventional modification - namely adding only one or multiple stickers to the poster.
		Illustration Titles Task 2 (DT300Q02C) Partial credit	13.0	85.7%	Students must suggest three title ideas for an illustration. Unlike most tasks in the test, a single word answer may be appropriate. The task context is very open: the illustration is surreal, meaning both literal and abstract interpretations may be appropriate. To achieve partial credit, students must suggest two appropriate and different ideas.

Source: OECD, PISA 2022 Database. The StatLink URL of this table is available at the end of the chapter.

Table III.1.3. Measuring creative thinking in PISA: Chapter 1 figures and tables

Figure III.1.1	Creativity in curricula worldwide
Table III.1.1	Description of the six levels of creative thinking proficiency in PISA 2022
Table III.1.2	Mapping of select creative thinking items to the proficiency levels

StatLink https://stat.link/ksegva

Notes

[1] Many international frameworks on the future of education and skills identify creativity, creative thinking and innovation as among the most important skills that students need to develop (Binkley et al., 2011[21]; European Commission, 2019[18]; Fadel and Groff, 2018[30]; OECD, 2018[1]; Pellegrino and Hilton, 2012[26]; Scott, 2015[19]; World Economic Forum, 2015[20]).

[2] Various studies or research papers have focused on how creativity and creative thinking support students' skill and personal development, for example identity formation (Barbot and Heuser, 2017[28]), academic achievement (Gajda, Karwowski and Beghetto, 2017[24]; Higgins et al., 2005[15]) and learning (Beghetto and Plucker, 2006[27]), various aspects of subjective well-being (Barnes, 2016[29]; Clarke and Basilio, 2018[22]; Connor, DeYoung and Silvia, 2018[23]; Tamannaeifar and Motaghedifard, 2014[25]) and physical well-being (Bungay and Vella-Burrows, 2013[16]), and social engagement (Spencer and Lucas, 2018[17]), amongst other things.

[3] In the PISA 2022 system-level survey, countries and economies were asked to report: i) how creativity is referenced within their jurisdiction's curriculum or standards for both primary and secondary education (i.e. as a priority cross-cutting theme or competency, within the broader umbrella of 21st century competencies, within subject-specific contexts, or not at all); and ii) the specific subject areas in which curricula or standards reference creativity. For the purposes of the PISA 2022 system-level survey, "creativity" was understood to include any of the following terms: creative thinking, creative problem solving, and innovation. In contrast, "creativity" was not understood to include the terms entrepreneurship, critical thinking or collaboration.

[4] Students with a proficiency score within the range of Level 1 are expected to complete most Level 1 tasks successfully, but are unlikely to be able to complete tasks at higher levels; students with scores in the Level 6 range are likely to be able to successfully complete all tasks included in the PISA 2022 assessment of creative thinking.

[5] Response probabilities for a given item are calculated using the item's international IRT parameters (discrimination and difficulty). Historically in PISA, a response probability of 0.62 (RP62) has been used to classify items into levels. Students with a proficiency located at or below this point have a probability of 0.62 or less of getting the item correct, while students with a proficiency above this point have a higher probability of getting the item correct higher than 0.62. Note that for polytomous items, the RP62 value is provided for partial credit as well as full credit responses. The partial credit RP62 has been defined as the minimum proficiency level a student needs to have an expected score that is 62% of the full credit. More information can be found in Chapter 14 of the PISA 2022 Technical Report (OECD, 2023[14]).

References

Baer, J. (2011), "Domains of creativity", in Runco, M. and S. Pritzker (eds.), *Encyclopedia of Creativity (Second Edition)*, Elsevier Inc. [11]

Baer, J. and J. Kaufman (2005), "Bridging generality and specificity: The amusement park theoretical (apt) model of creativity", *Roeper Review*, https://doi.org/10.1080/02783190509554310. [12]

Barbot, B. and B. Heuser (2017), "Creativity and identity formation in adolescence: A developmental perspective", in Karwowski, M. and J. Kaufman (eds.), *The Creative Self: Effect of Beliefs, Self-Efficacy, Mindset, and Identity*, Elsevier, https://www.sciencedirect.com/science/article/abs/pii/B9780128097908000054?via%3Dihub. [28]

Barnes, J. (2016), "Creativity and promoting wellbeing in children and young people through education", in Clift, S. and P. Camic (eds.), *Oxford Textbook of Creative Arts, Health, and Wellbeing: International Perspectives on Practice, Policy and Research*, Oxford University Press, Oxford. [29]

Beghetto, R. and J. Plucker (2006), "The relationship among schooling, learning, and creativity: "All roads lead to creativity" or "You can't get there from here"?", in Kaufman, J. and J. Baer (eds.), *Creativity and Reason in Cognitive Development*, Cambridge University Press, Cambridge, https://doi.org/10.1017/CBO9780511606915.019. [27]

Bungay, H. and T. Vella-Burrows (2013), "The effects of participating in creative activities on the health and well-being of children and young people: a rapid review of the literature.", *Perspectives in Public Health*, Vol. 133/1, pp. 44-52, https://doi.org/10.1177/1757913912466946. [16]

Clarke, T. and M. Basilio (2018), "Do arts subjects matter for secondary school students' wellbeing? The role of creative engagement and playfulness", *Thinking Skills and Creativity*, Vol. 29, pp. 97-114, https://doi.org/10.1016/j.tsc.2018.06.005. [22]

Connor, T., C. DeYoung and P. Silvia (2018), "Everyday creative activity as a path to flourishing", *The Journal of Positive Psychology*, Vol. 13, pp. 181-189, https://doi.org/10.1080/17439760.2016.1257049. [23]

Cropley, A. (2006), "In praise of convergent thinking", *Creativity Research Journal*, Vol. 18/3, pp. 391-404, https://doi.org/10.1207/s15326934crj1803_13. [10]

Csikszentmihalyi, M. (2013), *Creativity: The Psychology of Discovery and Invention*, Harper Collins, New York. [3]

European Commission (2019), *Key Competences for Lifelong Learning*, Publications Office of the European Union, Luxembourg, https://data.europa.eu/doi/10.2766/569540. [18]

Fadel, C. and J. Groff (2018), "Four-dimensional education for sustainable societies", in Cook, J. (ed.), *Sustainability, Human Well-Being, and the Future of Education*, Springer International Publishing, Cham, https://doi.org/10.1007/978-3-319-78580-6_8. [30]

Gajda, A., M. Karwowski and R. Beghetto (2017), "Creativity and academic achievement: A meta-analysis", *Journal of Educational Psychology*, Vol. 109/2, pp. 269-299, https://doi.org/10.1037/edu0000133. [24]

Griffin, P., B. McGaw and E. Care (eds.) (2011), *Defining twenty-first century skills*, Springer Netherlands, Dordrecht, https://doi.org/10.1007/978-94-007-2324-5_2. [21]

Guilford, J. (1956), "The structure of intellect", *Psychological Bulletin*, Vol. 53/4, pp. 267-293, https://doi.org/10.1037/h0040755. [7]

Guilford, J. (1950), "Creativity", *American Psychologist*, Vol. 5/9, pp. 444-454, https://doi.org/10.1037/h0063487. [9]

Higgins, S. et al. (2005), "A meta-analysis of the impact of the implementation of thinking skills approaches", *Research Evidence in Education Library*, https://eppi.ioe.ac.uk/cms/Portals/0/PDF%20reviews%20and%20summaries/t_s_rv2.pdf?ver=2006-03-02-125128-393. [15]

Kaufman, J. and R. Beghetto (2009), "Beyond Big and Little: The Four C model of creativity", *Review of General Psychology*, Vol. 13/1, pp. 1-12, https://doi.org/10.1037/a0013688. [5]

OECD (2023), *PISA 2022 Innovative Domain Test Design and Test Development*, OECD Publishing, Paris, https://www.oecd.org/pisa/data/pisa2022technicalreport/PISA-2022-Technical-Report-Ch-18-PISA-Proficiency-Scale-Construction-Domains-Creative-Thinking.pdf. [13]

OECD (2023), *Scaling Outcomes*, OECD Publishing, Paris, https://www.oecd.org/pisa/data/pisa2022technicalreport/PISA-2022-Technical-Report-Ch-14-Scaling-Outcomes.pdf. [14]

OECD (2023), *Supporting Students to Think Creatively: What Education Policy Can Do*, https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1_ (accessed on 28 March 2024). [2]

OECD (2022), *Thinking Outside the Box: The PISA 2022 Creative Thinking Assessment*, https://issuu.com/oecd.publishing/docs/thinking-outside-the-box (accessed on 4 March 2023). [6]

OECD (2018), *The Future of Education and Skills 2030*, OECD Publishing, Paris, https://www.oecd.org/education/2030-project/about/documents/E2030%20Position%20Paper%20(05.04.2018).pdf (accessed on 1 March 2023). [1]

Pellegrino, J. and M. Hilton (2012), *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*, National Academies Press, Washington, D.C., https://doi.org/10.17226/13398. [26]

Runco, M. and S. Acar (2012), "Divergent thinking as an indicator of creative potential", *Creativity Research Journal*, Vol. 24/1, pp. 66-75, https://doi.org/10.1080/10400419.2012.652929. [8]

Scott, C. (2015), *The futures of learning 2: What kind of learning for the 21st century?*, UNESCO, https://unesdoc.unesco.org/ark:/48223/pf0000242996. [19]

Simonton, D. (2013), "What is a creative idea? Little-c versus Big-C creativity", in Thomas, K. and J. Chan (eds.), *Handbook of Research on Creativity*, Edward Elgar Publishing, Cheltenham, https://doi.org/10.4337/9780857939814.00015. [4]

Spencer, E. and B. Lucas (2018), *Understanding the role of creative self-efficacy in youth social action: A literature review*, Centre for Real-World Learning, University of Winchester, Winchester, https://www.thersa.org/globalassets/pdfs/reports/teenagency-literature-review.pdf. [17]

Tamannaeifar, M. and M. Motaghedifard (2014), "Subjective well-being and its sub-scales among students: The study of the role of creativity and self-efficacy", *Thinking Skills and Creativity*, Vol. 12, pp. 37-42, https://doi.org/10.1016/j.tsc.2013.12.003. [25]

World Economic Forum (2015), *New Vision for Education: Unlocking the Potential of Technology*, https://www3.weforum.org/docs/WEFUSA_NewVisionforEducation_Report2015.pdf. [20]

2 Student performance in creative thinking

This chapter summarises students' overall performance in creative thinking by country/economy and the variation in creative thinking performance across countries. It also examines the association between student performance in creative thinking and the three PISA core domains (mathematics, reading and science), including countries' and economies' relative performance in creative thinking. It concludes by describing differences in students' creative thinking competencies across countries and economies.

For Australia*, Canada*, Denmark*, Hong Kong (China)*, Jamaica*, Latvia*, the Netherlands*, New Zealand* and Panama* caution is advised when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).

For Albania** and the Dominican Republic**, caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

> "Everyone has huge creative capacities. The challenge is to develop them."
>
> Ken Robinson (2011[1])

Every child has the potential to think creatively. But how well are education systems worldwide developing this potential? To what extent are different education systems preparing students to think outside of the box and to express their own original or diverse ideas? The previous chapter introduced the construct of creative thinking and its measurement framework in PISA 2022. It also provided initial insights into the kinds of tasks that students at different levels of proficiency in creative thinking can complete. This chapter presents the international results from the PISA 2022 Creative Thinking assessment and examines the relationship between student performance in creative thinking and in the core PISA domains of mathematics, reading and science.

What the data tell us

- Singapore, Korea, Canada* and Australia* are the highest-performing systems in creative thinking, with an average student score of 37 score points or above – significantly higher than the OECD average (33 score points). Students in Singapore achieved an average score of 41 points.
- Most of the countries and economies that scored above the OECD average in creative thinking also outperformed the OECD average in mathematics, reading and science. Only Portugal performed above the OECD average in creative thinking (34 points) but not significantly different from the OECD average in all three PISA core domains. Czechia, Hong Kong (China)*, Macao (China) and Chinese Taipei performed at or below the OECD average in creative thinking but scored above the OECD average in mathematics, reading and science.
- The performance gap in creative thinking between the highest-performing and lowest-performing country is very large, around 28 score points. Less than 3 in every 100 students in the five best-performing countries (Singapore, Korea, Canada*, Australia* and New Zealand*, in descending order) perform around or below the mean of the five lowest performing countries (Albania**, the Philippines, Uzbekistan, Morocco and the Dominican Republic**, in order).
- In general, variation in creative thinking performance is not strongly related to mean performance. Students in Belgium, Denmark*, Estonia, Korea, Latvia*, Portugal and Singapore combine high levels of creative thinking proficiency overall with small variations in performance.
- Only around 28% of the total variation in creative thinking performance can be uniquely associated to student performance in mathematics, on average across the OECD.
- Students who performed at the highest (or lowest) level in creative thinking tended to also perform at the highest (or lowest) level in mathematics. However, similar proportions of students within the third quintile of creative thinking (over one-quarter of students, OECD average) scored within the second, third and fourth quintiles, respectively, in mathematics; and around 14% of students (OECD average) within the third quintile of mathematics scored in the upper quintile of creative thinking. This implies that academic excellence is not a pre-requisite for excellence in creative thinking.
- In Chile, Mexico, Australia*, New Zealand*, Costa Rica, Canada* and El Salvador (in descending order), students scored over 4.5 points higher than expected in creative thinking after accounting for their mathematics performance. In Singapore, Australia*, Canada*, Latvia*, Korea, Belgium, Finland and New Zealand* (in descending order), students scored around 3 points or more higher than expected after accounting for their reading performance.
- On average across OECD countries, around 1 in 2 students could think of original and diverse ideas in the context of simple imagination tasks or everyday problem-solving situations (i.e. they performed at or above Level 4). In Singapore, Korea and Canada*, over 70% of students performed at this level.
- In Singapore, Latvia*, Korea, Denmark*, Estonia, Canada* and Australia* (in descending order), more than 88% of students reached a baseline level of creative thinking proficiency (Level 3), with the OECD

average being 78% of students. However, in 20 countries and economies, more than 50% of students did not reach proficiency Level 3. This means that many students in these countries/economies struggled to think of appropriate ideas for a range of tasks, and few could suggest original ideas for familiar problems.

- Australia*, Canada*, Finland and New Zealand* combined high levels of mean performance and overall relative performance in creative thinking (i.e. after accounting for students' mathematics and reading scores, respectively) with at least 75% of students who reached proficiency Level 3.

Mean performance in creative thinking across countries and economies

Students across OECD countries scored 33 points on average on the PISA 2022 Creative Thinking assessment (Table III.B1.2.1). 12 countries (Singapore, Korea, Canada*, Australia*, New Zealand*, Estonia, Finland, Denmark, Latvia*, Belgium, Poland and Portugal, in descending order) significantly outperformed the OECD average in creative thinking, with mean scores between 41 and 34 points on the creative thinking scale (Table III.2.1). Box III.1.1 explains how to interpret differences in creative thinking performance across countries.

Singapore is the top-performing education system in creative thinking, with a student average score of 41 points, and it is the only non-OECD country to score significantly above the OECD average. Most of the 12 countries that outperformed the OECD average in creative thinking also outperformed the OECD average in mathematics, reading and science. Only Portugal performed above the OECD average in creative thinking (34 points) but not significantly different from the OECD average in the three PISA core domains.[1] Four countries and economies – Czechia, Hong Kong (China)*, Macao (China) and Chinese Taipei – performed at or below the OECD average in creative thinking despite being high-performing systems (i.e. performing above the OECD average) in mathematics, reading and science.

Table III.2.1. Comparing countries' and economies' performance in creative thinking

(light blue)	Statistically significantly **above** the OECD average
(white)	**Not** statistically significantly **different** from the OECD average
(grey)	Statistically significantly **below** the OECD average

Mean score	Comparison country/economy	Countries and economies whose mean score is not statistically significantly different from the comparison country's/economy's score
41	**Singapore**	
38	**Korea**	Canada*, Australia*
38	**Canada***	Korea, Australia*
37	**Australia***	Korea, Canada*
36	**New Zealand***	Estonia, Finland
36	**Estonia**	New Zealand*, Finland, Denmark*
36	**Finland**	New Zealand*, Estonia, Denmark*, Latvia*
35	**Denmark***	Estonia, Finland, Latvia*, Belgium
35	**Latvia***	Finland, Denmark*, Belgium, Poland
35	**Belgium**	Denmark*, Latvia*, Poland
34	**Poland**	Latvia*, Belgium, Portugal
34	**Portugal**	Poland
33	**Lithuania**	Spain, Czechia, *Chinese Taipei*, Germany, France, Netherlands*, Israel
33	**Spain**	Lithuania, Czechia, *Chinese Taipei*, Germany, France, Netherlands*, Israel
33	**Czechia**	Lithuania, Spain, *Chinese Taipei*, Germany, France, Netherlands*, Israel
33	***Chinese Taipei***	Lithuania, Spain, Czechia, Germany, France, Netherlands*, Israel
33	**Germany**	Lithuania, Spain, Czechia, *Chinese Taipei*, France, Netherlands*, Israel, *Hong Kong (China)**
32	**France**	Lithuania, Spain, Czechia, *Chinese Taipei*, Germany, Netherlands*, Israel, *Hong Kong (China)**
32	**Netherlands***	Lithuania, Spain, Czechia, *Chinese Taipei*, Germany, France, Israel, *Macao (China)*, *Hong Kong (China)**, Italy
32	**Israel**	Lithuania, Spain, Czechia, *Chinese Taipei*, Germany, France, Netherlands*, *Macao (China)*, *Hong Kong (China)**, Italy
32	***Macao (China)***	Netherlands*, Israel, *Hong Kong (China)**, Italy, Malta, Hungary
32	***Hong Kong (China)****	Germany, France, Netherlands*, Israel, *Macao (China)*, Italy, Malta, Hungary, Chile
31	**Italy**	Netherlands*, Israel, *Macao (China)*, *Hong Kong (China)**, Malta, Hungary, Chile
31	**Malta**	*Macao (China)*, *Hong Kong (China)**, Italy, Hungary, Chile
31	**Hungary**	*Macao (China)*, *Hong Kong (China)**, Italy, Malta, Chile, Croatia, Iceland
31	**Chile**	*Hong Kong (China)**, Italy, Malta, Hungary, Croatia, Iceland, Slovenia
30	**Croatia**	Hungary, Chile, Iceland, Slovenia
30	**Iceland**	Hungary, Chile, Croatia, Slovenia
30	**Slovenia**	Chile, Croatia, Iceland, Slovak Republic
29	**Slovak Republic**	Slovenia, Mexico, Serbia, Uruguay, United Arab Emirates
29	**Mexico**	Slovak Republic, Serbia, Uruguay, United Arab Emirates
29	**Serbia**	Slovak Republic, Mexico, Uruguay, United Arab Emirates
29	**Uruguay**	Slovak Republic, Mexico, Serbia, United Arab Emirates
28	**United Arab Emirates**	Slovak Republic, Mexico, Serbia, Uruguay
28	**Qatar**	Costa Rica, Greece, *Ukrainian regions (18 of 27)*
27	**Costa Rica**	Qatar, Greece, *Ukrainian regions (18 of 27)*
27	**Greece**	Qatar, Costa Rica, *Ukrainian regions (18 of 27)*, Romania
27	***Ukrainian regions (18 of 27)***	Qatar, Costa Rica, Greece, Romania, Colombia, Jamaica*
26	**Romania**	Greece, *Ukrainian regions (18 of 27)*, Colombia, Jamaica*, Malaysia
26	**Colombia**	*Ukrainian regions (18 of 27)*, Romania, Jamaica*, Malaysia, Mongolia
26	**Jamaica***	*Ukrainian regions (18 of 27)*, Romania, Colombia, Malaysia, Mongolia
25	**Malaysia**	Romania, Colombia, Jamaica*, Mongolia
25	**Mongolia**	Colombia, Jamaica*, Malaysia
24	**Moldova**	Kazakhstan, Brunei Darussalam, *Cyprus*, Peru, Brazil, Saudi Arabia, Panama*

	Statistically significantly **above** the OECD average
	Not statistically significantly **different** from the OECD average
	Statistically significantly **below** the OECD average

Mean score	Comparison country/economy	Countries and economies whose mean score is not statistically significantly different from the comparison country's/economy's score
24	**Kazakhstan**	Moldova, Brunei Darussalam, *Cyprus*, Peru, Brazil, Saudi Arabia, Panama*, El Salvador
24	**Brunei Darussalam**	Moldova, Kazakhstan, *Cyprus*, Peru, Brazil, Saudi Arabia, Panama*, El Salvador
24	***Cyprus***	Moldova, Kazakhstan, Brunei Darussalam, Peru, Brazil, Saudi Arabia, Panama*, El Salvador
23	**Peru**	Moldova, Kazakhstan, Brunei Darussalam, *Cyprus*, Brazil, Saudi Arabia, Panama*, El Salvador, *Baku (Azerbaijan)*
23	**Brazil**	Moldova, Kazakhstan, Brunei Darussalam, *Cyprus*, Peru, Saudi Arabia, Panama*, El Salvador, *Baku (Azerbaijan)*
23	**Saudi Arabia**	Moldova, Kazakhstan, Brunei Darussalam, *Cyprus*, Peru, Brazil, Panama*, El Salvador, *Baku (Azerbaijan)*
23	**Panama***	Moldova, Kazakhstan, Brunei Darussalam, *Cyprus*, Peru, Brazil, Saudi Arabia, El Salvador, *Baku (Azerbaijan)*
23	**El Salvador**	Kazakhstan, Brunei Darussalam, *Cyprus*, Peru, Brazil, Saudi Arabia, Panama*, *Baku (Azerbaijan)*
23	***Baku (Azerbaijan)***	Peru, Brazil, Saudi Arabia, Panama*, El Salvador
21	**Thailand**	Bulgaria, Jordan
21	**Bulgaria**	Thailand, Jordan
20	**Jordan**	Thailand, Bulgaria
19	**North Macedonia**	Indonesia, *Palestinian Authority*
19	**Indonesia**	North Macedonia, *Palestinian Authority*
18	***Palestinian Authority***	North Macedonia, Indonesia
15	**Dominican Republic****	Morocco
15	**Morocco**	Dominican Republic**, Uzbekistan, Philippines
14	**Uzbekistan**	Morocco, Philippines
14	**Philippines**	Morocco, Uzbekistan, Albania**
13	**Albania****	Philippines

Note: Only countries and economies with available data are shown.
Countries and economies are ranked in descending order of the mean performance in creative thinking.
Source: OECD, PISA 2022 Database, Table III.B1.2.1. The StatLink URL of this table is available at the end of the chapter.

Box III.2.1. Interpreting differences in creative thinking performance

The performance of students in creative thinking is summarised on a single creative thinking scale (as described in Box III.I.2, Chapter 1) that provides an overall estimate of their creative thinking proficiency. The performance of students within each country and economy can then be summarised according to the average student creative thinking score.

Interpreting differences in rankings

Many countries and economies score at similar levels in creative thinking. Small differences that are not statistically significant or practically meaningful should not be considered (see Reader's Guide at the beginning of this volume). Because mean-score estimates are derived from samples and are thus associated with statistical uncertainty, it is often not possible to determine an exact ranking for all countries and economies. However, it is possible to identify the range of possible rankings for a country or economy's mean performance (see Table III.A7.1 in Annex A7). This range of rankings can be relatively wide, particularly for countries/economies whose mean scores are similar to those of many other countries/economies.

Interpreting differences in scores: How large is a "large" score difference in creative thinking?

The creative thinking data are summarised according to a different PISA scale than the assessments of mathematics, reading and science, with which readers may be more familiar. In this report, the following three benchmarks provide guidance for interpreting test-score differences in creative thinking.

A first benchmark, which defines a “large” change in creative thinking, is 3 score points. Typically, in the PISA core domain assessments, a “large” difference is defined as a change of 20 score points or more. This is approximately equivalent to the typical annual learning gain by students around the age of 15 and is around one-fifth of the OECD standard deviation in performance. Given the broader “grain” size of the creative thinking scale (see Annex A5 for more), a change of 3 score points is approximately equivalent to one-quarter of the OECD standard deviation in creative thinking performance.

A second benchmark, which defines a “small” change in creative thinking, is 1 score point. Changes of up to 1 score point correspond to just under one-tenth of the OECD standard deviation in creative thinking performance. Given the first two benchmarks discussed here, score changes of between 1 and 3 points can thus be considered “moderate” differences in performance.

The third benchmark for interpreting differences in performance is statistical significance (see Reader’s Guide). This confidence interval needs to be taken into account when making comparisons between estimates so that differences that may arise simply due to the sampling error and measurement error are not interpreted as real differences.

There are substantial differences in creative thinking performance across countries and economies. The lowest-performing system (Albania**) has an average student score of 13 points on the creative thinking scale – around 28 points lower than the average student in Singapore (the highest-performing system). This gap between average student performance in the highest- and lowest-performing systems is more than 2.5 times larger than the OECD average standard deviation in performance (10.8 points), or roughly equivalent to between three and four proficiency levels in creative thinking. Less than 3% of students in the five best-performing countries and economies (Singapore, Korea, Canada*, Australia* and New Zealand*, in descending order) perform at or below the mean of the five lowest-performing countries and economies (Albania**, the Philippines, Uzbekistan, Morocco, the Dominican Republic**, in order).

Eight countries (Lithuania, Spain, Czechia, Chinese Taipei, Germany, France, the Netherlands* and Israel, in descending order) score around the OECD mean in creative thinking (33 points). The lowest-performing OECD country in creative thinking, Colombia, has a mean score of 26 points (7 points below the OECD average).

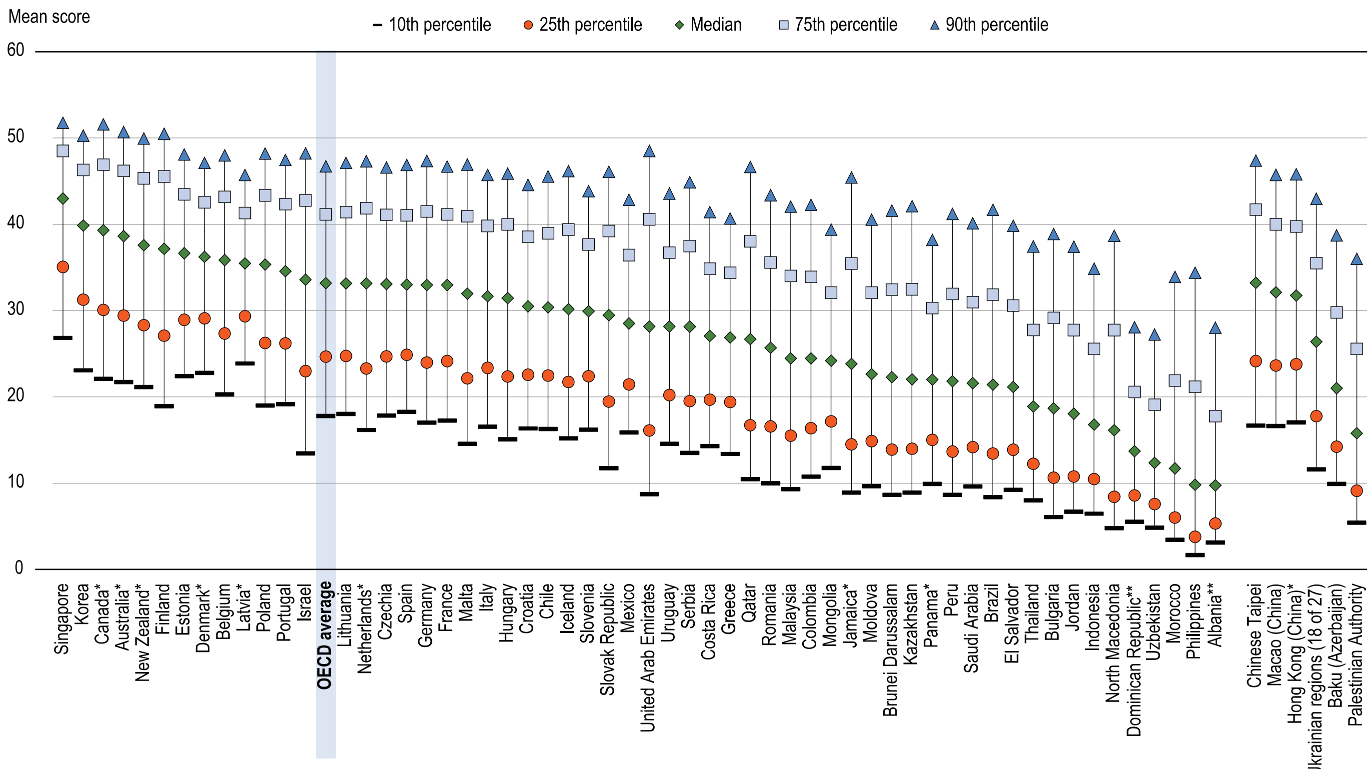
Variation in creative thinking performance across countries and economies

Comparing the mean performance of students in the 90th percentile in each country/economy with those in the 10th percentile in each country/economy is one way of examining the variation in student performance across countries and economies. Across the OECD, the average difference in creative thinking performance between these two groups of students is very large – around 29 score points (Table III.B1.2.1). This is roughly the equivalent to a difference of between three to four proficiency levels in creative thinking.

Significant differences in the variation in student performance exist across countries and economies (Figure III.2.1). The smallest variation in creative thinking performance between students in the 90th percentile and the 10th percentile is found in Latvia* and Uzbekistan (22 points), the Dominican Republic** (23 points) and Denmark* (24 points), although the average (mean) performance of students in these countries differs significantly. Among high-performing countries, in addition to Latvia* and Denmark*, Singapore has a relatively narrow spread of performance (25 points). At the other extreme, the United Arab Emirates, Jamaica* and Qatar (in descending order) have the largest variations in creative thinking performance, with a difference of more than 35 points between students in the top and bottom deciles. A large diversity in performance within a country/economy means that there are more students who tend to perform both relatively better and relatively worse than the average student in those countries/economies, compared to the average variation in performance observed across OECD countries.

Figure III.2.1. Variation in creative thinking performance across countries and economies

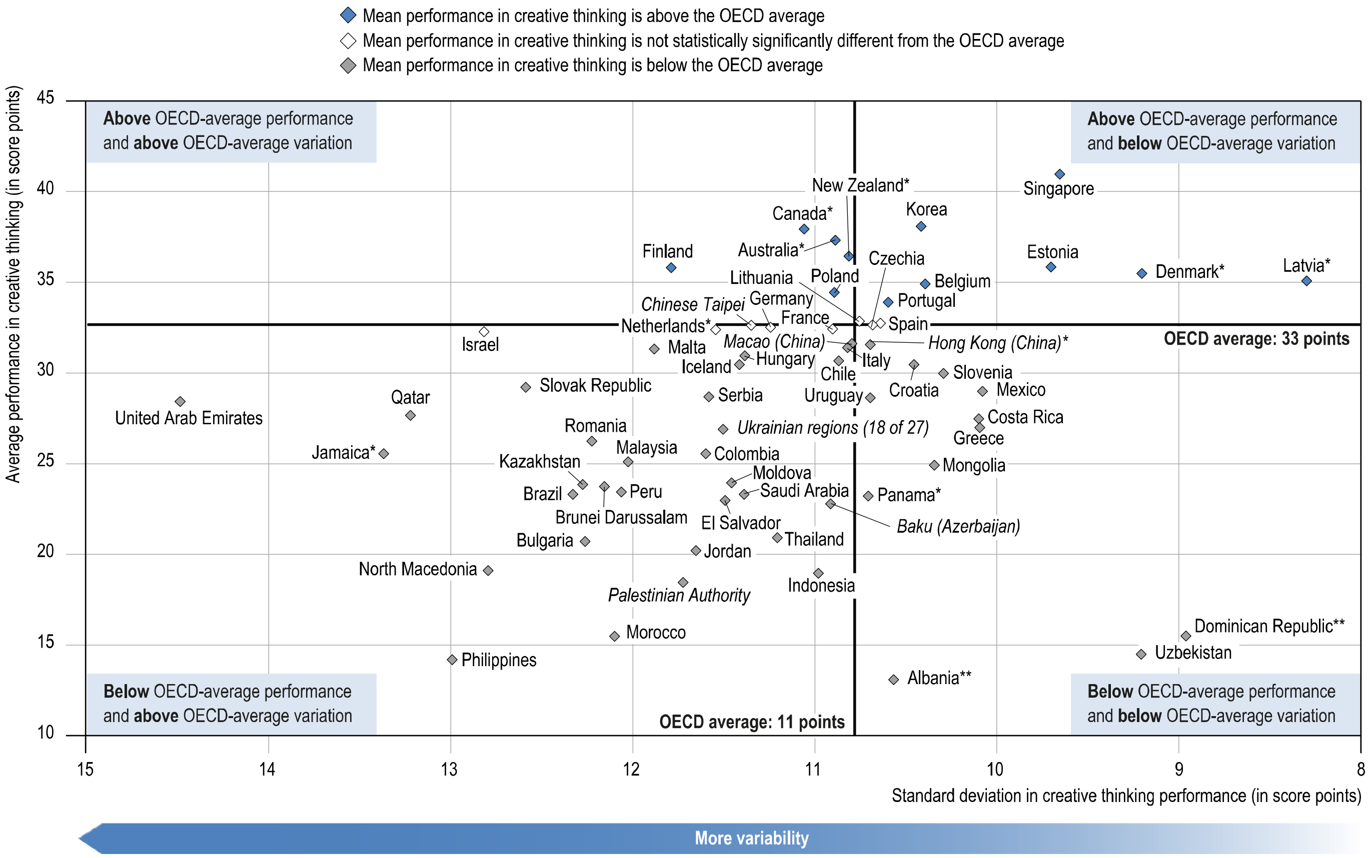
Differences in mean score between students in the 90th percentile and the 10th percentile



Notes: Only countries and economies with available data are shown.
All differences between the 90th and the 10th percentiles are statistically significant (see Annex A3).
Countries and economies are ranked in descending order of the median performance in creative thinking.
Source: OECD, PISA 2022 Database, Table III.B1.2.1. The StatLink URL of this figure is available at the end of the chapter.

In general, variation in creative thinking performance (as measured by standard deviation) is not strongly related to mean scores across participating countries and economies (Figure III.2.2).[2] Students in Belgium, Denmark*, Estonia, Korea, Latvia*, Portugal and Singapore combine high levels of average creative thinking proficiency with small variations in performance. This means that relatively more students in those countries and economies score close to the country/economy mean performance, which is above the OECD average. While students in Finland also score well above the OECD average, there is a much wider variation in student performance in the country, meaning that many students score significantly above and below the country mean.

Figure III.2.2. Average performance in creative thinking and variation in performance across countries and economies



Note: Only countries and economies with available data are shown.
Source: OECD, PISA 2022 Database, Table III.B1.2.1. The StatLink URL of this figure is available at the end of the chapter.

How performance in creative thinking compares to performance in mathematics, reading and science

To what extent does the PISA creative thinking assessment measure a different set of skills with respect to those measured in the core assessment domains? Generating, evaluating and improving upon ideas are fundamental cognitive processes in every curricular subject area. It should therefore be expected that student performance in creative thinking correlates positively with performance in mathematics, reading and science – even if the PISA 2022 Creative Thinking assessment places more emphasis on students' ability to generate original or qualitatively different ideas than in those domains. Students who perform well in creative thinking are likely to perform well in other subject areas, just as students who do not achieve high scores in mathematics, reading and science are likely to achieve low scores in creative thinking. This section examines these associations in more detail, including the relative performance of students in creative thinking given their performance in mathematics and reading.

Correlation with performance in mathematics, reading and science

Student performance in creative thinking correlates positively to performance in mathematics, reading and science respectively – but the strength of this association is weaker than the associations amongst mathematics, reading and science. Table III.2.2 shows the OECD average within-country correlations between student performance in creative thinking, mathematics, reading and science. The correlation between creative thinking, on the one hand, and each of the other three PISA domains on the other, is almost identical: 0.67 with mathematics, 0.66 with reading and 0.66 with science.[3] In comparison, performance scores among the three core PISA domains are more strongly associated, especially the correlation between performance in the mathematics and science assessments (0.87).[4] These results support the assertion that the creative thinking assessment measures a different subset of skills with respect to those measured in the mathematics, reading and science assessments.

Table III.2.2. Correlation in performance among creative thinking, mathematics, reading and science

OECD average

Correlation between:			
Mathematics	**Reading**	**Science**	**... and ...**
0.67	0.66	0.66	**Creative thinking**
	0.80	0.87	**Mathematics**
		0.80	**Reading**

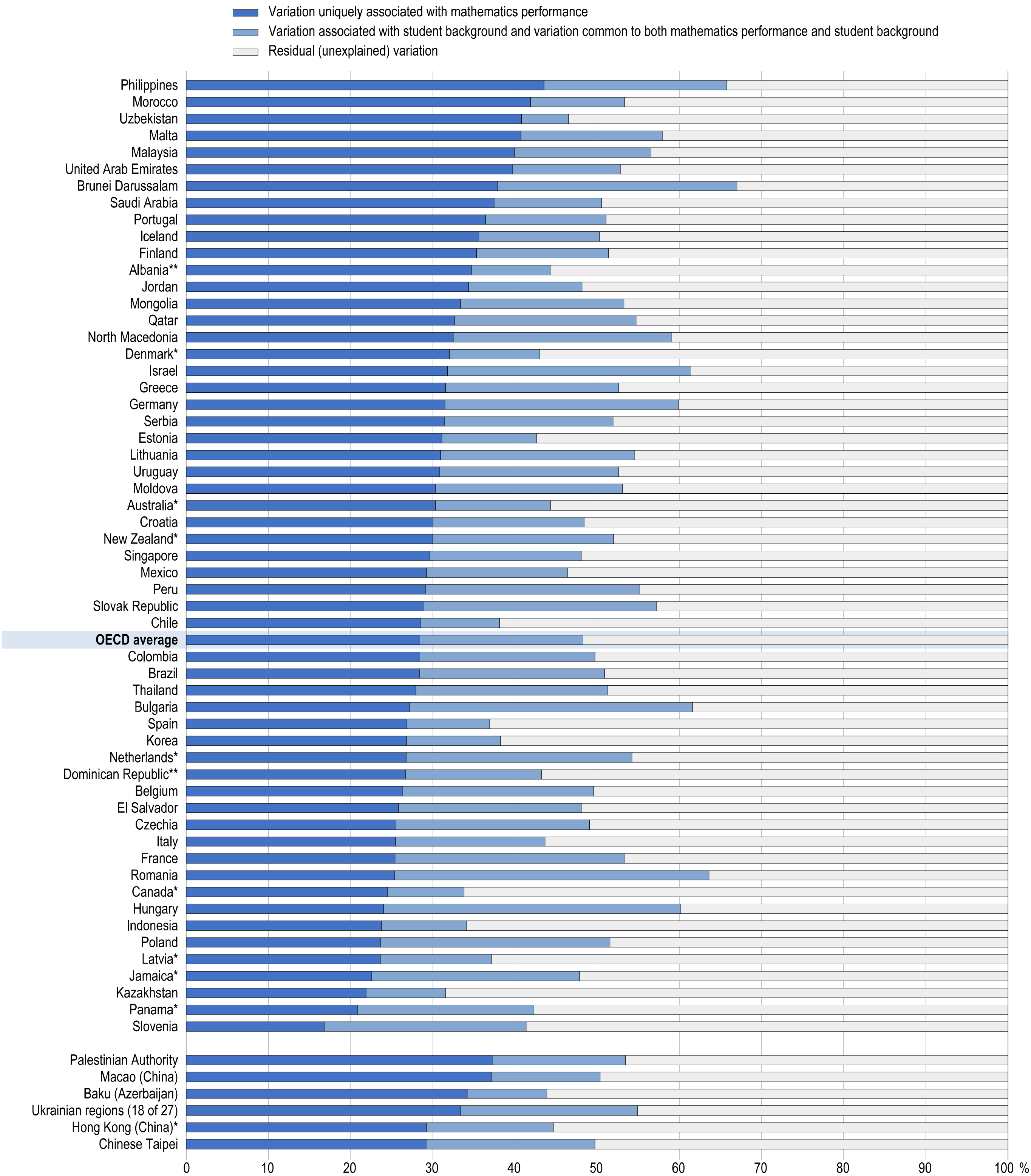
Source: OECD, PISA 2022 Database, Table III.B1.2.3. The StatLink URL of this table is available at the end of the chapter.

A different way of evaluating whether the skills measured in the PISA 2022 Creative Thinking assessment are unique is to examine the variation in student performance in creative thinking that can be associated with their performance in another assessment.[5] On average across the OECD, only around 28% of the variation in creative thinking performance can be uniquely associated to student performance in mathematics (the major domain focus in PISA 2022) (Figure III.2.3). This means that relatively little of the variation in performance across OECD countries can be accounted for simply by student performance in the mathematics assessment. A smaller proportion of the variation in student performance – around 20% – can be explained by student gender and student and school socio-economic profile (i.e. student background variables), and factors common to both student background and mathematics performance.

In four countries and economies (Slovenia, Panama*, Kazakhstan and Jamaica*, in order of smallest to largest), less than 23% of the variation in students' creative thinking performance can be associated with their performance in mathematics uniquely. In these countries and economies, more than in others, performance differences in creative thinking do not necessarily match those found in mathematics. For example, some students who perform at a high level of proficiency in mathematics achieve relatively low scores in creative thinking (and vice versa) in these countries/economies. In contrast, in the Philippines, Morocco, Uzbekistan, Malta, Malaysia, and the United Arab Emirates (in descending order), around 40% or more of the variation in creative thinking performance reflects performance differences captured uniquely in the mathematics assessment.

While the relative strength of the association between creative thinking and mathematics performance, as well as certain student and school characteristics, varies across countries and economies, in only one country do these factors account for more than two-thirds of the total variation in creative thinking performance (Brunei Darussalam, 67%). Again, these findings support the assumption that the PISA 2022 Creative Thinking assessment measures a different subset of skills with respect to the other PISA assessments.

Figure III.2.3. Variation in creative thinking performance associated with performance in mathematics



Notes: Only countries and economies with available data are shown.

Explained variation is the R squared coefficient from a regression of creative thinking score on mathematics, gender and students' and schools' socio-economic profile (ESCS).

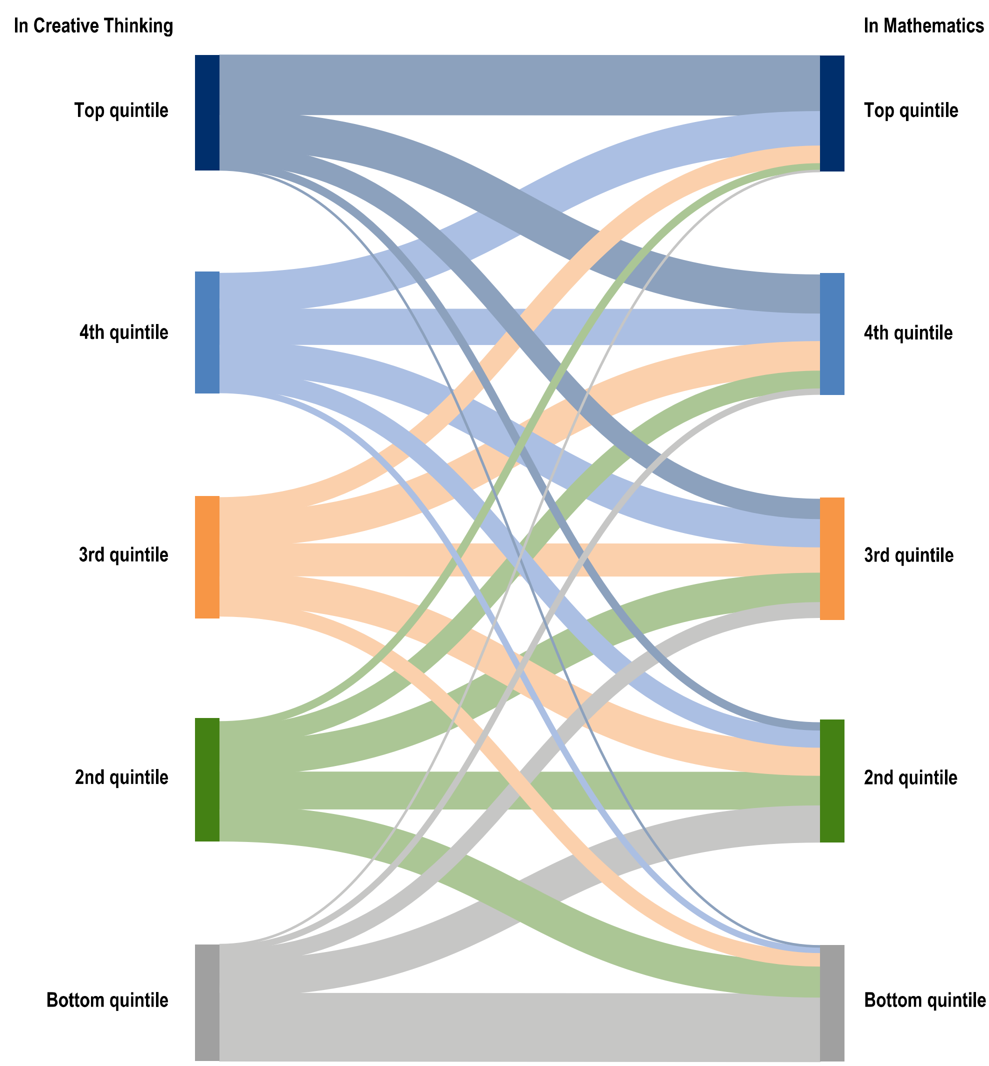
Countries and economies are ranked in descending order of the percentage of variation in creative thinking performance explained uniquely by performance in mathematics.

Source: OECD, PISA 2022 Database, Table III.B1.2.3. The StatLink URL of this figure is available at the end of the chapter.

Is the correlation between creative thinking performance and performance in mathematics linear across the entire performance scale? Or is there more variability in creative thinking performance at different skill levels in the core domains? Figure III.2.4 shows the proportion of students (OECD average) within each quintile on the mathematics scale who score within each quintile on the creative thinking scale. At the upper and lower ends of both scales, there is less variability in student performance: around half of all students in the top quintile of performance in mathematics (and over half of all students in the bottom quintile) are in the top quintile of performers in creative thinking (or bottom quintile, respectively). In other words, students who performed at either the highest or lowest levels in mathematics tended to also perform at the highest or lowest levels in creative thinking. Yet far greater variability in creative thinking performance was observed amongst students in the second, third and fourth quintiles of mathematics performance. For example, just over one-quarter of all students within the third quintile in creative thinking also performed within the third quintile in mathematics, with similar proportions of students performing within the second and fourth quintiles in mathematics; and around 14% of all students within the third quintile in mathematics performed within the upper quintile in creative thinking. Similar patterns were observed when examining the distribution of students across quintiles of performance in creative thinking and reading.[6]

Figure III.2.4. Distribution of students across quintiles of performance in creative thinking and mathematics

OECD average



Source: OECD, PISA 2022 Database. The StatLink URL of this figure is available at the end of the chapter.

These data imply that performance in creative thinking and academic performance go hand in hand to some extent, particularly at the upper and lower ends of the proficiency scales. Yet academic excellence is not a pre-requisite for excellence in creative thinking. While creative thinking performance and academic performance complement one another, PISA data show that it is possible for many students to be strong creative thinkers. While all students have the potential to excel in creative thinking, this is especially the case for those who reached at least a baseline level of proficiency in mathematics, reading and science.

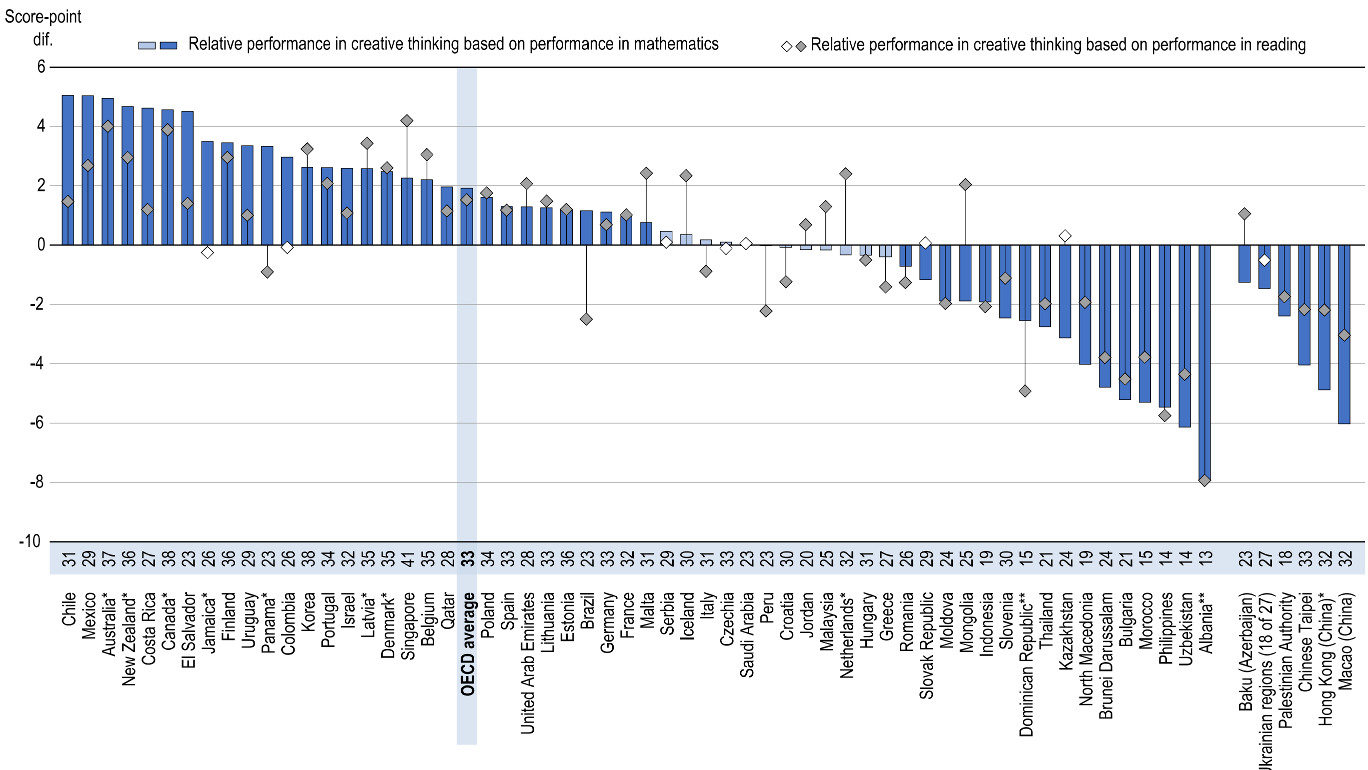
Countries' and economies' relative performance in creative thinking

In general, the positive correlation between performance in creative thinking and performance in mathematics, reading and science means that students who perform well in the PISA core domains will likely perform well in creative thinking. However, in some countries and economies, students may have performed relatively better or worse than expected in creative thinking given their scores on the other PISA assessments. In this section, "relative performance" refers to students' performance in creative thinking after accounting for their mathematics or reading performance.[7] In other words, relative performance describes how well students performed in creative thinking compared to other students with similar mathematics or reading scores.

In seven countries (Chile, Mexico, Australia*, New Zealand*, Costa Rica, Canada* and El Salvador, in descending order), students scored over 4.5 points higher than expected in creative thinking – a large relative performance advantage – after accounting for their mathematics performance (Figure III.2.5). These seven countries include education systems across the entire performance range of creative thinking, including both high- and low-performing systems, meaning it is possible for students with both stronger and weaker mathematics proficiency to perform relatively well in creative thinking. By some margin, the country with the weakest relative performance after accounting for students' mathematics performance is Albania**, with students scoring nearly 8 points lower in creative thinking than expected, followed by Uzbekistan and Macao (China) (both around -6 points). Among OECD countries, Slovenia (-2.5 points) and the Slovak Republic (-1.2 points) had the largest relative performance deficit. All countries with a negative relative performance in creative thinking after accounting for their mathematics performance scored significantly below the OECD average in creative thinking, except for Chinese Taipei (whose mean score was not statistically different to the OECD average).

Figure III.2.5. Countries' and economies' relative performance in creative thinking

Score-point difference between actual and expected performance in creative thinking



Note: Only countries and economies with available data are shown. The actual mean score in creative thinking is shown next to the country/economy name.
Statistically significant score-point differences are shown in a darker tone (see Annex A3).
A student's relative performance in creative thinking is defined as the residual obtained upon a cubic polynomial regression of the student's performance in creative thinking over his or her performance in mathematics or reading. The regression is performed at an international level, pooling data from all countries and economies that participated in the creative thinking assessment.
Countries and economies are ranked in descending order of the relative performance in creative thinking based on performance in mathematics.
Source: OECD, PISA 2022 Database, Table III.B1.2.4. The StatLink URL of this figure is available at the end of the chapter.

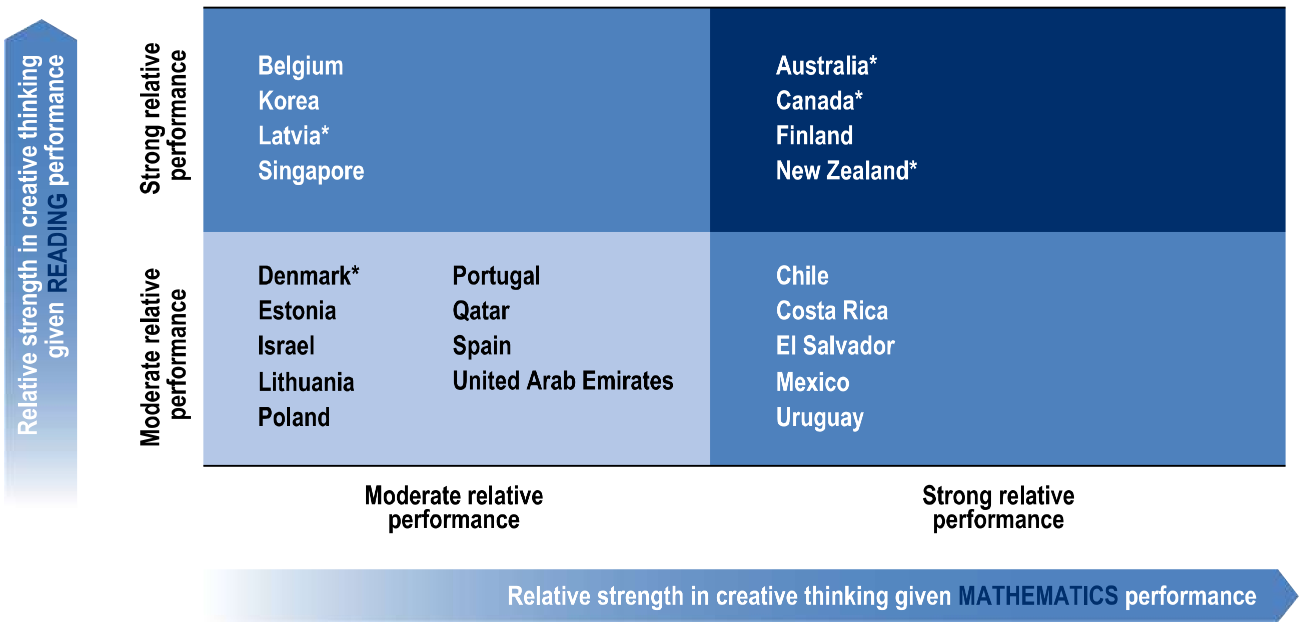
Are similar patterns observed when examining students' relative performance in creative thinking given their reading scores? In general, students in countries/economies who performed relatively better in creative thinking after accounting for their mathematics performance tended to also perform relatively better after accounting for their reading performance, and vice versa (Figure III.2.5). In Singapore, Australia*, Canada*, Latvia*, Korea, Belgium, Finland and New Zealand* (in descending order), students had the largest relative performance in creative thinking after accounting for their reading performance – scoring around 3 or more points higher in creative thinking than expected.

When considering both relative performance measures, students in four countries demonstrated a large relative strength in creative thinking overall (Figure III.2.6): in Australia*, Canada*, Finland and New Zealand*, students scored around 3 points higher in creative thinking after accounting for both their mathematics performance and after accounting for their reading performance, respectively. Other clusters of countries also demonstrated a moderate to strong relative performance in creative thinking overall. For example, in the Latin American region, Chile, Costa Rica, El Salvador, Mexico and Uruguay all demonstrated a strong relative performance in creative thinking (i.e. scored around 3 or more points higher than expected) given their mathematics performance, and a moderate relative performance (scoring between 1 and 2.75 points higher) given their reading performance. A cluster of European countries also demonstrated a moderate relative performance in creative thinking given their mathematics scores, combined with either a strong (Belgium, Latvia*) or moderate (Denmark*, Estonia, Lithuania, Poland, Portugal and Spain) relative performance in creative thinking given their reading performance. Students in Israel, Qatar and the

United Arab Emirates also demonstrated a moderate strength in creative thinking with respect to both reading and mathematics scores. Only Singapore and Korea showed a relative strength in creative thinking overall amongst East Asian countries, combining a large relative performance in creative thinking after accounting for reading scores with a moderate relative performance in creative thinking after accounting for mathematics scores.

In several of these countries/economies with a notable relative strength in creative thinking, system-level reforms of curricula and assessment practices over the past decade have focused on furthering the importance of creative thinking in education (see Box III.2.2).

Figure III.2.6. Countries and economies that perform better than expected in creative thinking



Note: Countries/economies with a "strong" relative performance in creative thinking are those whose students score significantly higher than 2.75 score-points in creative thinking after accounting for mathematics/reading performance (see Annex A3). Countries/economies with a "moderate" relative performance in creative thinking are those whose students score significantly higher than 1 score-point but less than 2.75 score-points higher in creative thinking after accounting for mathematics/reading performance.
Source: OECD, PISA 2022 Database, Table III.B1.2.4. The StatLink URL of this figure is available at the end of the chapter.

Students in other countries/economies demonstrated a mixed or negative overall relative performance in creative thinking compared to their performance in the PISA core domains. In Baku (Azerbaijan), Iceland, Malaysia, Mongolia and the Netherlands*, students scored as or lower than expected in creative thinking after accounting for their mathematics performance but scored at least 1 point higher than expected in creative thinking after accounting for their reading performance. Conversely in Brazil, Colombia, Jamaica* and Panama*, students scored relatively lower in creative thinking after accounting for their reading performance despite scoring at least 1 point higher than expected after accounting for their mathematics scores. In both cases, the mixed direction of relative performance results in creative thinking across the two measures likely reflects relative weaknesses in either reading (for Baku (Azerbaijan), Iceland, Malaysia, Mongolia and the Netherlands*) or mathematics (for Brazil, Colombia, Jamaica* and Panama*) performance, rather than a relative strength in creative thinking overall.

Students in Albania**, Brunei Darussalam, Bulgaria, Macao (China), Morocco, the Philippines and Uzbekistan demonstrated the largest overall relative weaknesses in creative thinking, scoring at least 3 points lower than expected after accounting both for mathematics and for reading performance, respectively. Students in the Dominican Republic**, Hong Kong (China)*, Indonesia, Moldova, North Macedonia, the Palestinian Authority, Slovenia, Chinese Taipei and Thailand also demonstrated a moderate overall relative weakness in creative thinking.

Box III.2.2. System-level efforts to integrate creative thinking into the curriculum and assessment

Promoting the development of creative thinking consistently and effectively in education requires educators, curriculum developers and assessment designers to have a shared understanding of what creative thinking is, how students can develop creative thinking skills, and how their progress can be measured. Redefining curricula and learning progressions with these goals in mind can facilitate the development of creativity-supportive teaching and learning. A recent publication providing a snapshot of progress in integrating creative thinking in schools around the world concluded that while creative thinking is increasingly specified in curricula, only a small number of jurisdictions provide strategic leadership and clear guidance in practice (Lucas, 2022[2]). However, there are a growing number of promising examples.

From high-level strategy to curriculum reform

In 2019, **Norway** published a new strategy recognising the link between creative work and learning in all subjects (Ministry of Education and Research, 2019[3]). The strategy's goals were to reduce curriculum content to facilitate deeper learning experiences, strengthen the practical and aesthetic aspects of the curriculum (including arts, crafts, music, and food and health education), and develop new guidelines to support teacher practice. A new national curriculum was introduced in 2020, and accompanying resources for teaching and learning in the practical-aesthetic subjects were developed. Similarly, in **Denmark,** a cross-party strategy published in 2018 stressed that pupils should have more opportunities to develop imaginative and creative skills in primary and lower secondary school (Government of Denmark, 2018[4]). Among other aspects, a two-year practical/musical elective subject was made a compulsory element in the curriculum that must be completed with an exam.

In **Korea**, an important goal of the national curriculum reform back in 2009 was "raising a creative person" and the government has since made several efforts to integrate creative thinking into the education system (So, Hu and Park, 2017[5]). As a result, Korea reduced the number of compulsory curriculum areas and established "creative experiential learning activities" at both primary and secondary education levels as a holistic accompaniment to compulsory and elective subjects. These creative experiential activities are units in which teachers and students can choose a topic of interest to study in any way they wish. Although elementary and secondary schools are required to allocate three to four units to these activities, they remain limited to extra-curricular offerings. However, in 2016, an exam-free semester was also introduced in middle schools throughout the country to create more flexible space in the curriculum for creative projects and to relieve students of the pressures of regular mid- and end-of-term examinations. Other countries have also introduced similar exam-free-semester initiatives (see Box III.4.4 in Chapter 4).

Developing detailed learning progressions

Several jurisdictions have gone a step further by developing detailed guidance and learning progressions to help teachers understand the types of outcomes that ought to be expected of students and the learning trajectories they typically follow to reach them. In **Australia**, for example, the Assessment and Reporting Authority (ACARA) developed a "critical and creative thinking learning continuum" that maps progression in creative thinking from Level 1 to Level 6. The continuum supports the 2010 curriculum reform which included "critical and creative thinking" as one of seven general capabilities that intersect with the eight subjects or learning areas. The continuum describes, in concise and simple statements, the behaviours of students at each level and for each sub-element that evidences critical and creative thinking. Some states, for example **Victoria (Australia)**, have subsequently adapted their own learning progressions connected to years of schooling and standards describing expected student outcomes at each two-year interval.[8]

In **Canada**, several provinces have also been active in this space. In **Alberta (Canada),** creative thinking is framed as a competency that intersects with knowledge and skills across all disciplines, and as such, it has been mapped across the content of all subject areas in the curriculum. An online platform provides teachers with competency progressions across grades and ages.[9] In **Ontario (Canada)**, guidelines on assessment, evaluation and reporting for schools describe performance standards related to creative and critical thinking processes across subjects, with example criteria in the arts, sciences and English subject areas (Ministry of Education, Ontario, 2010[6]).

Integrating creative thinking in system-level assessments

While progress has been made to better integrate creative thinking in curricula and support educators in recognising how creative thinking can be developed and evidenced, very few systems assess creative thinking in a standardised way. One exception is in **Victoria (Australia)**: since 2016, the VCAA has administered Critical and Creative Thinking (CCT) assessments annually to a sample of schools. The CCT assessments support its commitment to measure its Education State Targets, one of which aims for 25% or more Year-10 students to have developed excellent critical and creative thinking skills.[10]

Sources: OECD (2023[7]), *Supporting Students to Think Creatively: What Education Policy Can Do* Lucas (2022[2]), *Creative thinking in schools around the world: A snapshot of progress in 2022.*

Differences in student competencies across countries and economies

What can students do in terms of their creative thinking proficiency? On average across OECD countries, around 1 in 2 students could think of original and diverse ideas in familiar contexts (i.e. they performed at proficiency Level 4 or above). This means that around half of the OECD student population struggled to think of original and different ideas for different types of tasks, even in the context of simple imagination tasks or everyday problem-solving situations. In Singapore, Korea and Canada*, over 70% of students performed at or above Level 4.

Figure III.2.7 shows the distribution of students at each proficiency level within each country/economy, where Level 6 is the highest proficiency level and Level 1 is the lowest described level.[11] There is significant variation across participating countries and economies in the distribution of students across proficiency levels. In most countries and economies, the largest proportion of students performs at Level 4 or at Level 3, with Level 3 considered to be a baseline level of proficiency in creative thinking (Box III.2.3). In Singapore, Latvia*, Korea, Denmark*, Estonia, Canada* and Australia* (in descending order), more than 88% of students were proficient at Level 3 or above – with the OECD average just over 78% of students. However, in 20 countries and economies, more than 50% of students did not reach a baseline level of proficiency in creative thinking.[12] This means that many students in these countries/economies struggled to think of appropriate ideas for a range of tasks, and few were able to suggest original ideas for familiar problems.

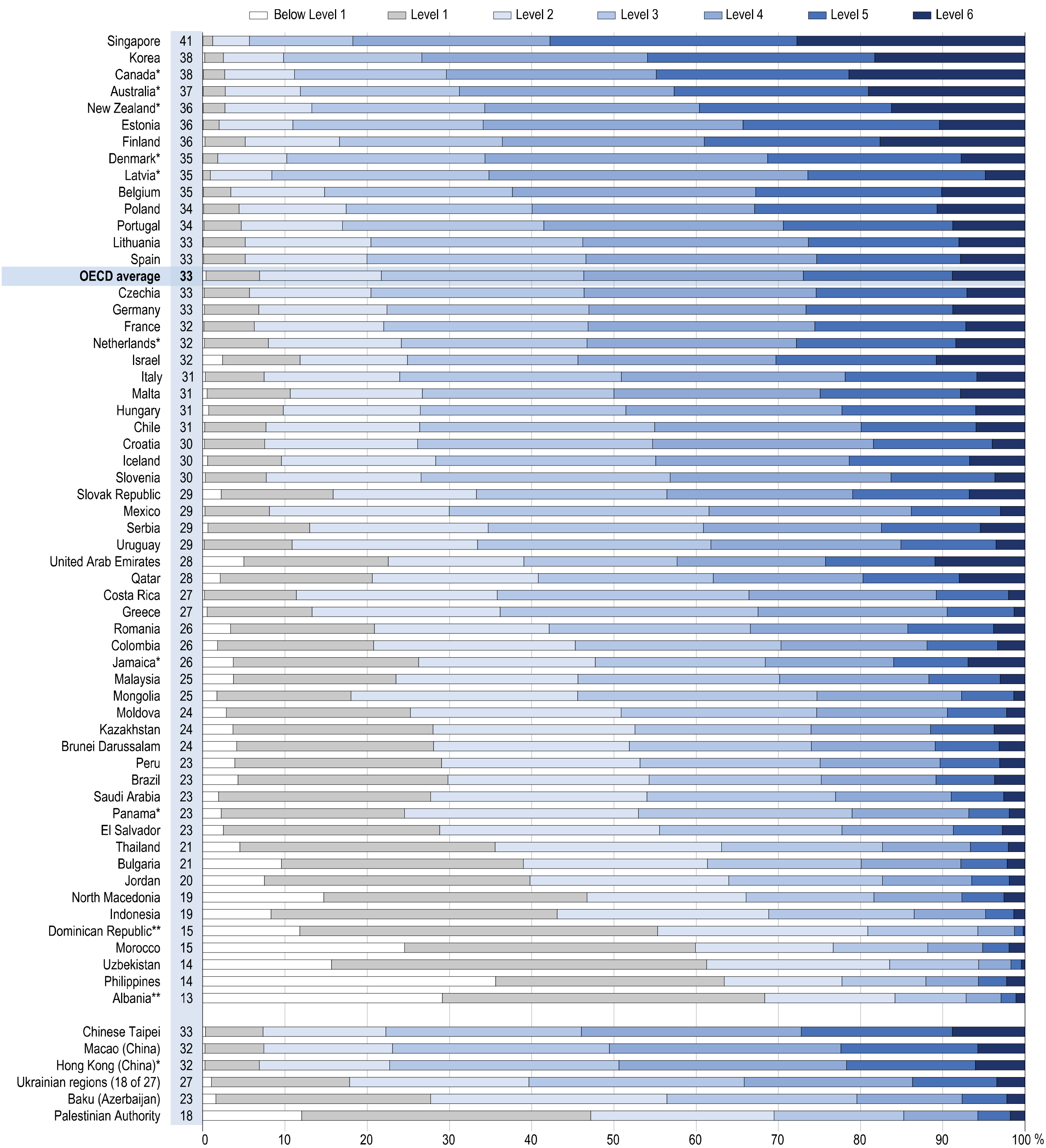
Box III.2.3. Creative thinking proficiency: What is a baseline target for education systems?

In the PISA core domain assessments of mathematics, reading and science, Level 2 is considered as a baseline level of proficiency that students need to fully participate in society. In the PISA assessment of creative thinking, Level 3 can be interpreted as the baseline level of skills that all systems should target. In creative thinking, students at Proficiency Level 3 demonstrated the capacity to generate appropriate ideas for simple to moderately complex expressive and problem-solving tasks. At this level, they also began to demonstrate the ability to generate original ideas or solutions in familiar task contexts (see Tables III.1.1 and III.1.2 in Chapter 1).

A different baseline proficiency level is used for creative thinking, given the PISA creative thinking assessment differs with respect to the PISA assessments of mathematics, reading and science in two significant ways. First, students engaged with open-ended, constructed-response tasks in the creative thinking assessment. To successfully engage with the tasks and demonstrate proficiency, students needed to utilise both divergent and convergent thinking processes and have some level of task engagement (OECD, 2023[8]). Second, in the creative thinking test, partial credit responses demonstrated that students could generate appropriate and relevant ideas but not that they could generate original or diverse ideas – in other words, only full credit responses differentiated creative ideas from those that were simply appropriate, common and/or alike one another. At Level 3, students began to achieve full credit in some task contexts.

Very few students in OECD countries performed at the lowest described level of creative thinking (Level 1). However, in Colombia, the Slovak Republic, Greece, Israel and Costa Rica (in order of larger share to smaller), over 1 in 10 students performed at Level 1 or below; in Colombia, it was around 2 in 10 students. For many low-performing countries/economies in creative thinking overall, a relatively large share of students performed at Level 1 or below – possibly reflecting poor levels of student engagement with the creative thinking items (Box III.2.4).

Figure III.2.7. Students' proficiency level in creative thinking, by country/economy



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown.

The mean score in creative thinking is shown next to the country/economy name.

Countries and economies are ranked in descending order of the mean performance in creative thinking.

Source: OECD, PISA 2022 Database, Table III.B1.2.2. The StatLink URL of this figure is available at the end of the chapter.

Top-performing students

In this report, students performing at Proficiency Levels 5 or 6 are referred to as "top performers" in creative thinking. Top performers demonstrated the ability to generate, evaluate and improve creative ideas in diverse and complex tasks, including abstract design tasks or more constrained/unfamiliar scientific and social problem-solving scenarios. Over 1 in 4 students on average across the OECD are top performers in creative thinking (Figure III.2.7). Some high-performing countries have a large share of top-performing students: around 40% of students in Australia*, Finland and New Zealand* and 45% in Canada* and Korea. Singapore has the largest proportion of top performers in creative thinking by far of all countries and economies (58% of all students).

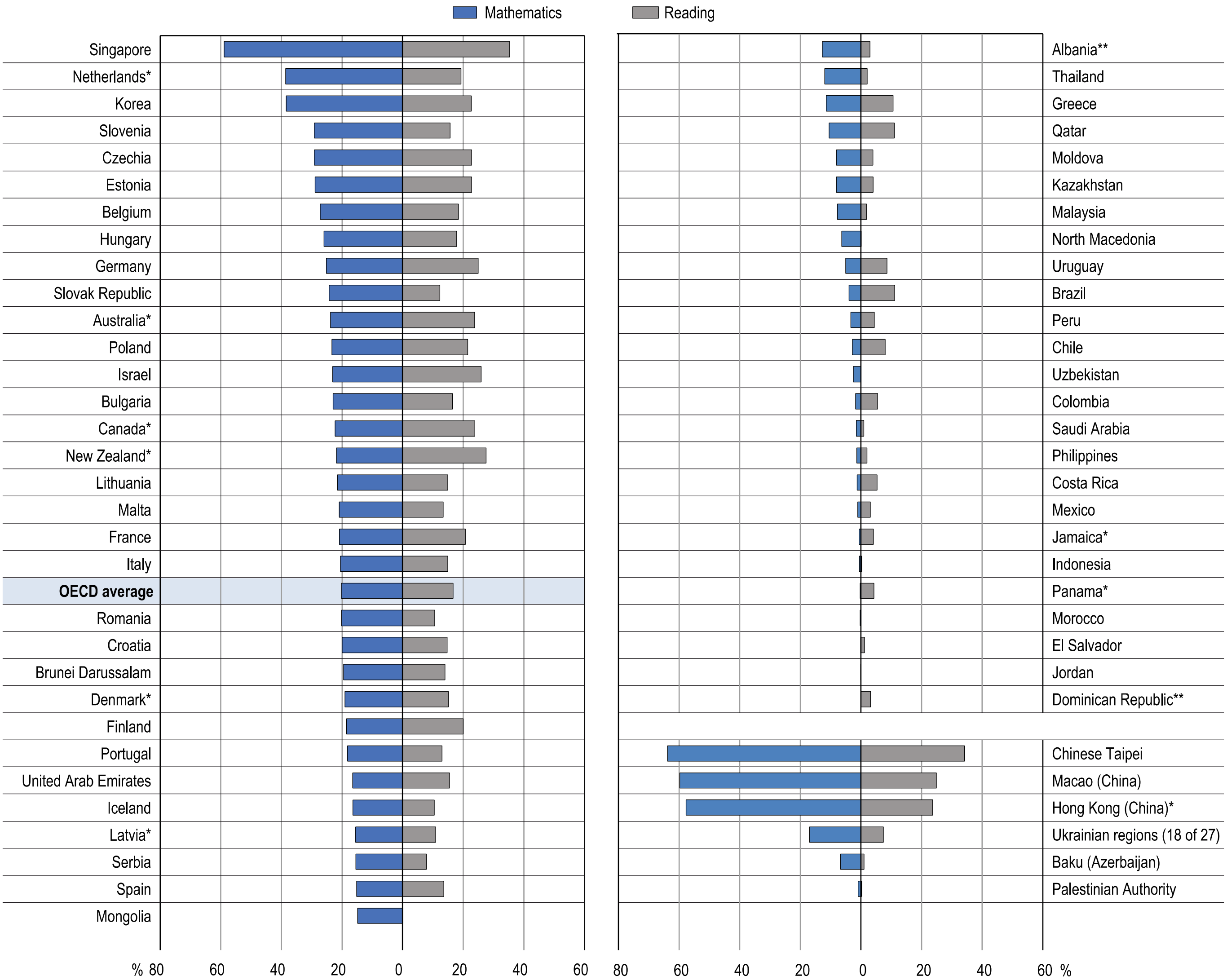
The share of top performers within a country/economy largely reflects its ranking position by mean performance, with some exceptions: for example, while students in Estonia and Finland scored 36 points on average, Finland has relatively more top performers than Estonia (39% of students compared to 34%); in Israel, despite scoring around the OECD average overall, the proportion of top performers is above the OECD average; and in the United Arab Emirates, the proportion of top-performing students is relatively large (24%) compared to other countries with a similar mean performance (20% of students in Qatar or 15% in Uruguay).

It might be expected that students who were top performers in creative thinking were also top performers in other PISA domains. However, given only around 28% of the total variation in creative thinking performance is uniquely associated with students' performance in mathematics (Figure III.2.3), it may not necessarily be the same students that performed at the highest level in creative thinking that performed at the highest level in other subject areas.

Figure III.2.8 shows the percentage of top performers in mathematics and reading, respectively, amongst top performers in creative thinking. In all but 12 countries and economies (in descending order, Chinese Taipei, Macao (China), Singapore, Hong Kong (China)*, the Netherlands*, Korea, Slovenia, Czechia, Estonia, Belgium, Hungary and Germany), less than 25% of top performers in creative thinking also performed at Level 5 or above in mathematics. In all but four countries and economies (in descending order, Singapore, Chinese Taipei, New Zealand* and Israel), 25% or less top performers in creative thinking are also top performers in reading.

Figure III.2.8. Top performers in creative thinking and mathematics/reading

Percentage of top performers in mathematics or reading among top performers in creative thinking



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4). Notes: Only countries and economies with available data are shown. *Countries and economies are ranked in descending order of the percentage of students who spent less than 30 seconds on an item and who achieved no credit for their response to that item.*
Source: OECD, PISA 2022 Database, Table III.A8.1. The StatLink URL of this figure is available at the end of the chapter.

While around 9% of students on average across the OECD performed at the very highest level of proficiency in creative thinking (Level 6), more than double this proportion performed at Level 6 in Australia*, Canada*, Korea and Singapore (Figure III.2.7). In both Israel and the United Arab Emirates, despite mean performance being around or below the OECD average, a relatively large share of students performed at Level 6 in creative thinking.

Box III.2.4. Student engagement with the Creative Thinking assessment

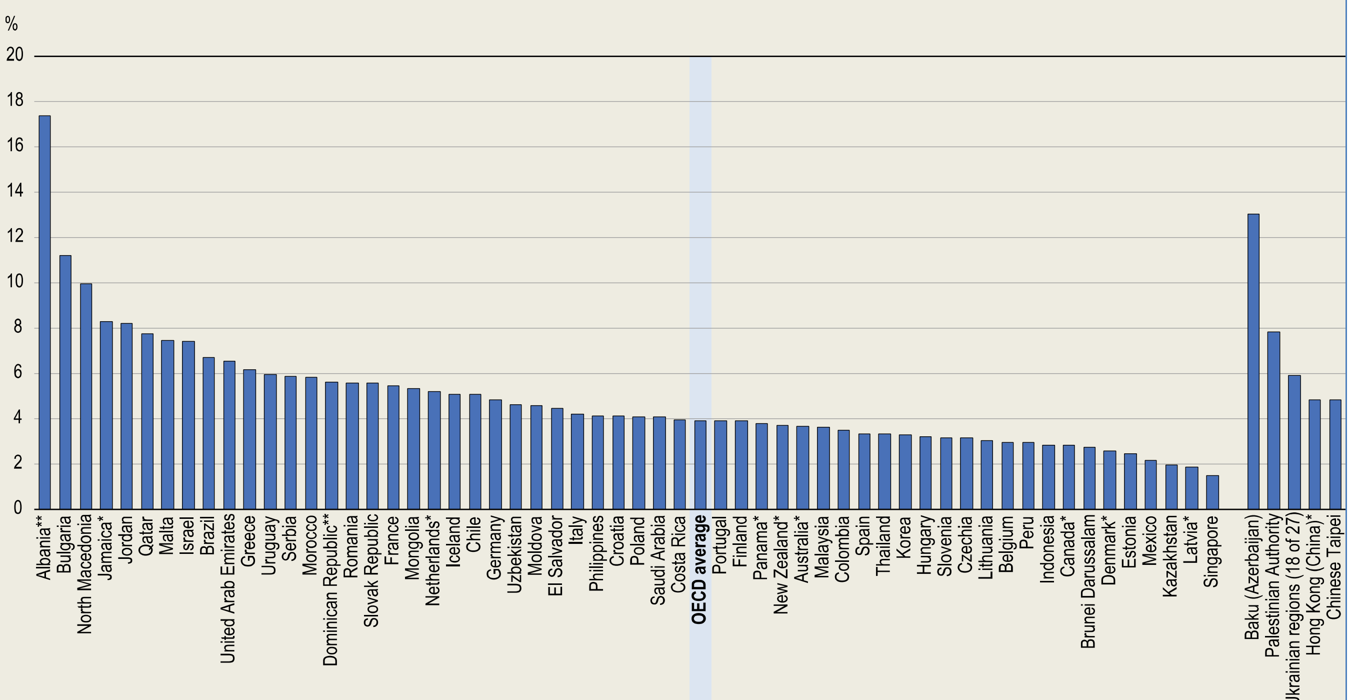
In general, creative work requires task engagement (OECD, 2022[9]). The PISA 2022 Creative Thinking assessment was no exception, with most items in the test requiring students to elaborate a written or visual output. Students needed to invest time in reading the task prompt, understanding the stimulus material, and actively constructing a response in the format required.

Recent research has focused on identifying characteristics of items that are more engaging for test takers (Avvisati et al., 2023[10]) and on measuring engagement in the context of PISA assessments (Buchholz, Cignetti and Piacentini, 2022[11]), often by constructing indicators of disengagement. To examine the relationship between task engagement and creative thinking performance, several indicators of disengaged student behaviour have been constructed. These include identifying students who rapidly moved through the test items leaving insufficient time to provide a valid response ("rapid responders"), as well as students who provided no answers to items (i.e. missing responses) (see Annex A8 for a full description and comparison of different indicators).

Figure III.2.9 shows the percentage of so-called rapid responders for each country/economy.[13] In 4 countries and economies (in descending order, Albania**, Baku (Azerbaijan), Bulgaria and North Macedonia) students exhibited rapid responding behaviours on around 10% or more of all items, compared to the OECD average of just under 4% of all items. In all cases, these countries performed well below the OECD average in creative thinking. An alternative indicator of disengagement – the percentage of missing responses for items seen by students – was also large in some countries and economies: for example, over 15% of all items seen by students in 6 countries/economies were not responded to (OECD average around 6%), and in Albania** and Baku (Azerbaijan), this proportion rose to over 20% of all items (Table III.A8.1 in Annex A8).

Figure III.2.9. Engagement with the creative thinking items

Percentage of students who spent less than 30 seconds and did not achieve any credit on an item



Note: Only countries and economies with available data are shown.

Countries and economies are ranked in descending order of the percentage of students who spent less than 30 seconds on an item and who achieved no credit for their response to that item.

Source: OECD, PISA 2022 Database, Table III.A8.1. The StatLink URL of this figure is available at the end of the chapter.

While no single indicator of (dis)engagement is able to capture the full spectrum of disengaged behaviours – especially as some disengaged behaviours may manifest very differently – it should be expected that valid measures of disengagement focusing on similar behaviours correlate highly. For the three measures computed in Annex A8, strong correlations are observed.[14]

A snapshot of system success in creative thinking

When considering the overall success of education systems in developing creative thinkers, some systems performed better than others. Figure III.2.10 summarises the performance of countries and economies according to three indicators of system success examined in this chapter. The first two indicators describe successful systems in absolute terms: i) those with high mean performance (i.e. countries/economies where the average student score was statistically significantly greater than the OECD average); and ii) systems with a large share of students that reached a baseline level of creative thinking proficiency (at least 75% of students who performed at Proficiency Level 3 or above). The third indicator describes successful systems in relative terms: those where students demonstrated an overall relative strength in creative thinking performance (i.e. they scored around 3 points higher than expected in creative thinking both after accounting for performance in mathematics and after accounting for performance in reading, respectively).

Figure III.2.10. Indicators of system success in creative thinking proficiency

High-performing countries

Australia*
Belgium
Canada*
Denmark*
Estonia
Finland
Korea
Latvia*
New Zealand*
Poland
Portugal
Singapore

Countries with 75% of students at baseline proficiency

Australia*
Belgium
Canada*
Czechia
Denmark*
Estonia
Finland
France
Germany
*Hong Kong (China)**
Israel
Italy
Korea
Latvia*
Lithuania
Macao (China)
Netherlands*
New Zealand*
Poland
Portugal
Singapore
Spain
ChineseTaipei

Relative high-performing countries

Australia*
Canada*
Finland
New Zealand*

Notes: High-performing countries are countries with a performance in creative thinking statistically higher than the OECD average (see Annex A3).
Countries with 75% of students at baseline proficiency are those where at least 75% of students performed at or above Proficiency Level 3 in creative thinking.
Relative high-performing countries are countries with a relative performance in creative thinking after accounting for both mathematics and reading performance, respectively, that is statistically significant and higher than 2.75 score-points.
Source: OECD, PISA 2022 Database, Tables III.B1.2.1, III.B1.2.2 and III.B1.2.4. The StatLink URL of this figure is available at the end of the chapter.

When considered together, these three indicators show that, overall, Australia*, Canada*, Finland and New Zealand* are the most successful systems in developing students' capacity to engage in creative thinking. These systems combine high levels of absolute and relative performance in creative thinking. Many education systems performed well in absolute terms, successfully ensuring the majority of their students have reached a baseline level of creative thinking proficiency; and students in Belgium, Denmark, Estonia, Korea, Latvia*, Poland, Portugal and Singapore also performed at a high level in creative thinking compared to the OECD average. However, students in these countries did not show a strong relative performance in creative thinking after accounting for both their performance in mathematics and in reading, respectively.

A cluster of Latin American and Caribbean countries, including Chile, Colombia, Costa Rica, El Salvador, Jamaica*, Mexico, Panama* and Uruguay, demonstrated a relative strength in creative thinking after accounting for students' mathematics performance. While these results largely reflect a weakness in mathematics in the region, students in Chile, Costa Rica, El Salvador, Mexico and Uruguay also demonstrated a moderate relative strength in creative thinking after accounting for their reading performance. Nonetheless, performance in absolute terms in most of these countries remained low – in fact, in El Salvador and Panama*, less than 50% of students reached Proficiency Level 3 in creative thinking (Figure III.2.7).

Table III.2.3. Student performance in creative thinking: Chapter 2 figures and tables

Table III.2.1	Comparing countries' and economies' performance in creative thinking
Table III.2.2	Correlation in performance among creative thinking, mathematics, reading and science
Figure III.2.1	Variation in creative thinking performance across countries and economies
Figure III.2.2	Average performance in creative thinking and variation in performance across countries and economies
Figure III.2.3	Variation in creative thinking performance associated with performance in mathematics
Figure III.2.4	Distribution of students across quintiles of performance in creative thinking and mathematics
Figure III.2.5	Countries' and economies' relative performance in creative thinking
Figure III.2.6	Countries and economies that perform better than expected in creative thinking
Figure III.2.7	Students' proficiency level in creative thinking, by country/economy
Figure III.2.8	Top performers in creative thinking and mathematics/reading
Figure III.2.9	Engagement with the creative thinking items
Figure III.2.10	Indicators of system success in creative thinking proficiency

StatLink https://stat.link/o12ktl

Notes

[1] In PISA 2022, students in Portugal performed around the OECD average (i.e. not statistically significantly different) in mathematics, reading and science. Students in Belgium and Latvia* also performed around the OECD average in reading but performed statistically significantly above the OECD average in mathematics and science.

[2] The correlation coefficient between mean performance and standard deviation (at the system-level) is -0.26.

[3] The correlation between student performance in creative thinking with mathematics, reading and science, respectively, when computed at the PISA average level (all participating countries), is very similar to the OECD average: 0.68 for mathematics, 0.68 for reading, and 0.67 for science.

[4] In previous years, correlations between performance in the PISA innovative domain assessments and the PISA core domains have also tended to be stronger than those between the creative thinking assessment and the PISA core domains. For reference, the correlations between performance in global competence and the other PISA domains in 2018, among the 27 countries who took the global competence assessment, were as follows: mathematics (0.73), reading (0.84), and science (0.79). In 2015, the correlation between performance in the collaborative problem-solving assessment and performance in the PISA core domains (OECD average) was as follows: mathematics (0.70), reading (0.74), and science (0.79). In 2012, the correlation between performance in the problem-solving assessment and performance in the PISA core domains (OECD average) was as follows: mathematics (0.81), reading (0.75), and science (0.78).

[5] The analysis in this chapter primarily focuses on the variation in creative thinking associated with mathematics performance for two reasons. First, mathematics was the major focus of the PISA 2022 cycle, meaning around 86% of students who sat the creative thinking assessment also completed one hour of mathematics items (with the remaining 14% of students who sat the creative thinking assessment equally split between reading (around 7%) and science (around 7%) for the other hour of testing time). Second, there are significant correlations between student performance in mathematics, reading and science.

[6] Very similar proportions of students (OECD average) within each quintile on the reading scale scored within the equivalent quintiles on the creative thinking scale as was observed in mathematics. For example: around 58% of all students who performed in the bottom quintile in mathematics, and around 57% of all students who performed in the

bottom quintile in reading, also performed in the bottom quintile in creative thinking; and around 51% of all students who performed in the top quintile in mathematics and in reading, respectively, also performed in the top quintile in creative thinking. Amongst students in the third quintile in creative thinking, 23% performed in second quintile in reading, 27% performed in the third quintile in reading, and 24% performed in the fourth quintile, compared to 23% (second quintile), 28% (third quintile) and 24% (fourth quintile) in mathematics. In both mathematics and reading, 14% of all students within the third quintile performed within the upper quintile in creative thinking.

[7] Relative performance in creative thinking is estimated by the residual obtained from a cubic polynomial regression of the student's performance in creative thinking over his or her performance in mathematics (or reading). The regression is performed at the international level, pooling data from all countries and economies that participated in the creative thinking assessment. Students who scored higher than expected in creative thinking are those with positive relative scores.

[8] The Australian Curriculum, Assessment and Reporting Authority (ACARA) "Critical and Creative Thinking learning continuum" can be accessed at the following link: https://www.australiancurriculum.edu.au/media/1072/general-capabilities-creative-and-critical-thinking-learning-continuum.pdf. The adaptation of the ACARA learning continuum and standards by the Victorian Curriculum and Assessment Authority (VCAA) in the state of Victoria (Australia) can be accessed here: https://victoriancurriculum.vcaa.vic.edu.au/critical-and-creative-thinking/curriculum/f-10.

[9] The LearnAlberta platform provides simple competency progressions for cross-cutting competencies, including creativity and innovation, for different age ranges.

[10] More information on the Education State Targets and the CCT assessment can be found online at the following link: https://www.vcaa.vic.edu.au/assessment/f-10assessment/edstateap/Pages/index.aspx. Selected examples from the psychometrically-validated tasks can also be accessed via the website.

[11] For a detailed description of student performance at each proficiency level in creative thinking, please refer to Table III.1.1 in Chapter 1 of this volume.

[12] In descending order – from largest share (84%) of students to smallest share of students (just above 50%) that did not reach Level 3 in creative thinking – these countries and economies are: Albania**, Uzbekistan, the Dominican Republic**, the Philippines, Morocco, the Palestinian Authority, Indonesia, North Macedonia, Jordan, Thailand, Bulgaria, Baku (Azerbaijan), El Salvador, Brazil, Saudi Arabia, Peru, Panama*, Kazakhstan, Brunei Darussalam and Moldova.

[13] Three items from the creative thinking item pool were excluded from the engagement analysis due to their different item characteristics. Two items (T400Q02 and T420Q02) enabled students to select an idea from the previous question via a multiple-choice response format, while for the third item (T300Q01), students could reasonably submit a one-word answer and achieve full credit. It was therefore not appropriate to include these items in measures of disengagement focusing on time-on-task (rapid responders and relative rapid responders). For consistency, these items were also dropped from the measure of leaving responses blank. For more information on the construction of indicators and for results by country, see Annex A8.

[14] The OECD average correlation between the two "rapid responder" measures (rapid responders and relative rapid responders) is 0.71. The OECD average correlation between rapid responders and students who left responses blank is 0.77. The OECD average correlation between relative rapid responders and students who left responses blank is 0.67. Correlations are computed at the country level and are the average correlations across OECD countries.

References

Avvisati, F. et al. (2023), *Item characteristics and test-taker disengagement in PISA*, https://one.oecd.org/document/EDU/PISA/GB(2023)5/en/pdf. [10]

Buchholz, J., M. Cignetti and M. Piacentini (2022), *Developing measures of engagement in PISA*, OECD Publishing, Paris, https://doi.org/10.1787/2d9a73ca-en. [11]

Government of Denmark (2018), *Aftale om styrket praksisfaglighed i folkeskolen [Agreement on strengthening practical expertise in primary school]*, https://www.regeringen.dk/media/5650/180612-aftale-om-styrket-praksisfaglighed-i-folkeskolen-ny.pdf (accessed on 29 March 2024). [4]

Lucas, B. (2022), *Creative thinking in schools across the world: A snapshot of progress in 2022*. [2]

Ministry of Education and Research (2019), *Skaperglede, engasjement og utforskertrang: Praktisk og estetisk innhold i barnehage, skole og lærerutdanning [Creative joy, engagement and exploration: Practical and aesthetic content in kindergarten, school and teacher training]*, https://www.regjeringen.no/contentassets/c8bbb637891443fea7971ba8e936bca4/skaperglede-engasjement--og-utforskertrang.pdf (accessed on 29 March 2024). [3]

Ministry of Education, Ontario (2010), *Growing Success: Assessment, Evaluation and Reporting in Ontario Schools. First Edition, Covering Grades 1 to 12*, https://www.edu.gov.on.ca/eng/policyfunding/growSuccess.pdf. [6]

OECD (2023), *PISA 2022 Creative Thinking Framework*, OECD Publishing, Paris, https://doi.org/10.1787/dfe0bf9c-en. [8]

OECD (2023), *Supporting Students to Think Creatively: What Education Policy Can Do*, OECD Publishing, Paris, https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1_?fr=sMGE0ZjYxMjMxNTE. [7]

OECD (2022), *Thinking Outside the Box: The PISA 2022 Creative Thinking Assessment*, https://issuu.com/oecd.publishing/docs/thinking-outside-the-box (accessed on 4 March 2023). [9]

Robinson, K. (2011), *Out of Our Minds: Learning to be Creative*, Capstone Publishing Ltd., Chichester, https://doi.org/10.1002/9780857086549. [1]

So, K., Y. Hu and J. Park (2017), “Making our schools more creative: Korea’s efforts and challenges”, *The International Education Journal: Comparative Perspectives*, Vol. 16/4, pp. 77-88, https://openjournals.library.sydney.edu.au/index.php/IEJ. [5]

3 Variation within countries and economies in creative thinking performance

This chapter examines how performance in creative thinking varies within countries and economies. First, it analyses within- and between-school variation in creative thinking performance. It then explores differences in performance by student characteristics, such as gender, socio-economic and cultural status, and immigrant background, as well as differences in performance associated with school characteristics and study programmes.

For Australia*, Canada*, Denmark*, Hong Kong (China)*, Jamaica*, Latvia*, the Netherlands*, New Zealand* and Panama* caution is advised when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).

For Albania** and the Dominican Republic**, caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Students' capacity for creative thinking depends on both internal resources and external factors (OECD, 2022[1]; OECD, 2023[2]). To what extent does performance in creative thinking depend on student and school characteristics? This chapter examines the between- and within-school variation in creative thinking within countries and economies, and considers performance differences by various student characteristics (e.g. gender, socio-economic status and immigrant background) and school characteristics (e.g. school socio-economic profile, school type, school location and study programmes).

What the data tell us

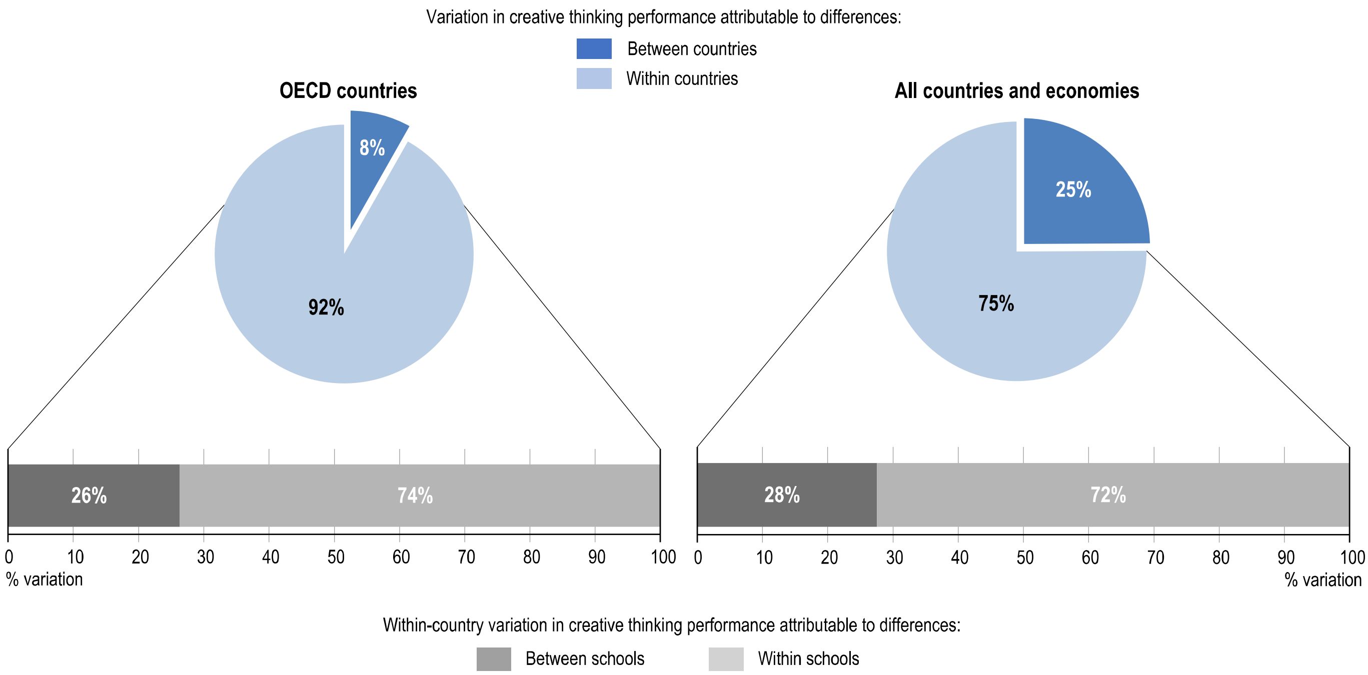
- Students can excel in creative thinking in all types of schools. Of the variation in creative thinking performance observed within countries/economies, only 26% is observed between schools on average across the OECD (with the remaining 74% variation in student performance observed within schools).
- There is a strong gender difference in creative thinking performance: in no country/economy did boys outperform girls, but in Chile, Mexico and Peru performance differences between boys and girls were not statistically significant. In Jordan, Finland, the Palestinian Authority, Saudi Arabia, Jamaica*, the United Arab Emirates and Qatar (in descending order), girls scored at least 5 points higher than boys – around half the OECD average standard deviation in performance in creative thinking.
- In all countries and economies, gender differences in creative thinking performance in favour of girls were significant after accounting for mathematics performance, and in around half of all countries and economies it remained significant after accounting for reading performance.
- On average, students with higher socio-economic status performed better in creative thinking, scoring around 9.5 points higher than disadvantaged students. In Brunei Darussalam, Bulgaria, Hungary, Israel, Romania, the Slovak Republic and Peru, the difference in performance between advantaged and disadvantaged students was well over 12 score points. However, in general, this association is weaker for creative thinking than it is for mathematics, reading and science. Students in advantaged schools also performed better than those from disadvantaged schools, but this advantage was similarly relatively weaker for creative thinking compared to the PISA curricular domains.
- Like other PISA domains, students with an immigrant background scored lower in creative thinking than their non-immigrant peers – but performance differences can be explained, to a large extent, by the socio-economic and linguistic barriers that immigrant students face in many countries. Once these factors are accounted for, the gap in performance narrows significantly. Despite this, the performance disadvantage of students with an immigrant background remained large (over -3 points) in Brazil, Bulgaria, El Salvador, Finland, Jamaica*, Mexico, Morocco, North Macedonia, the Palestinian Authority, the Philippines, Poland, the Slovak Republic and Chinese Taipei.
- On average across the OECD, students in general study programmes outperformed those enrolled in pre-vocational or vocational study programmes in creative thinking. In Hungary, Lithuania, Romania, the Slovak Republic, Spain and Greece, students in general education programmes scored around 10 more points than students in vocational study programmes. However, in a few Latin American countries with available data, students in pre-vocational or vocational study programmes performed better on average than students in general education programmes, including in Costa Rica (scoring around 3 points higher), the Dominican Republic** (around 5 points) and Brazil (around 6 points).

Variation in creative thinking performance within countries and economies

Variation in student performance in creative thinking can be broken down into differences at the student, school and education system levels. Across OECD countries, only about 8% of the variation in creative thinking performance lies between countries and economies (Figure III.3.1). Across all participating countries and economies, the share of the variation in creative thinking performance attributable to differences across education systems is about 25%.

Figure III.3.1. Variation in creative thinking performance between systems, schools and students

Between-country variation and within-country variation, by OECD countries only and by all countries and economies



Source: OECD, PISA 2022 Database. The StatLink URL of this figure is available at the end of the chapter.

Within-system variation in student performance is substantial compared to between-system variation. Examining the variation in performance within each country/economy provides an indication of whether students within the same education system have been offered similar opportunities to develop creative thinking skills. Within-system variation includes two components: within-school variation (i.e. performance differences between students from the same school) and between-school variation (i.e. performance differences between groups of students from different schools). Identifying where the major variation in creative thinking performance lies within each country is important from a policy perspective to inform interventions that might support creative thinking.

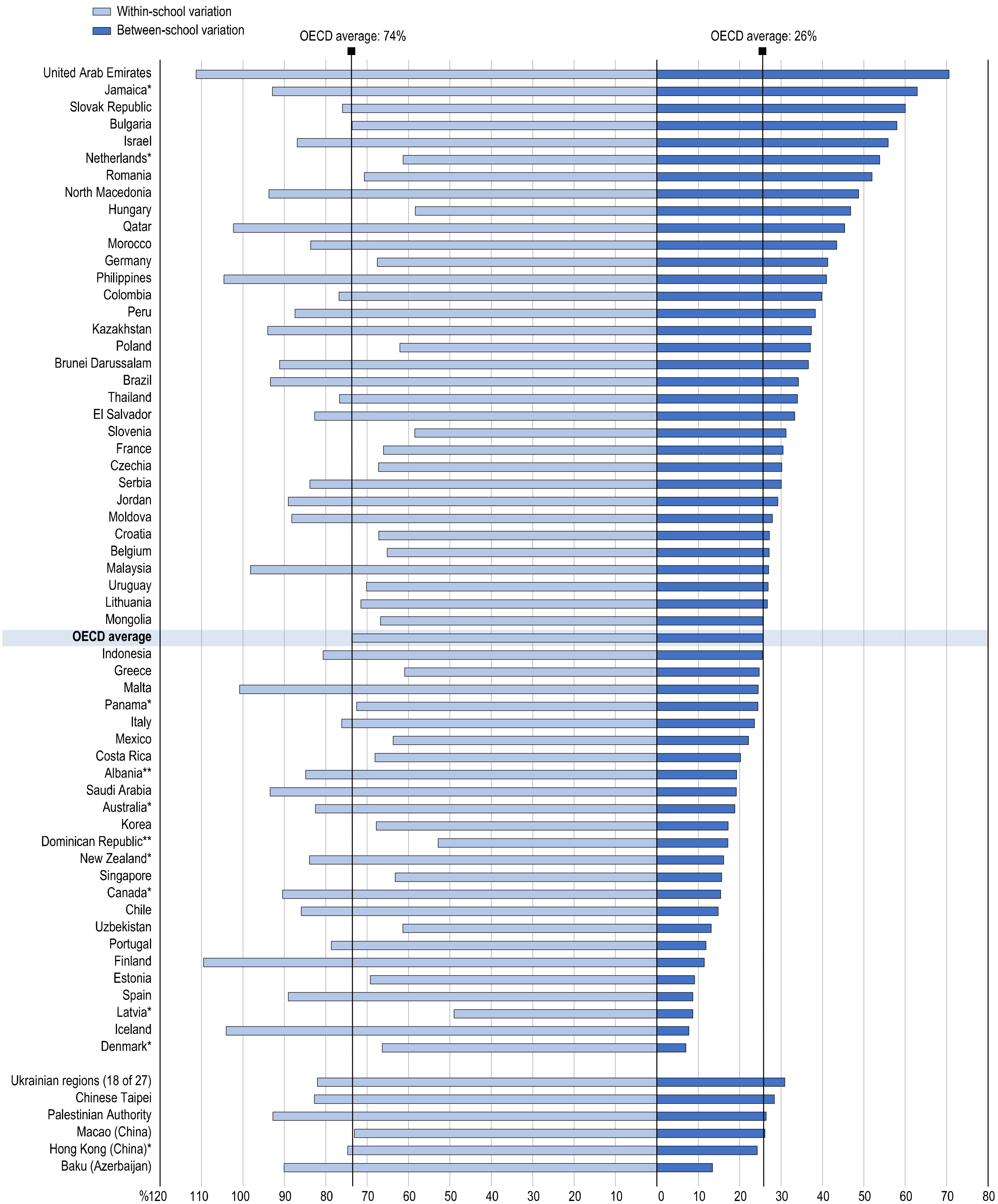
Variation in creative thinking performance between schools

The variation in performance between schools is a measure of how big "school effects" are. These school effects may reflect selection or school tracking mechanisms that determine which school students attend; they may be the result of differences in policies and practices across different schools; or they may reflect differences in how parents select schools for their children to attend (e.g. electing for private education). School effects might also arise from differences in the diversity of the student populations within them: differences in student intake are the result of many factors such as schools' admission policies, local school competition (i.e. the number of schools available to students), and school catchment areas (i.e. the relative integration or segregation of families with varying socio-economic status within the same neighbourhood).

In general, school characteristics do not play a dominant role in explaining student performance in creative thinking (see Box III.1.1). The between-school variation in creative thinking performance amounts to around one-quarter (26%) of the variation in creative thinking performance observed within countries/economies, on average across OECD countries, with the remaining variation (74%) due to differences in student performance within the same schools (Figure III.3.1). This means that it is the characteristics of students themselves (e.g. their education history, family background, attitudes and behaviour), and differences in the student population across grades and classrooms within schools, that account for most of the overall variation in creative thinking performance. Similar proportions of within-school and between-school variation are observed across all countries and economies, with slightly more (28%) of the variation in creative thinking attributable to between-school differences.

In most countries and economies, the between-school variation in creative thinking performance accounts for less than one-third of the overall within-country variation in performance (Figure III.3.2). However, this share of between-school variation differs substantially across some countries and economies. In general, high-performing systems tend to have relatively less variation in performance between schools than other systems – in fact, in 10 of the 12 highest-performing countries in creative thinking, less than 20% of the variation in student performance is attributed to between-school differences. In Denmark*, Iceland, Latvia*, Spain and Estonia (in order of increasing share), between-school differences account for less than 10% of the total within-country variation in performance. In contrast, in the United Arab Emirates, Jamaica*, the Slovak Republic, Bulgaria, Israel, the Netherlands* and Romania (in order of decreasing share), between-school differences account for over 50% of the total variation in the country's performance. In most of these latter countries, between-school differences also account for over 50% of the total variation in students' mathematics performance.

Figure III.3.2. Variation in creative thinking performance between and within schools



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. This figure is restricted to schools with the modal ISCED level for 15-year-old students (see Annex A3).
Countries and economies are ranked in descending order of the between-school variation in creative thinking performance, as a percentage of the total variation in performance across OECD countries. Source: OECD, PISA 2022 Database, Table III.B1.3.1. The StatLink URL of this figure is available at the end of the chapter.

Box III.3.1. Challenges to developing creative thinking in education systems

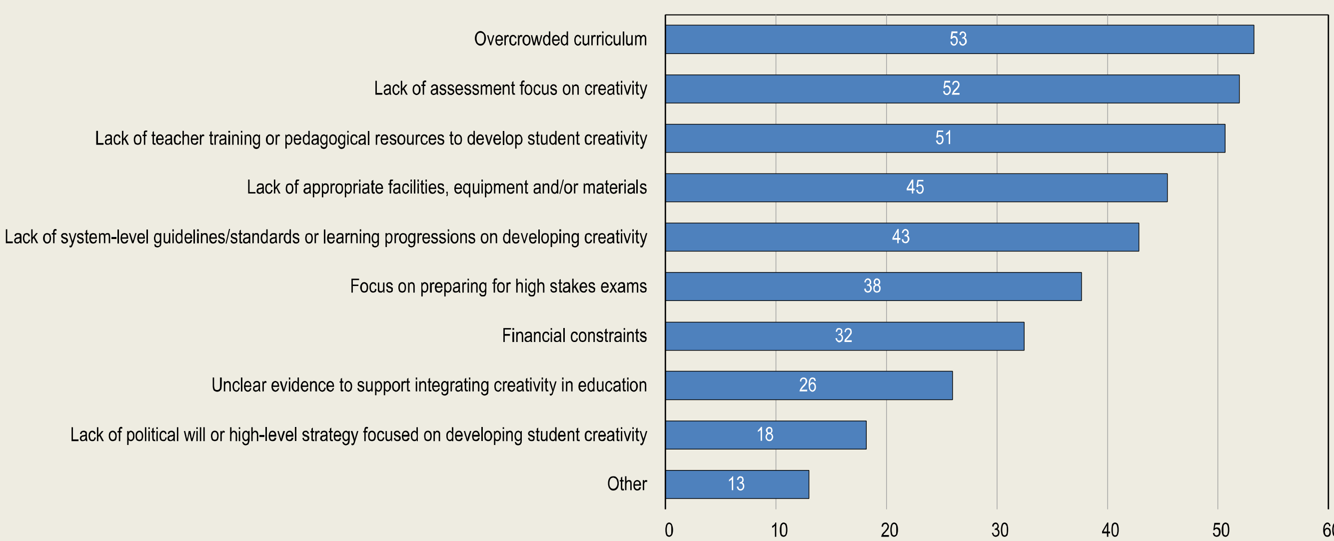
On average across the OECD, the between-school variation in creative thinking (26%) is comparatively less than the OECD average between-school variation in mathematics performance (32%, see Figure I.2.6 in PISA 2022 Results (Volume I) (OECD, 2023[3])). In other words, student performance in creative thinking tends to be less closely related to school policies, practices and contextual factors than mathematics performance. Why might this be the case?

For one, the skillset measured in the creative thinking assessment is usually not taught as a standalone school subject, unlike the skills measured in the mathematics, reading and science assessments. Indeed, policymakers identified concerns about overcrowded curricula as the greatest obstacle to developing students' creative skills (Figure III.3.3). Although many countries identify creativity as a priority cross-cutting theme or competency in curricula, only around half of countries/economies with available data explicitly refer to developing creative skills in specific subject areas (OECD, 2023[4]). Even fewer provide guidelines or learning progressions to orient educators on how to integrate opportunities to recognise and develop creative thinking in different curricular areas (see Box III.2.3 in Chapter 2 for some examples of best practice).

As a corollary, few systems explicitly assess creative thinking skills – and inevitably, what systems choose to assess ends up being the focus of school instruction (Pellegrino, 2023[5]). Assessments can serve as important references for educators to identify aspects of performance that they should focus on during instruction, as well as provide potential sources of feedback on student progress to inform their formative decisions. Assessments that can positively contribute to encouraging creative thinkers must be able to collect evidence on how students deal with complex situations and work towards solutions. This requires open-ended assessment tasks (e.g. projects, presentations) and tools (e.g. rubrics, portfolios) that can document a wide range of student performances (Beghetto, 2019[6]; Foster and Piacentini, 2023[7]; Lucas, 2022[8]; Vincent-Lancrin et al., 2019[9]). Over half of all participating countries and economies with available data identified the lack of systematic assessment focus on creativity as a key challenge (Figure III.3.3).

Figure III.3.3. Major challenges in the context of integrating creative thinking in education

Percentage of jurisdictions reporting the following challenges to integrating creative thinking in their education system



Notes: For each type of perceived challenge, the reported share is based on the number of jurisdictions that indicated the challenge over the total number of valid responses (n=77 jurisdictions). Missing responses were not counted as valid responses.
Source: OECD (2023[4]), *Supporting Students to Think Creatively: What Education Policy Can Do.* The StatLink URL of this figure is available at the end of the chapter.

On average across OECD countries, around three-quarters of the variation in creative thinking scores was due to differences in student performance within the same schools. Which student characteristics are associated with greater performance in creative thinking? Are these characteristics as strongly associated with performance in creative thinking as they are with performance in the core PISA domains? The following sections examine how gender, socio-economic status and immigrant background relate to differences in creative thinking performance.

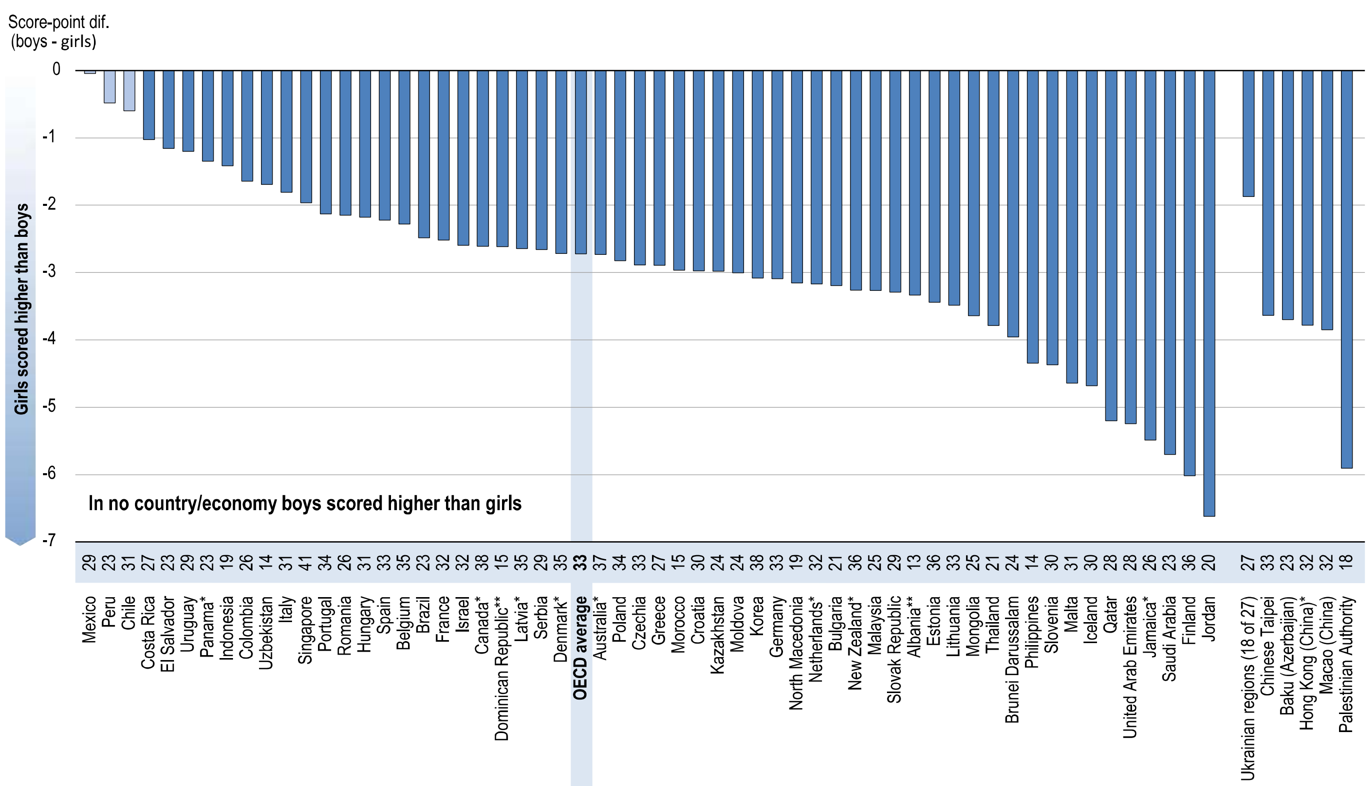
Performance differences related to gender

There is a clear and significant association between gender and creative thinking performance. In no participating country/economy did boys outperform girls in creative thinking (Figure III.3.4). In all but three countries and economies – Chile, Mexico and Peru – the difference in average performance between boys and girls was statistically significant in favour of girls. On average across OECD countries, girls had a large performance advantage, scoring nearly 3 points higher than boys. In Jordan, Finland, the Palestinian Authority, Saudi Arabia, Jamaica*, the United Arab Emirates and Qatar (in descending order), girls scored at least 5 points higher than boys – around half the OECD average standard deviation in performance in creative thinking.

In most high-performing countries, the gender gap in creative thinking performance is similar to that of the OECD average (3 points). However, in Finland, boys scored 6 points less than girls on average – lower than girls on average across the OECD, as well as boys in most other high-performing countries – in turn dragging down the overall performance score in the country.

Figure III.3.4. Gender differences in creative thinking performance

Score-point difference in creative thinking between boys and girls



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. The mean score in creative thinking for all students is shown next to the country/economy name.

Statistically significant score-point differences are shown in a darker tone (see Annex A3).

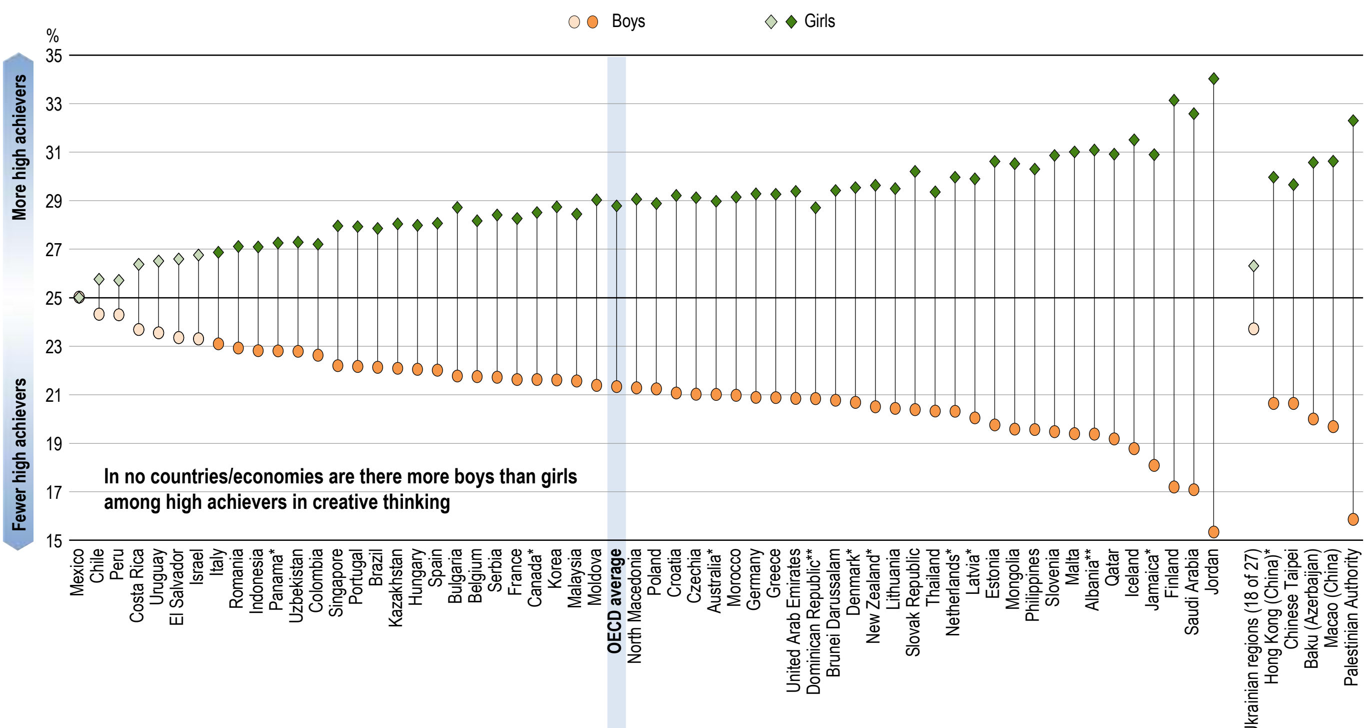
Countries and economies are ranked in descending order of the score-point difference related to gender (boys minus girls).

Source: OECD, PISA 2022 Database, Tables III.B1.2.1 and III.B1.3.2. The StatLink URL of this figure is available at the end of the chapter.

In addition to being lower performers, on average, the overall variation in performance in creative thinking among boys is larger than among girls (Table III.B1.3.2) and boys were also less likely to be high achievers (i.e. score within the 75th percentile) within their country/economy (Figure III.3.5). On average across the OECD, 29% of girls were high achievers compared to 21% of boys. In Finland, Jordan, Saudi Arabia and the Palestinian Authority, the difference in the proportion of girls who are high achievers compared to boys more than doubled with respect to the OECD average, rising to a difference of over 15 percentage points. In other words, while around one in three girls in these countries and economies performed within the 75th percentile, only around one in six boys performed similarly. In Jordan, girls were more likely to be high achievers than boys by almost 19 percentage points. In nearly all countries and economies, gender differences in favour of girls among high achievers in creative thinking are statistically significant.

Figure III.3.5. High achievers in creative thinking, by gender

Percentage of boys and girls who scored at or above the 75th percentile in their country/economy in creative thinking



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. Statistically significant differences between boys and girls are shown in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the percentage of high-achieving boys.

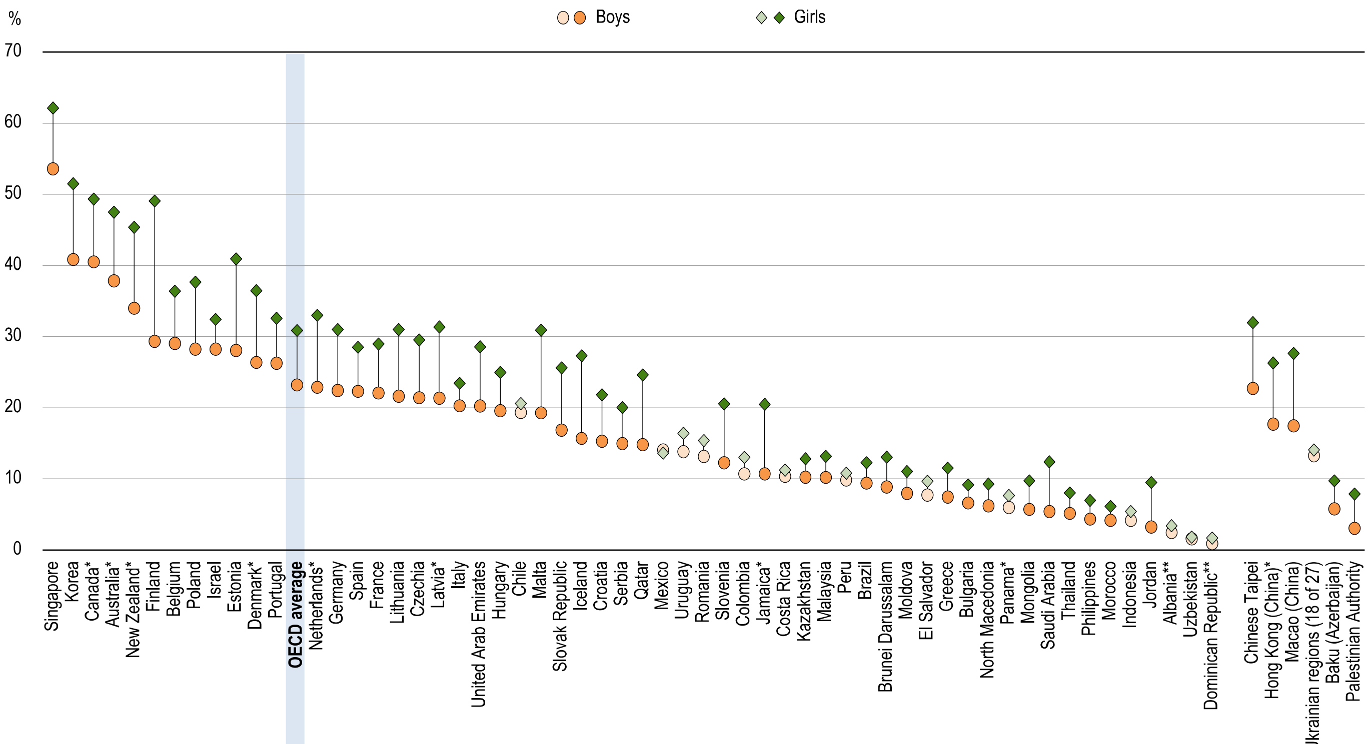
Source: OECD, PISA 2022 Database, Table III.B1.3.3. The StatLink URL of this figure is available at the end of the chapter.

Some clear regional patterns emerge when considering both the overall association between gender and creative thinking, and the share of boys and girls who are high achievers in creative thinking across countries and economies. In several countries in Latin America, there are no significant differences between boys and girls in performance overall (Chile, Mexico and Peru) and with respect to the percentage of high achievers (Chile, Costa Rica, El Salvador, Mexico, Peru and Uruguay). In Brazil, Colombia and Panama*, gender differences in overall performance are also relatively small compared to other countries. On the opposite end of the spectrum, Middle Eastern countries are overrepresented amongst countries with the largest gender gaps in mean performance (the United Arab Emirates, Qatar, Saudi Arabia, Jordan and the Palestinian Authority) and amongst high achievers (Jordan, Saudi Arabia and the Palestinian Authority).

Significant gender gaps are also observed in most countries and economies amongst top performers (i.e. students performing at Proficiency Levels 5 or 6 in creative thinking) (Figure III.3.6).[1] Overall, the proportion of top-performing girls was 1.3 times larger than the proportion of top-performing boys across OECD countries and economies (Figure III.3.7 and Table III.B1.3.4). Differences are even starker amongst students internationally at the lower end of the performance scale: the proportion of boys who performed at or below Proficiency Level 2 is 1.4 times larger than that of girls.

Figure III.3.6. Top performers in creative thinking, by gender

Percentage of boys and girls who scored at Proficiency Level 5 or above in creative thinking



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

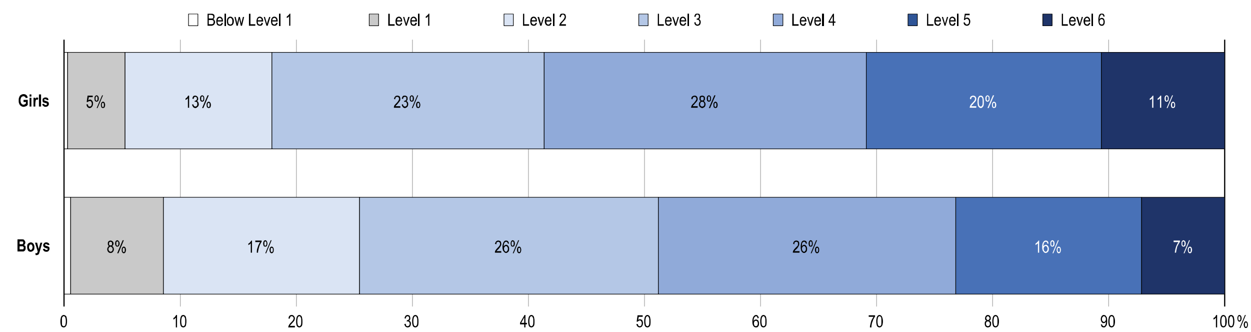
Notes: Only countries and economies with available data are shown. The top-performing percentage difference related to gender (boys minus girls) is shown next to the country/economy name. Statistically significant differences between boys and girls are shown in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the percentage of top-performing boys.

Source: OECD, PISA 2022 Database, Table III.B1.3.3. The StatLink URL of this figure is available at the end of the chapter.

Figure III.3.7. Students' proficiency in creative thinking, by gender

OECD average



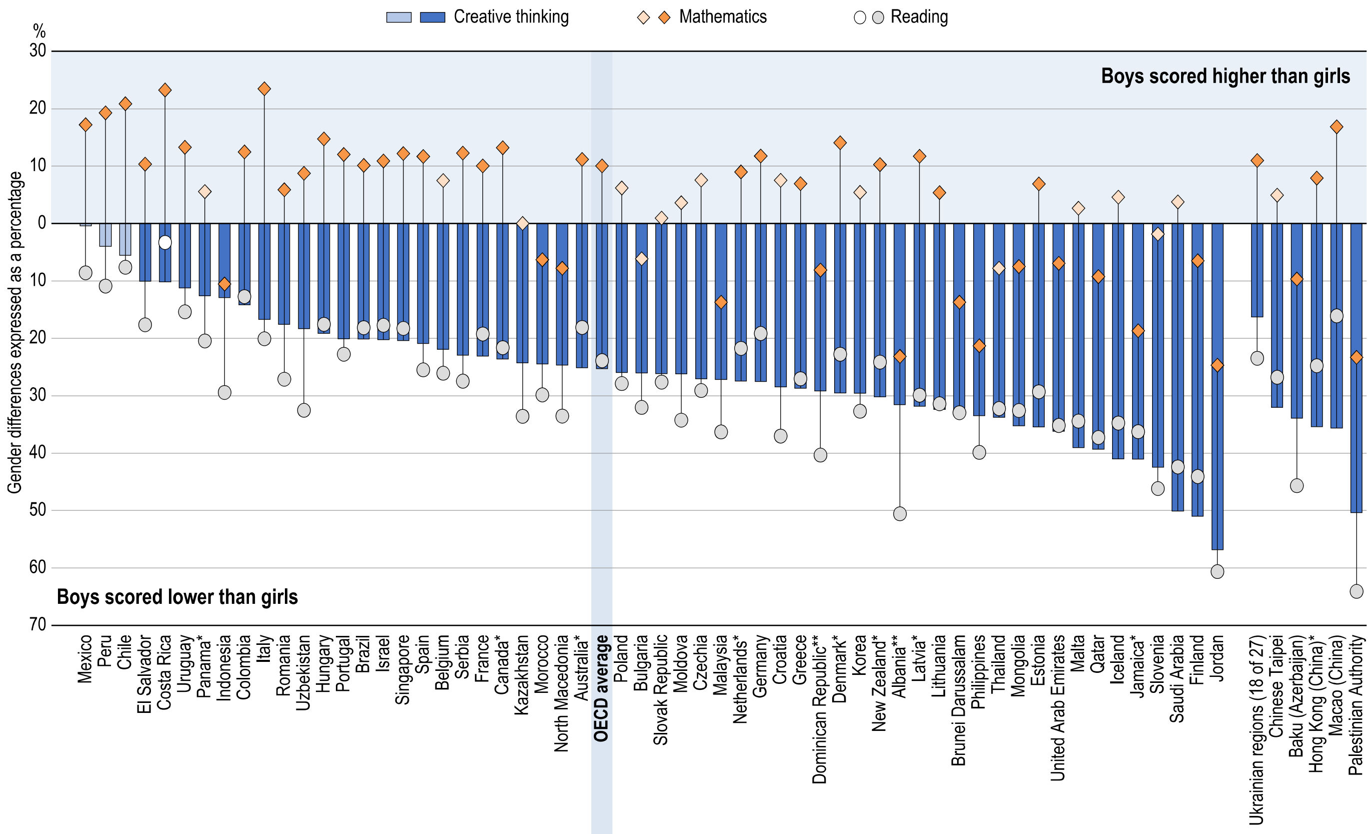
Source: OECD, PISA 2022 Database, Table III.B1.3.4. The StatLink URL of this figure is available at the end of the chapter.

Gender differences in creative thinking compared to mathematics and reading

The higher performance of girls, on average, is not a unique finding to creative thinking. Gender differences in mean performance in the PISA core domains across those countries also participating in the creative thinking assessment varied substantially, and in both directions: from close to 24% of a standard deviation across OECD countries in favour of girls in reading, to around 10% of a standard deviation across OECD countries in favour of boys in mathematics.[2] Girls' performance advantage in creative thinking – around 25% of a standard deviation across OECD countries – is similar to the one observed in reading across OECD countries (Figure III.3.8).

Figure III.3.8. Gender differences in creative thinking, mathematics and reading performance

Gender differences expressed as a percentage of the within-country standard deviation in performance



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. Statistically significant gender differences are shown in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the effect size in creative thinking performance related to gender (boys minus girls).

Source: OECD, PISA 2022 Database, Table III.B1.3.5. The StatLink URL of this figure is available at the end of the chapter.

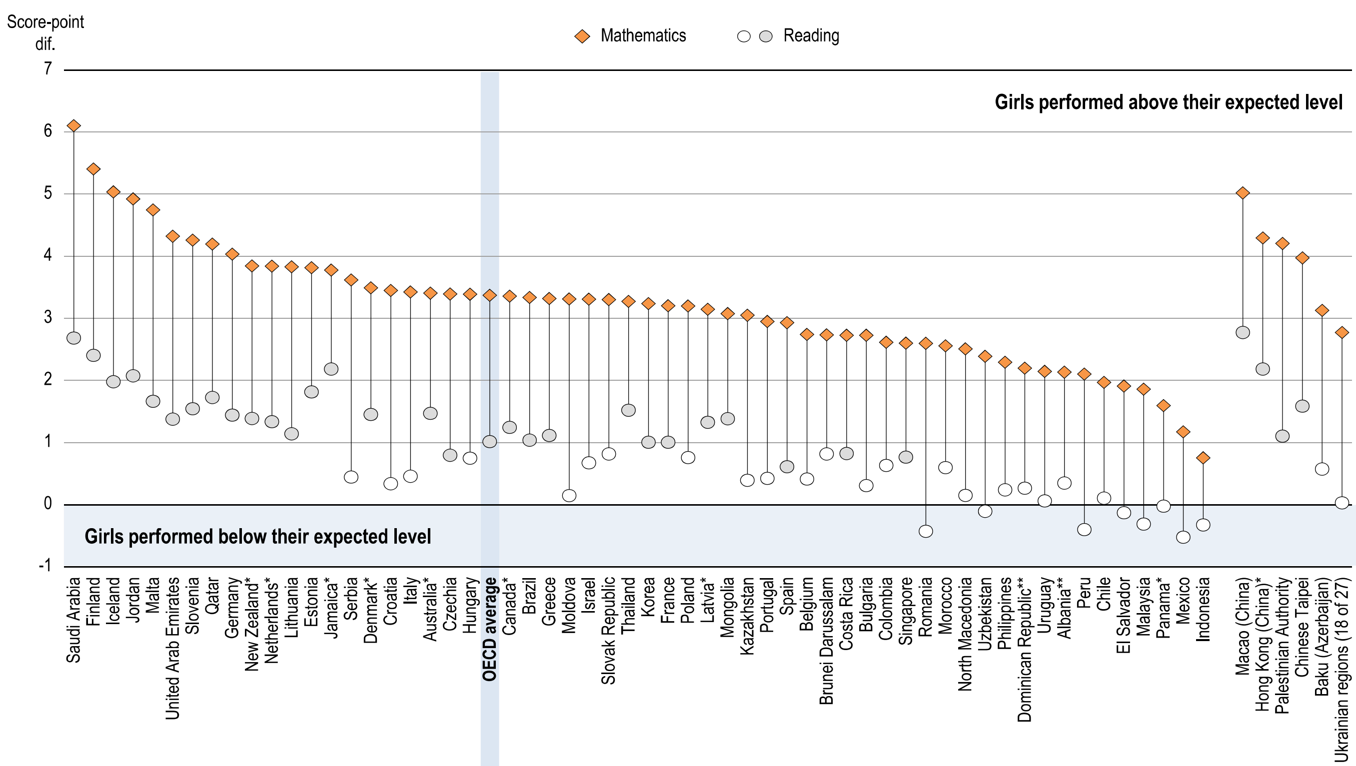
While gender differences in both creative thinking and reading are similar across most countries and economies, there are some exceptions to this general pattern. In Albania**, Indonesia, Uzbekistan, the Palestinian Authority, Baku (Azerbaijan) and the Dominican Republic** (in descending order), the gender effect size in favour of girls is over 10% of a standard deviation less for creative thinking than it is for reading. In other words, in these countries/economies, girls outperformed boys by over 10% of a standard deviation in performance more in reading than in creative thinking. In Hong Kong (China)* and Macao (China), the opposite is true: girls' performance advantage in creative thinking is significantly greater than it is for reading (by over 10% of a standard deviation performance).

It is not obvious whether a gender gap in creative thinking should be expected (Box III.3.2). The creative thinking assessment requires students to read and understand the item prompt and, in most cases, provide a written answer – like all PISA tests, this demands some level of reading comprehension and writing proficiency. However, the creative thinking test differs significantly from the PISA reading test in that students must use their imagination to come up with new ideas rather than find answers in the item stimulus using reasoning processes; they must use evaluative processes to filter their ideas and choose the best one(s) to respond to the task criteria; and they must articulate their ideas in an open response format rather than selecting pre-defined responses from a multiple-choice list. The creative thinking test also situates items in multiple domain contexts, potentially mitigating differences in performance by gender arising from domain-specific knowledge, skills and preferences.

After accounting for students' performance in the PISA core domains, girls still outperformed boys in creative thinking (Table III.B1.3.6).[3] In all countries and economies, girls performed relatively better than boys after accounting for mathematics performance (Figure III.3.9). This relative performance gap can be large: in well over half of all participating countries/economies, girls scored at least 3 points higher in creative thinking, on average, than boys with the same mathematics scores, and in Saudi Arabia, Finland, Iceland and Macao (China) (in descending order), girls scored at least 5 points higher than boys in creative thinking after accounting for mathematics performance. Even after accounting for reading performance – and despite similar gender differences observed in reading performance in general – girls' performance advantage in creative thinking remains statistically significant in around half of all countries/economies. On average across the OECD, girls scored 1 point higher in creative thinking than boys with similar reading scores. In Macao (China), Saudi Arabia, Finland, Jamaica*, Hong Kong (China)* and Jordan (in descending order), girls scored over 2 points higher than boys in creative thinking after accounting for reading performance.

Figure III.3.9. Gender differences in relative performance in creative thinking

Score-point difference between the actual and expected performance of girls in creative thinking



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown.
Statistically significant score-point differences are shown in a darker tone (see Annex A3). All gender differences in relative creative thinking performance with a similar mathematics performance are statistically significant. A student's relative performance in creative thinking is defined as the residual obtained upon a cubic polynomial regression of the student's performance in creative thinking over his or her performance in mathematics (reading). The regression is performed across students at the national level.
Countries and economies are ranked in descending order of the score-point difference in relative creative thinking performance between boys and girls with a similar mathematics performance.
Source: OECD, PISA 2022 Database, Table III.B1.3.6. The StatLink URL of this figure is available at the end of the chapter.

Box III.3.2. Gender differences in creative thinking performance and engagement with the PISA test

Empirical studies have found that girls tend to outperform boys in specific types of creative tasks. For example, girls often excel in tasks requiring associative thinking and elaboration (Baer and Kaufman, 2005[10]). In measurement contexts, researchers have found that girls tend to score higher than boys on tests of originality and verbal creativity, while boys tend to excel in tasks measuring divergent thinking (Awamleh, Farah and Zraigat, 2012[11]; Baer and Kaufman, 2008[12]; Kazemian et al., 2024[13]; Kim, 2006[14]). Studies suggesting that boys have better creative thinking abilities have mostly focused on personality traits associated with creativity, for example finding that boys exhibit higher levels of openness to experience in general (Feist, 1998[15]), as well as reporting greater assertiveness and risk-taking behaviours (Byrnes, Miller and Schafer, 1999[16]).

In the PISA creative thinking test, task engagement as well as other personality traits like conscientiousness may be additional drivers of the observed gender gap in performance. Examining gender differences in engagement with the test reveals that boys showed higher levels of task disengagement than girls, in general, and that this pattern was consistent across all the engagement indicators examined (see Annex A8, Tables III.A8.8 to III.A8.13). Indeed, significant gender gaps across engagement indicators are observed in many of the countries and economies where there are large differences in the performance of girls and boys (e.g. Albania**, the Palestinian Authority, Qatar, the United Arab Emirates). Box III.4.5 in Chapter 4 examines gender differences by different kinds of task in the creative thinking test in further detail.

It is important to acknowledge that differences in the association between gender and creative thinking across countries/economies may arise from differential opportunities, experiences and socialisation practices that reinforce certain cognitive styles and creative self-efficacy, and/or discourage others based on gender roles (Bem, 1981[17]; Kim, 2006[14]). Research from the neurosciences suggests that gender variation may stem from different preferences in cognitive processes, such as problem-solving strategies, information processing styles and cognitive flexibility. For example, boys tend to adopt analytical and systematic approaches to creative thinking tasks while girls favour more intuitive and holistic processing. Studies using neuroimaging techniques to investigate brain structures and neural activation patterns associated with creative cognition also suggest that men and women may recruit different brain regions when faced with situations requiring creative responses, particularly those involved in divergent thinking (Abraham et al., 2013[18]).

Performance differences related to students' socio-economic and cultural status

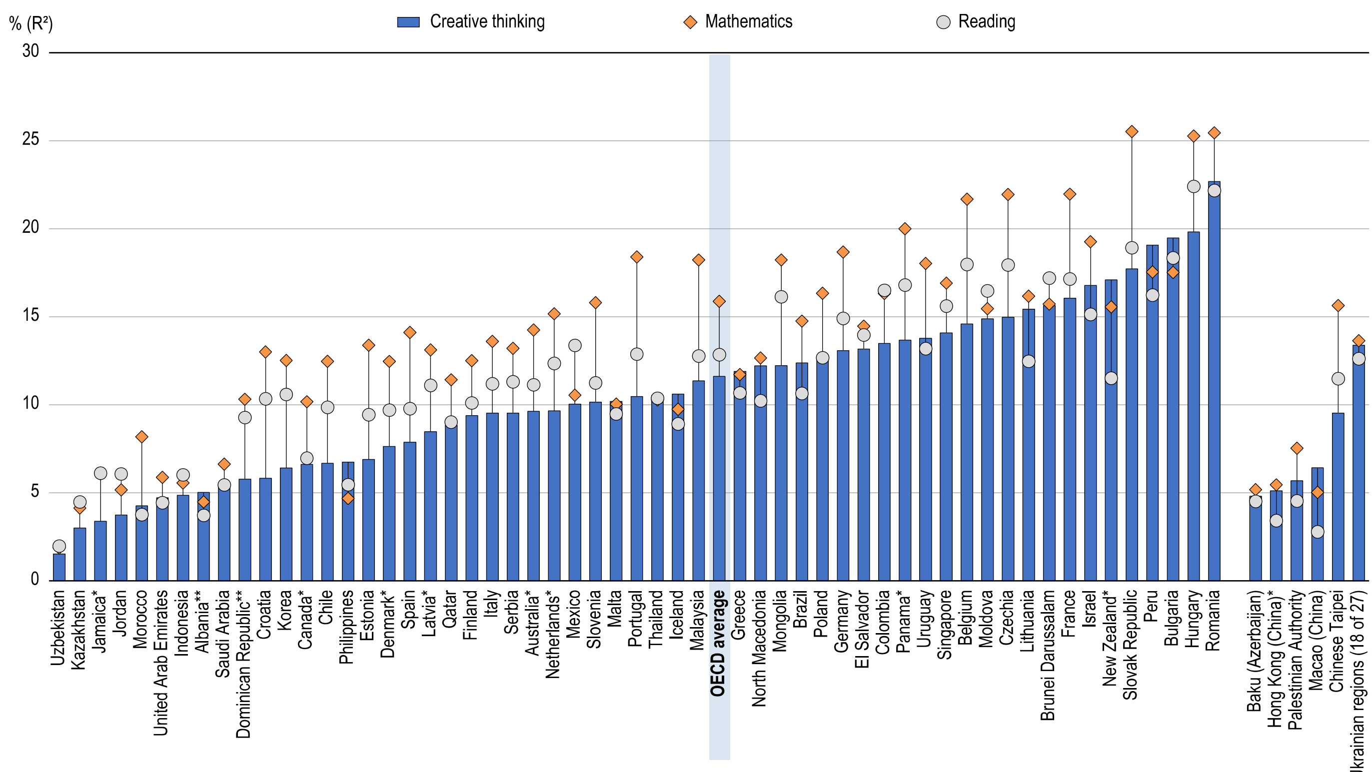
Fairness in education means that all students, irrespective of their background, are given the opportunity to realise their full learning potential.[4] Students' socio-economic status relates positively to performance in creative thinking, as it does to performance in all other PISA assessment domains (Table III.B1.3.7). Across OECD countries, the difference in performance between students in the top quarter of the PISA index of socio-economic and cultural status (ESCS) – or advantaged students – and students in the bottom quarter of the index – disadvantaged students – is large at 9.5 score points (close to the OECD average standard deviation in performance) (Table III.B1.3.7). In Brunei Darussalam, Bulgaria, Hungary, Israel, Romania, the Slovak Republic and Peru, the difference in performance between advantaged and disadvantaged students is well over 12 score points.

Reducing socio-economic differences in performance would serve to improve the overall performance of students in countries. For example, consider the performance of students in the two neighbouring countries of Czechia and the Slovak Republic. Advantaged students in both countries scored relatively similarly on average (38 points and 36 points, respectively), yet differences in the performance of disadvantaged students are much larger: in Czechia, disadvantaged students scored 27 points on average in creative thinking, while disadvantaged students in the Slovak Republic scored over 5 points lower on average. As a result, overall performance in the country is significantly lower in the Slovak Republic (a difference of -4 points).

The strength of the association between socio-economic status and performance, however, is weaker in creative thinking than it is in mathematics, reading and science respectively, on average across the OECD (Figure III.3.10 and Table III.B1.3.8).[5] In some countries, like Croatia, Jamaica*, Mongolia and Korea, this relationship between socio-economic status and performance is significantly weaker in creative thinking, although in around one-third of countries and economies this association is at least as strong for creative thinking as it is for both mathematics and reading.

Figure III.3.10. Relationship between student's socio-economic status and performance in creative thinking, mathematics and reading

Percentage of variation in performance explained by socio-economic status



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. The socio-economic status of students is measured by the PISA index of economic, social and cultural status. *Countries and economies are ranked in ascending order of how well socio-economic status predicts performance in creative thinking.*

Source: OECD, PISA 2022 Database, Table III.B1.3.8. The StatLink URL of this figure is available at the end of the chapter.

In general, the association between socio-economic status and performance in creative thinking is likely due to the poorer performance, overall, observed among disadvantaged students in PISA. Indeed, after accounting for students' mathematics and reading performance, differences in the performance of advantaged and disadvantaged students are much smaller in all countries/economies – and even become statistically non-significant in 14 countries/economies (Table III.B1.3.7). Socio-economic disparities in creative thinking performance therefore rather reflect a range of economic and cultural factors, experiences and mechanisms known to affect student achievement overall. For example, socio-economic segregation across neighbourhoods can result in unequal access to quality teaching, school environments conducive to learning, and adequate school materials among students within the same country. Other disadvantages relate to students' family circumstances – students whose parents have higher levels of education, and more prestigious and better-paid jobs, benefit from a wider range of financial (e.g. private tutoring, computers, books), cultural (e.g. extended vocabulary, time management skills) and social (e.g. role models, networks) resources. Students from advantaged families are also more likely to have better access to quality early childhood education and care. These factors make it easier for students from advantaged backgrounds to succeed in school compared to students from families with lower levels of education or that are affected by chronic unemployment, low-paid jobs or poverty.

In some countries and economies, the performance of disadvantaged students compared to advantaged students remains large even after accounting for performance in mathematics and reading. In Bulgaria, disadvantaged students scored nearly 4 points lower than advantaged students with similar mathematics and reading performance (i.e. after accounting), and in New Zealand* and Peru, this gap was over 4.5 score points.

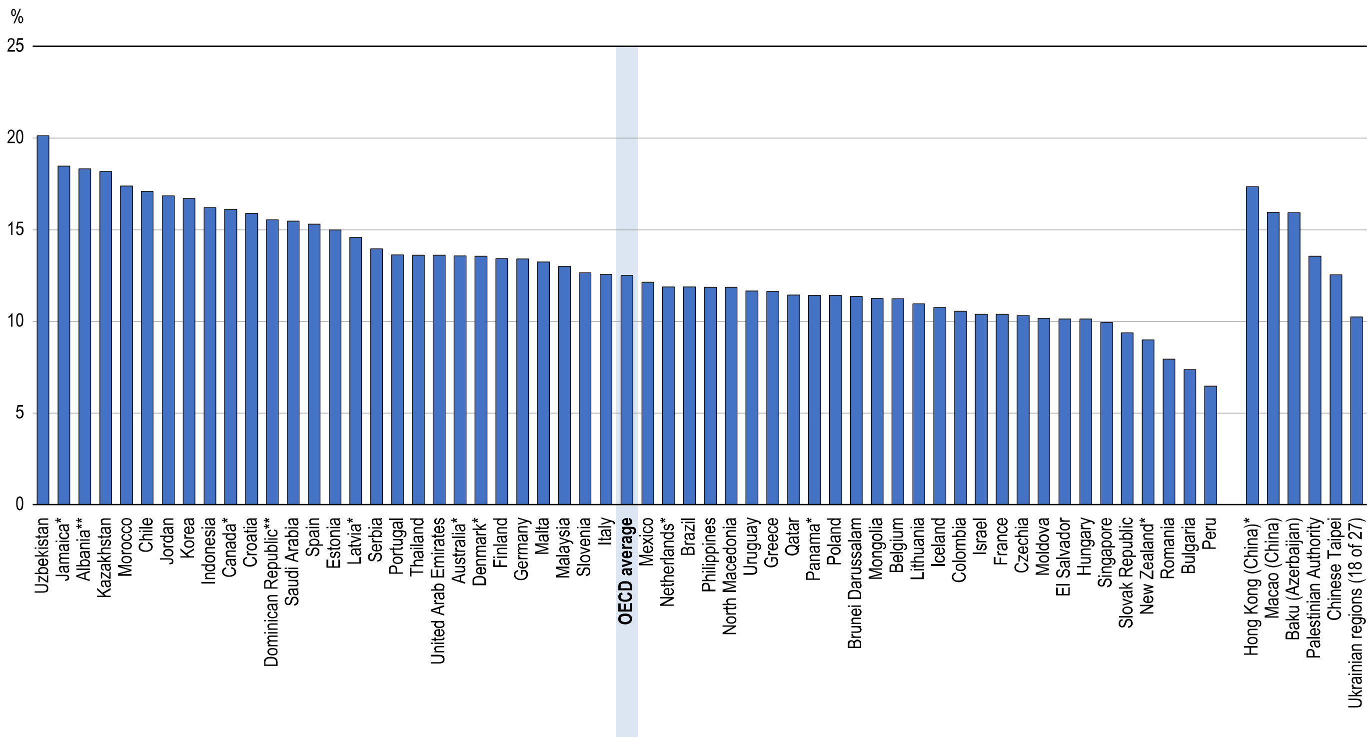
Resilience in creative thinking among disadvantaged students

Academically resilient students are defined in PISA as students who are in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in their own country/economy (i.e. disadvantaged students) and who scored in the top quarter in that country/economy (i.e. high achievers). These students are academically resilient because, despite their socio-economic disadvantage, they have attained educational excellence in comparison with students in their own country. The share of academically resilient students in creative thinking varies across countries and economies, from as much as 20% of disadvantaged students in Uzbekistan to below 8% of disadvantaged students in Romania, Bulgaria and Peru (Figure III.3.11). In these latter countries, few disadvantaged students are high achievers in creative thinking.

Amongst the highest-performing systems overall, Korea (16.7%), Canada* (16.1%), Estonia (15.0%) and Latvia* (14.6%) have the largest share of resilient students in creative thinking, and Singapore (9.9%) and New Zealand* (9.0%) have the smallest shares. In New Zealand*, this low share of resilient students is combined with a relatively large gap in the performance of advantaged and disadvantaged students (11.7 score points compared to 9.5 score points in Singapore).

Figure III.3.11. Share of resilient students in creative thinking, by country/economy

Percentage of socio-economically disadvantaged students who scored in the top quarter of creative thinking performance in their own country/economy



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Note: A socio-economically disadvantaged student is a student in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in his or her own country/economy. *Countries and economies are ranked in descending order of the percentage of resilient students.*
Source: OECD, PISA 2022 Database, Table III.B1.3.7. The StatLink URL of this figure is available at the end of the chapter.

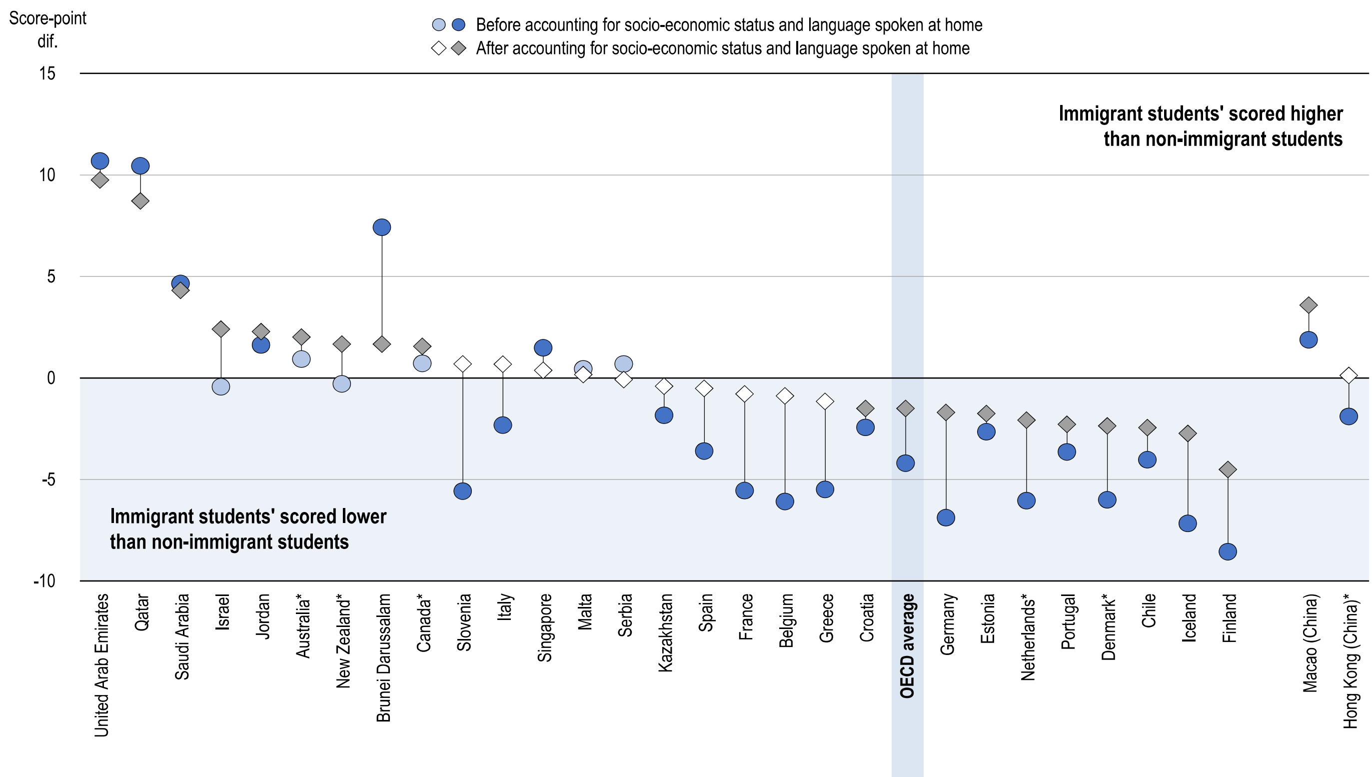
Immigrant background and relationship to performance in creative thinking

A fair education system also gives students with an immigrant background an equal opportunity to thrive at school and realise their full learning potential. In many countries and economies, children of immigrant parents are more at risk of low performance in education compared to the children of parents who were born in the country.[6] In general, this pattern is also observed in creative thinking – on average across the OECD, students with an immigrant background scored over 4 points lower than students without an immigrant background.

Education systems around the world vary greatly in terms of how large their immigrant student population is, and performance differences between students with an immigrant and non-immigrant background across systems should be interpreted with this in mind. Amongst systems where over 5% of the student population has an immigrant background, these students have a particularly large performance disadvantage in Finland – having scored over 8 points lower than their non-immigrant peers in creative thinking, on average (Table III.B1.3.9). The opposite is true in a handful of countries, with immigrant students having scored, on average, around 4.5 points higher in creative thinking in Saudi Arabia, over 7 points higher in Brunei Darussalam, and over 10 points higher in both the United Arab Emirates and Qatar. In both the United Arab Emirates and Qatar, over 50% of the student population has an immigrant background (Table III.B1.3.9).

Figure III.3.12. Differences in creative thinking performance, by immigrant background

Score-point difference in creative thinking between non-immigrant and immigrant students (immigrant – non-immigrant), before and after accounting for socio-economic status and language spoken at home



Notes: Countries/economies where less than 5% of students have an immigrant background are not represented in the figure.
Statistically significant with non-immigrant students are shown in a darker tone (see Annex A3).
The socio-economic status of students is measured by the PISA index of economic, social and cultural status.
Countries and economies are ranked in descending order of the gap in creative thinking performance related to immigrant background, after accounting for students' and schools' socio-economic status and language spoken at home.
Source: OECD, PISA 2022 Database, Table III.B1.3.10. The StatLink URL of this figure is available at the end of the chapter.

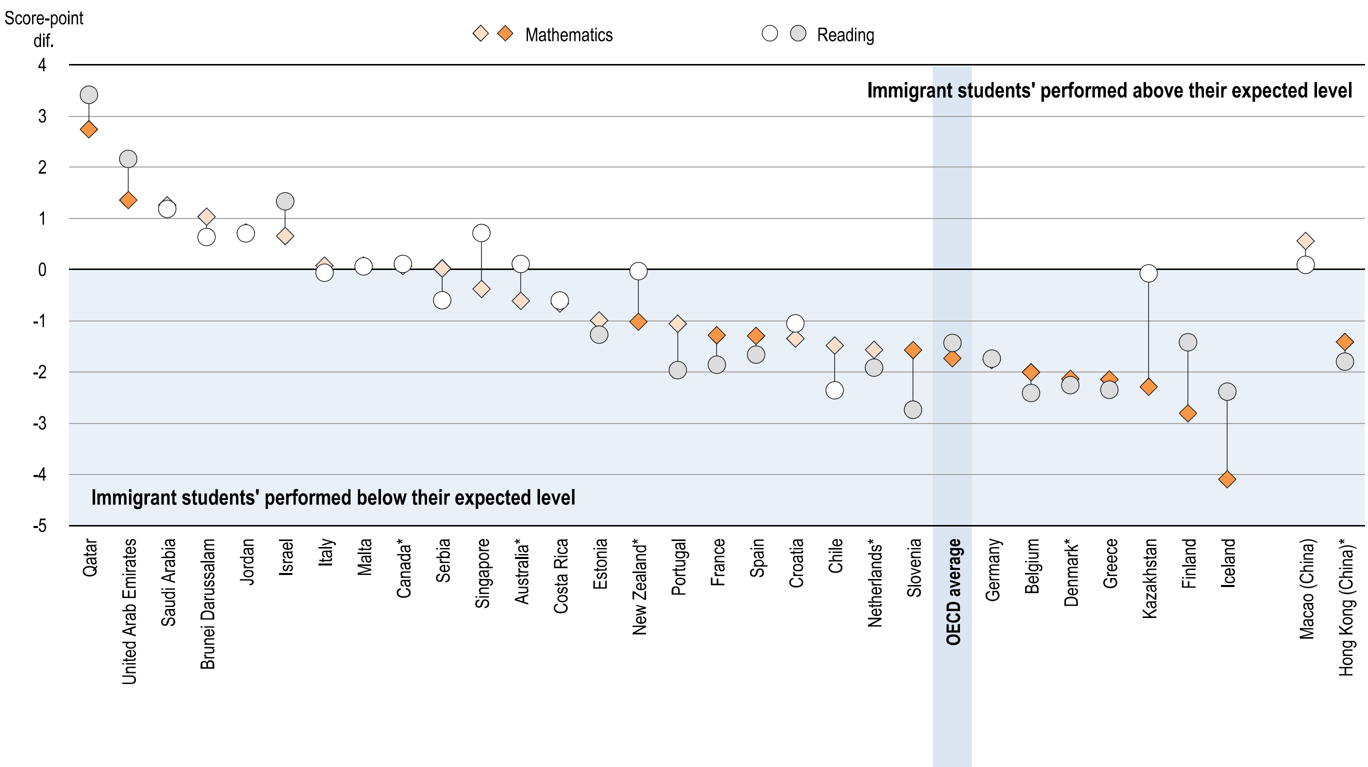
The large gap in performance in favour of non-immigrant students can be explained, to a large extent, by the socio-economic and linguistic barriers that immigrant students face in many countries. Once students' socio-economic status and language spoken at home are accounted for, the gap in performance narrows significantly (Figure III.3.12). In Belgium, Czechia, Denmark*, France, Germany, Greece, Iceland, the Netherlands*, Slovenia, Spain and Thailand, large differences in performance (i.e. over 3 points) between immigrant and non-immigrant students more than halve or become insignificant after accounting for these factors. In Australia*, Canada*, Israel and New Zealand*, the net association (i.e. after accounting) between immigrant background and performance in creative thinking even becomes significantly positive. However, in Brazil, Bulgaria, El Salvador, Finland, Jamaica*, Mexico, Morocco, North Macedonia, the Palestinian Authority, the Philippines, Poland, the Slovak Republic and Chinese Taipei, the performance disadvantage of students with an immigrant background nonetheless remains large even after controlling for these factors, and in Chile, Denmark*, Estonia, Germany, Iceland, the Netherlands* and Portugal, the net disadvantage (i.e. after accounting for these factors) of immigrant students remains moderate (between 1.5 and 3 score points less than non-immigrant students).

The performance of immigrant students can also be examined in comparison to non-immigrant students with similar mathematics and reading scores. An analysis accounting for mathematics performance shows that, on average across OECD countries, immigrant students scored nearly 2 points less in creative thinking than non-immigrant students; similarly, immigrant students scored over 1 point less than non-immigrant students, on average across the

OECD, after accounting for reading performance (Figure III.3.13). In some cases, this performance gap related to immigrant background is larger when comparing students with similar performance in the PISA core domains: for example, in Slovenia – where around 10% of the student population has an immigrant background – immigrant students scored around 3 points less than their non-immigrant peers with similar reading scores. Only in the United Arab Emirates and Qatar did students with an immigrant background score significantly higher in creative thinking than non-immigrant students, after accounting for mathematics and reading performance respectively.

Figure III.3.13. Relative performance in creative thinking, by immigrant background

Score-point difference among non-immigrant students compared to immigrant students with similar mathematics and reading performance



Notes: Countries/economies where less than 5% of students have an immigrant background are not represented in the figure.
Statistically significant differences are shown in a darker tone (see Annex A3).
A student's relative performance in creative thinking is defined as the residual obtained upon a cubic polynomial regression of the student's performance in creative thinking over his or her performance in mathematics (reading). The regression is performed across students at the national level.
Countries and economies are ranked in descending order of the score-point difference in relative creative thinking performance between immigrant students and non-immigrant students with a similar mathematics performance.
Source: OECD, PISA 2022 Database, Table III.B1.3.13. The StatLink URL of this figure is available at the end of the chapter.

School characteristics and relationship to performance in creative thinking

While student characteristics like gender, socio-economic background and immigrant background may be associated with differences in performance in creative thinking within schools, a non-negligeable proportion of the total variation in creative thinking performance is attributed to between-school differences (26%, OECD average). At the school level, certain characteristics may reflect different opportunities for different groups of students to access quality teaching and school facilities. Analysing student performance with respect to different school characteristics can provide insights about the extent to which school-level factors might be associated with creative thinking performance or present barriers for diverse students to access quality teaching within countries. Table III.3.1 summarises the relationship between student performance in creative thinking and school ESCS index (socio-economically advantaged/disadvantaged schools), school location (urban or rural), school type (public or private), and educational track (general study programmes or vocational and pre-vocational programmes).

Performance differences by school advantage

In all countries and economies, students in socio-economically advantaged schools have a large performance advantage compared to students from disadvantaged schools (Table III.3.1).[7] In over half of all participating countries and economies, the strength of this relationship is roughly equal to or greater than the OECD average standard deviation in performance. In Romania, Bulgaria, Hungary, the Slovak Republic, Jamaica*, North Macedonia and Israel (in descending order), the strength of this relationship is over 1.5 times the OECD average standard deviation in performance – or equivalent to a vast performance advantage of between 16 and 19 score points for students in advantaged schools. Amongst OECD countries, in order of increasing size, Iceland, Denmark*, Finland, Estonia, Spain, Canada* and Latvia*, record the smallest differences in performance between students in advantaged and disadvantaged schools (between 4.5 and 7 score points in favour of students in advantaged schools) (Table III.B1.3.15).

Table III.3.1. Differences in creative thinking performance, by school characteristic

- Significantly positive difference
- Significantly negative difference
- Difference is not significant
- Missing values

	School characteristics			
	Advantaged - Disadvantaged schools	City - Rural schools	Private - Public schools	General - vocational
Romania	19	14		13
Bulgaria	19	10	8	9
Hungary	18	10		14
Slovak Republic	17	10		12
Jamaica*	17	6		
North Macedonia	17	9	7	7
Israel	16			
Netherlands*	16			
Peru	15	7	8	
Brunei Darussalam	15		12	
Germany	15			7
Poland	15	7		8
Qatar	14		10	
France	14	10		10
Brazil	14	9	12	-6
Colombia	13	6	7	
El Salvador	13	9	10	-7
Serbia	13			8
Panama*	13	10	8	
Czechia	13			
Philippines	13		12	
Moldova	13	10		
Thailand	13	9		
Slovenia	12		6	9
Uruguay	12	7	9	
Belgium	12			9
Lithuania	12	7	6	14
Croatia	12			9
United Arab Emirates	11	10	12	
Mexico	11	8		
Italy	11			6
OECD average	11			6
Greece	11		7	10
Mongolia	10			6
Malaysia	10			
New Zealand*	10			
Morocco	10	6	6	
Countries/economies with a positive difference	62	46	35	28
Countries/economies with no difference	0	7	17	7
Countries/economies with a negative difference	0	0	2	5

- Significantly positive difference
- Significantly negative difference
- Difference is not significant
- Missing values

	School characteristics			
	Advantaged - Disadvantaged schools	City - Rural schools	Private - Public schools	General - vocational
Australia*	9			
Malta	9			
Singapore	9			
Dominican Republic**	9	6	6	
Kazakhstan	9	6		
Portugal	8			
Indonesia	8	7		
Chile	8	9		
Korea	7			6
Albania**	7		6	
Latvia*	6			
Canada*	6			
Spain	6			11
Estonia	6			
Jordan	6		6	
Iceland				
Saudi Arabia				
Denmark*				
Uzbekistan				
Finland				
Costa Rica			8	
Ukrainian regions (18 of 27)	13	6		7
Chinese Taipei	12	6		8
Hong Kong (China)*	10			
Macao (China)	9			
Baku (Azerbaijan)	6			
Palestinian Authority	5		10	
Countries/economies with a positive difference	62	46	35	28
Countries/economies with no difference	0	7	17	7
Countries/economies with a negative difference	0	0	2	5

** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown.
The socio-economic status of students is measured by the PISA index of economic, social and cultural status.
Values shown in cells indicate where a difference is greater than half the OECD standard deviation.
Countries and economies are ranked in descending order of the difference in creative thinking performance across schools' socio-economic profile.
Source: OECD, PISA 2022 Database, Table III.B1.3.15. The StatLink URL of this table is available at the end of the chapter.

While students attending an advantaged school scored better in creative thinking on average, this association is smaller than the equivalent association with student performance in the PISA curricular domains. Only in Iceland, Macao (China), North Macedonia and Peru does school advantage have a bigger association with performance in creative thinking than it does with performance in all other PISA curricular domains (Table III.B1.3.16).

As might be expected given the association observed between performance and school advantage, students attending private school performed better in the creative thinking assessment than those attending public schools in most countries/economies (Table III.3.1). However, the strength of this association differs between high-performing and low-performing countries/economies. In under two-thirds of all countries that perform at or above the OECD average and with available data, students in private schools outperformed their peers in public schools – but differences in performance are often small to moderate, except in Lithuania (over 6 points), New Zealand* (5 points), and Australia* and Finland (both 3 points); and in Chinese Taipei, students who attend private schools even performed significantly worse than those who attend public schools (scoring over 4 points less). In the remaining countries and economies with available data that performed below the OECD average in creative thinking, school type has a more significant association with performance: in over two-thirds of these countries/economies, private school students outperformed their peers in public schools; and in most countries/economies where this was the case, the difference in performance is equal to or greater than half of the OECD average standard deviation in performance.

Are these differences in the performance of students in private and public schools a reflection of differences in school quality and educational offering? Or are they rather a reflection of the associations between performance in creative thinking and certain student characteristics, such as student and school socio-economic profile, that likely differ between these two student populations? After accounting for students' gender, socio-economic status and school socio-economic profile, the relationship between school type and creative thinking performance becomes non-significant in around half of all countries and economies (Table III.B1.3.17). In fact, in 16 countries/economies, the net association (i.e. after accounting for student and school characteristics) with creative thinking performance is actually significantly negative for students who attend private schools. Only in Albania**, Brunei Darussalam, El Salvador, Jordan, the Palestinian Authority, the Philippines, Qatar and the United Arab Emirates is there still a significant and positive net association between attending a private school and creative thinking performance, after accounting for student and school characteristics. In the United Arab Emirates in particular, students at private schools scored nearly 11 points higher in creative thinking than those who attend public schools, after accounting for these factors.

Performance differences by educational track

Does the type of educational track or study programme in which a student is enrolled also influence their creative thinking competencies? In most education systems, there is a major distinction in curricula between general study programmes and vocational or pre-vocational study programmes. On average across the OECD, students in general study programmes performed stronger in the creative thinking assessment than those enrolled in pre-vocational or vocational study programmes (Table III.3.1). This was the case in Hungary, Lithuania, Romania, the Slovak Republic, Spain and Greece (in descending order of magnitude), where the performance advantage of students in general education programmes equalled or exceeded 10 score points (around the OECD standard deviation in performance). Even in Germany – a country with a traditionally strong vocational education and training system – students in general education programmes still scored significantly better, on average, in creative thinking (around 7 score points higher) than students in vocational or pre-vocational study programmes. Amongst European countries with available data, only Czechia, the Netherlands*, Latvia* and Moldova recorded no significant differences in the creative thinking performance of students in different study programmes.

In a few Latin American countries with available data, students in pre-vocational or vocational study programmes performed better on average than their peers in general education study programmes. In Costa Rica, the performance advantage of students in pre-vocational and vocational education is around 3 points, and in the Dominican Republic** and Brazil, this difference is around 5 score points respectively. Similar results are observed in other countries from the region that have only a few students in the PISA sample enrolled in vocational programmes (e.g. Chile, El Salvador and Panama*, Table III.B1.3.14). In Uruguay however, students in general study programmes scored around 3 points higher, on average, on the creative thinking test than students in vocational or pre-vocational programmes.

In general, across the OECD, the performance advantage associated with being enrolled in general study programmes is weaker for creative thinking than it is for mathematics, reading and science (Table III.B1.3.16). In other words, although students in general study programmes scored higher in creative thinking than students in vocational programmes, they have an even bigger advantage in mathematics, reading and science. This may be because vocational programmes emphasise creative thinking processes and practical engagement in creative work more than general study programmes do (e.g. troubleshooting faulty machinery or technology, or engaging in craft, design and/or engineering work); or, it may be because of a relatively weaker focus on developing knowledge and skills in more traditionally "academic" subject areas in vocational programmes (or indeed, a combination of both).

Table III.3.2. Variation in student performance in creative thinking: Chapter 3 figures and tables

Figure III.3.1	Variation in creative thinking performance between systems, schools and students
Figure III.3.2	Variation in creative thinking performance between and within schools
Figure III.3.3	Challenges to integration of creative thinking in education: Policymakers' perspective
Figure III.3.4	Gender differences in creative thinking performance
Figure III.3.5	High achievers in creative thinking, by gender
Figure III.3.6	Top performers in creative thinking, by gender
Figure III.3.7	Students' proficiency in creative thinking, by gender
Figure III.3.8	Gender differences in creative thinking, mathematics and reading performance
Figure III.3.9	Gender differences in relative performance in creative thinking
Figure III.3.10	Relationship between students' socio-economic status and performance in creative thinking, mathematics and reading
Figure III.3.11	Share of resilient students in creative thinking, by country/economy
Figure III.3.12	Differences in creative thinking performance, by immigrant background
Figure III.3.13	Relative performance in creative thinking, by immigrant background
Table III.3.1	Differences in creative thinking performance, by school characteristic

StatLink https://stat.link/0tjcad

Notes

[1] Note that this chapter includes analysis referring to both "high achievers" and "top performers" in creative thinking. "High achievers" are students who performed highly in creative thinking with reference to their national population (i.e. they scored within the 75th percentile nationally, or within the top quarter of students). "Top performers" are students who performed highly in creative thinking with reference to the international student population (i.e. those who performed at Proficiency Levels 5 and 6). With respect to the analysis on top performers, it should be noted that in some countries/economies, there were very few students who are top performers.

[2] To compare the difference in performance between boys and girls in creative thinking and in mathematics, reading and science, respectively, gender differences are expressed as a percentage of the standard deviation in performance. Differences are expressed in this way given the different PISA scale used for the creative thinking assessment, on the one hand, and the "typical" PISA scales for mathematics, reading and science. As such, score point differences between boys and girls in the different PISA assessments cannot be directly compared.

[3] Relative performance refers to the residual performance attributable to creative thinking proficiency uniquely after accounting for performance in mathematics, reading or science, respectively, in cubic polynomial regressions performed across students at the national level.

[4] When interpreting results in this chapter, keep in mind that the coverage of the population of 15-year-olds enrolled in school varies significantly across countries/economies (PISA's Coverage Index 3 [CI3] measures the proportion of the national population of 15-year-olds represented in the PISA sample). For analysis on the association between socio-economic status and performance, low coverage is an issue because research suggests that socio-economically disadvantaged and low-performing students are less likely to be enrolled in school by age 15

(UNESCO, 2015[19]; Spaull, 2018[20]; Taylor and Spaull, 2015[21]). This means that in countries/economies with lower coverage, the most disadvantaged 15-year-olds might not have been represented in the PISA sample. This, in turn, might introduce a bias in the estimation of students' socio-economic status and in the analysis of the relationship between socio-economic status and student performance.

[5] Students' socio-economic status is measured by the PISA index of socio-economic and cultural status (ESCS). The strength of the association between performance and socio-economic status is measured by the percentage of variation explained by socio-economic disparities. The strength of this association among OECD countries and economies that participated in the creative thinking assessment is 11.6% for creative thinking, compared to 15.9% for mathematics, 12.9% for reading and 14.6% for science, respectively.

[6] PISA defines immigrant students as students whose mother and father were both born in a country/economy other than that where the student took the PISA test. Non-immigrant students are students who have at least one parent born in the country of assessment. PISA data show that students with an immigrant background typically have a more disadvantaged socio-economic profile than non-immigrant students.

[7] To define advantaged and disadvantaged schools, all schools in each PISA participating education system are ranked according to their average PISA index of economic, social and cultural status (ESCS) and then divided into four groups with approximately an equal number of students (quarters). Schools in the bottom quarter are referred to as "socio-economically disadvantaged schools"; and schools in the top quarter are referred to as "socio-economically advantaged schools". Advantaged schools are those where the typical student in the school is statistically significantly above the socio-economic status of the typical student in the country.

References

Abraham, A. et al. (2013), "Gender differences in creative thinking: behavioral and fMRI findings", *Brain Imaging and Behavior*, Vol. 8/1, pp. 39-51, https://doi.org/10.1007/s11682-013-9241-4. [18]

Awamleh, H., Y. Farah and I. Zraigat (2012), "The level of creative abilities dimensions according to torrance formal test (B) and their relationship with some variables (sex, age, GPA)", *International Education Studies*, Vol. 5/6. [11]

Baer, J. and J. Kaufman (2008), "Gender differences in creativity", *The Journal of Creative Behavior*, Vol. 42/2, pp. 75-105, https://doi.org/10.1002/j.2162-6057.2008.tb01289.x. [12]

Baer, J. and J. Kaufman (2005), "Bridging generality and specificity: The amusement park theoretical (apt) model of creativity", *Roeper Review*, https://doi.org/10.1080/02783190509554310. [10]

Beghetto, R. (2019), "Large-scale assessments, personalised learning, and creativity: Paradoxes and possibilities", *ECNU Review of Education*, Vol. 2/3, pp. 311-327, https://doi.org/10.1177/2096531119878963. [6]

Bem, S. (1981), "Gender schema theory: A cognitive account of sex typing", *Pschological Review*, Vol. 88/4, https://doi.org/10.1037/0033-295X.88.4.354. [17]

Byrnes, J., D. Miller and W. Schafer (1999), "Gender differences in risk-taking: A meta-analysis", *Psychological Bulletin*, Vol. 125/3, pp. 367-383, https://doi.org/10.1037/0033-2909.125.3.367. [16]

Feist, G. (1998), "A meta-analysis of personality in scientific and artistic creativity", *Personality and Social Psychology Review*, Vol. 2/4, pp. 290-309, https://doi.org/10.1207/s15327957pspr0204_5. [15]

Foster, N. and M. Piacentini (eds.) (2023), *Innovating Assessments to Measure and Support Complex Skills*, OECD Publishing, Paris, https://doi.org/10.1787/e5f3e341-en. [7]

Kazemian, N. et al. (2024), "Some effects of sex and culture on creativity, no effect on incubation", *Empirical Studies of the Arts*, Vol. 0/0, https://doi.org/10.1177/02762374231217638. [13]

Kim, K. (2006), “Can we trust creativity tests? A review of the Torrance Tests of Creative Thinking (TTCT)”, *Creativity Research Journal*, Vol. 18/1, pp. 3-14, https://doi.org/10.1207/s15326934crj1801_2. [14]

Lucas, B. (2022), *Creative thinking in schools across the world: A snapshot of progress in 2022*. [8]

OECD (2023), *PISA 2022 Creative Thinking Framework*, OECD Publishing, Paris, https://doi.org/10.1787/dfe0bf9c-en. [2]

OECD (2023), *PISA 2022 Results (Volume I): The State of Learning and Equity in Education*, OECD Publishing, Paris, https://doi.org/10.1787/53f23881-en. [3]

OECD (2023), *Supporting Students to Think Creatively: What Education Policy Can Do*, OECD Publishing, Paris, https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1_. [4]

OECD (2022), *Thinking Outside the Box: The PISA 2022 Creative Thinking Assessment*, https://issuu.com/oecd.publishing/docs/thinking-outside-the-box (accessed on 4 March 2023). [1]

Pellegrino, J. (2023), *Introduction: Arguments in support of innovating assessments*, OECD Publishing. Paris, https://doi.org/10.1787/e5f3e341-en. [5]

Spaull, N. (2018), “Who makes it into PISA? Understanding the impact of PISA sample eligibility using Turkey as a case study (PISA 2003–PISA 2012)”, *Assessment in Education: Principles, Policy & Practice*, Vol. 26/4, pp. 397-421, https://doi.org/10.1080/0969594x.2018.1504742. [20]

Taylor, S. and N. Spaull (2015), “Measuring access to learning over a period of increased access to schooling: The case of Southern and Eastern Africa since 2000”, *International Journal of Educational Development*, Vol. 41, pp. 47-59, https://doi.org/10.1016/j.ijedudev.2014.12.001. [21]

UNESCO (2015), *Education for All 2000-2015: Achievements and Challenges. EFA Global Monitoring Report.*. [19]

Vincent-Lancrin, S. et al. (2019), *Fostering Students’ Creativity and Critical Thinking: What It Means In School*, Educational Research and Innovation, OECD Publishing, Paris., https://doi.org/10.1787/62212c37-en. [9]

4 Strengths and weaknesses in creative thinking performance

This chapter describes strengths and weaknesses in creative thinking performance across countries and economies. It examines performance differences across items in the three ideation processes (generate diverse ideas, generate creative ideas, and evaluate and improve ideas) and the four domain contexts (written expression, visual expression, social problem solving and scientific problem solving) of creative thinking. It also explores performance differences across domains and ideation processes with respect to student characteristics, such as gender and socio-economic and cultural status.

For Australia*, Canada*, Denmark*, Hong Kong (China)*, Jamaica*, Latvia*, the Netherlands*, New Zealand* and Panama* caution is advised when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).

For Albania** and the Dominican Republic**, caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Thinking outside of the box, improving ideas and processes, applying new techniques and methods, and making connections across disciplines are important skills for success in school, the workplace and society. To what extent are students capable of applying creative thinking processes across different activities and subject areas? Which students are better prepared to think of original solutions and which are better at thinking of different ways to address the same problem? While student performance in creative thinking is measured by scores on the PISA scale, single scores do not provide any information about the relative strengths and weaknesses in performance across and within countries. This chapter further examines performance differences in creative thinking by different types of task groupings, including by ideation process and by domain context. It also analyses performance differences across task types by student characteristics including gender and socio-economic status.

What the data tell us

- Students in Singapore were the most successful (i.e. achieved full credit) in several types of tasks, particularly social problem-solving tasks. Students in Korea were the most successful in scientific problem-solving contexts and in tasks requiring students to evaluate and improve ideas, and students in Portugal performed the most successfully in visual expression tasks. In total, 7 of the 12 countries that performed significantly above the OECD mean in creative thinking (Australia*, Canada*, Denmark*, Estonia, Korea, New Zealand*, Poland) performed significantly above the OECD average in each task subset.
- Within each country/economy, students' success in a subset of tasks compared to their performance on all other tasks can identify relative strengths and weaknesses in performance. After accounting for the international difficulty of items, students in Lithuania, Serbia and Moldova showed the largest relative strength in "generate creative ideas" tasks compared to other countries, whereas students in Korea and Portugal showed the largest relative weakness in these tasks (while still performing highly in absolute terms). Students in the Ukrainian regions (18 of 27) had the strongest relative performance by far in "evaluate and improve ideas" items, whereas students in Albania** and Hungary demonstrated the weakest relative performance in those items. Students in many countries demonstrated relative weakness in generating diverse ideas, particularly in Germany, Slovenia and the Ukrainian regions (18 of 27).
- In general, and after accounting for the difficulty of items, students demonstrated relative strengths in creative expression tasks (written and visual) and relative weaknesses in creative problem-solving tasks, compared to their performance across all other tasks. Countries with the weakest relative performance in written expression tasks compared to other tasks were Malaysia (by some margin, around 8 percentage points) and Thailand (5 percentage points). Students in Italy, Mexico, Chile, Iceland and Czechia showed the largest relative weakness in social problem-solving tasks, compared to their performance on other tasks, whereas students in in Slovenia, Latvia* and Panama* demonstrated the largest weakest relative performance in scientific problem-solving tasks compared to their performance on other tasks.
- Gender differences persist across all task subsets. Girls were more successful than boys in all three ideation processes, and considerably more successful than boys in creative expression tasks on average (between 6 and 8 percentage points, OECD average). Girls' performance advantage was weakest (though still positive) in scientific problem-solving tasks, on average girls outperformed boys in only 13 countries and economies (and performed significantly worse than boys in Mexico). Differences in performance across tasks generally remain significant when comparing boys and girls with similar performance in reading and in mathematics.
- The performance gap between advantaged and disadvantaged students across all task groupings is vast, although this association is significantly moderated after accounting for students' reading and mathematics performance. Nonetheless, it remains significant across all task groupings.

A snapshot of strengths and weaknesses in creative thinking

Items in the PISA 2022 Creative Thinking assessment measure three ideation processes involved in creative thinking: generating diverse ideas, generating original ideas, and evaluating and improving ideas. Items were also contextualised within four distinct domains: written expression, visual expression, social problem solving and scientific problem solving (see Chapter 1 and Annex A1 for more information on the ideation processes and domain contexts included in the PISA 2022 Creative Thinking assessment). By analysing student performance on subsets of test items across countries/economies, it is possible to identify systematic differences in success when tackling different types of tasks (see Box III.1.1).

Box III.4.1. How success at the item level is analysed and reported

The PISA creative thinking scale reports student performance according to a single score. While this approach to scaling and reporting data has many advantages, it can hide interesting differences in patterns of performance at lower levels of aggregation, i.e. on single items or on subsets of items. To explore these patterns, the responses of students who answered each item must be analysed.

The analyses throughout this chapter are based on the average percentages of correct responses for different subsets of items at the country/economy level. For each item, the percentage of correct responses is simply the number of correct answers divided by the number of students who encountered the question (non-reached questions are counted as missing). This percentage is then averaged across groups of items. Table III.4.1 shows the distribution of items in the final item pool across the different task groupings.

Table III.4.1. Distribution of items in the PISA 2022 Creative Thinking test

Items grouped by ideation process and by domain context

Ideation process	Domain context				Total
	Written expression	Visual expression	Social problem solving	Scientific problem solving	
Generate diverse ideas	4	1	4	3	12
Generate creative ideas	6	1	3	1	11
Evaluate and improve ideas	2	2	3	2	9
Total	12	4	10	6	32

When computing the average percentage correct on a subset of items, “correct” responses might include both partial and full credit responses or full credit responses only. For most analyses presented in this chapter, the average percentage correct is computed using full credit responses only. This is because full credit responses reflect ideas that are either sufficiently diverse from each other or sufficiently original compared to other responses, whereas partial credit responses reflect only conventional or similar ideas. In other words, full credit responses reflect skill in *creative* idea generation as opposed to simply appropriate idea generation.

Measuring the percentage of correct responses on average across countries is also a proxy for the difficulty of items (at the international level). By comparing the percentage of correct responses across two distinct sets of items, it is possible to identify the relative difficulty of each set. By further comparing the percentage of correct responses across two sets of items and across countries, it is possible to identify where the relative strengths and weaknesses of each country lie.

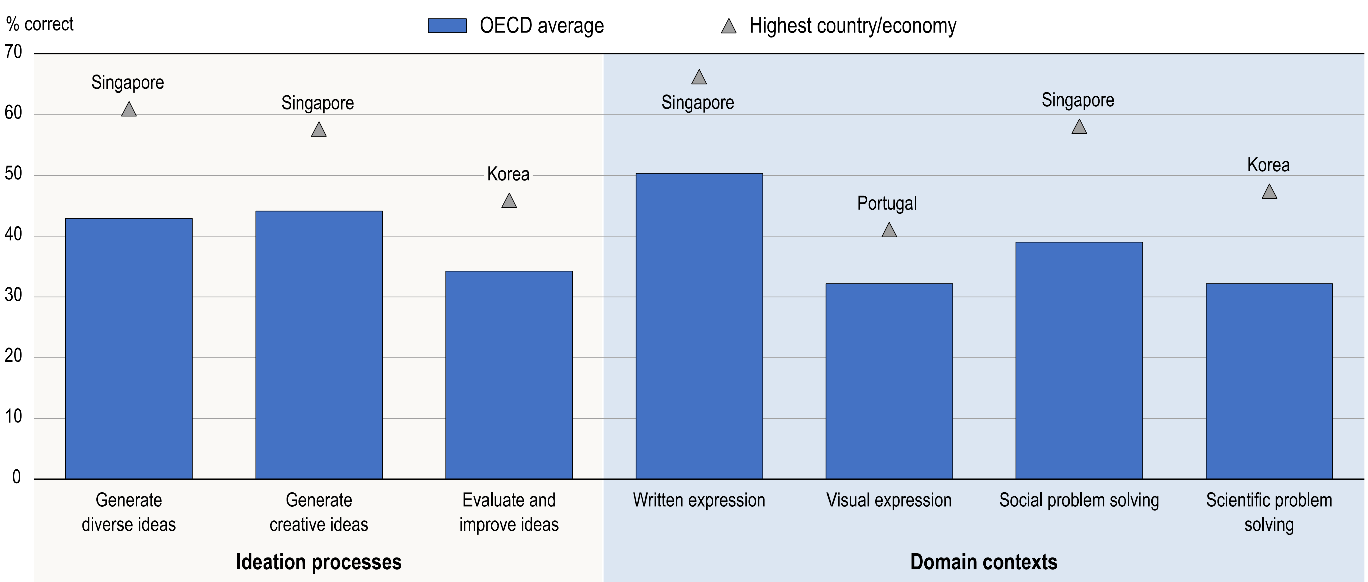
Figure III.4.1. provides an initial snapshot of student success across different types of tasks, on average across OECD countries. In general, students achieved full credit in tasks that required them to think of their own original or diverse ideas more often than those that required them to build on others' ideas. In terms of task context, students achieved full credit in written expression tasks more than in any of the other domains: students could suggest original or diverse ideas for close to half of all written expression tasks they encountered, on average across OECD countries. In contrast, visual expression tasks were the hardest in which to achieve full credit, with students having done so in only around one-third of the items of this type they encountered, on average. It may be that specific drivers of difficulty were associated with tasks in the visual expression domain (see Box III.4.2).

Figure III.4.1 also shows the highest-performing country/economy for each task subset. Students in Singapore performed the highest in creative thinking overall and were the most successful in several types of tasks, especially social problem-solving tasks. In Korea, students performed the best out of all countries/economies in tasks in the scientific problem-solving domain and in evaluate and improve ideas tasks. Students in Portugal were the most successful in tasks in the visual expression domain out of all countries and economies.

In total, 7 of the 12 countries that performed significantly above the OECD mean in creative thinking (Australia*, Canada*, Denmark*, Estonia, Korea, New Zealand*, Poland) performed significantly above the OECD average in each task subset (Table III.B1.4.1 and Table III.B1.4.2). In Portugal, despite students having performed significantly above the OECD average overall, they performed significantly below the OECD average in generate creative ideas tasks.

Figure III.4.1. Performance in creative thinking, across domain contexts and ideation processes

Average percent of correct responses (full credit only), OECD average and highest-performing country/economy, across domain contexts and ideation processes



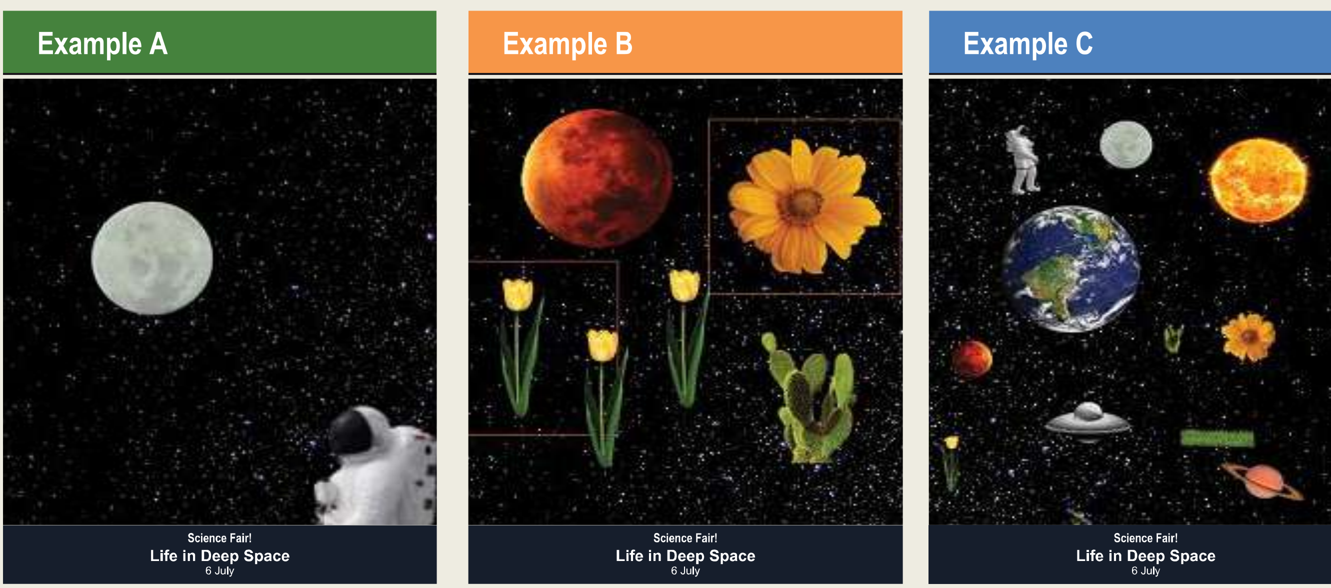
Source: OECD, PISA 2022 Database, Tables III.B1.4.1 and III.B1.4.2 The StatLink URL of this figure is available at the end of the chapter.

Box III.4.2. Success in visual expression tasks: Drivers of difficulty

The relative difficulty (internationally) of achieving full credit for items in the visual expression domain may be explained by several factors. Firstly, students across many countries and economies may have little prior experience engaging with tasks asking them to create visual outputs in a formal assessment context. Secondly, the visual expression tasks required students to use a design tool; despite the tool's simplicity, some students may not have been familiar with using such graphic design tools. However, when considering student success in the visual domain including partial credit responses, students are the *most* successful in these kinds of tasks, which implies that their relatively weaker performance at the full credit level reflects a greater difficulty in producing *original* and *diverse* designs, specifically, rather than any designs at all.

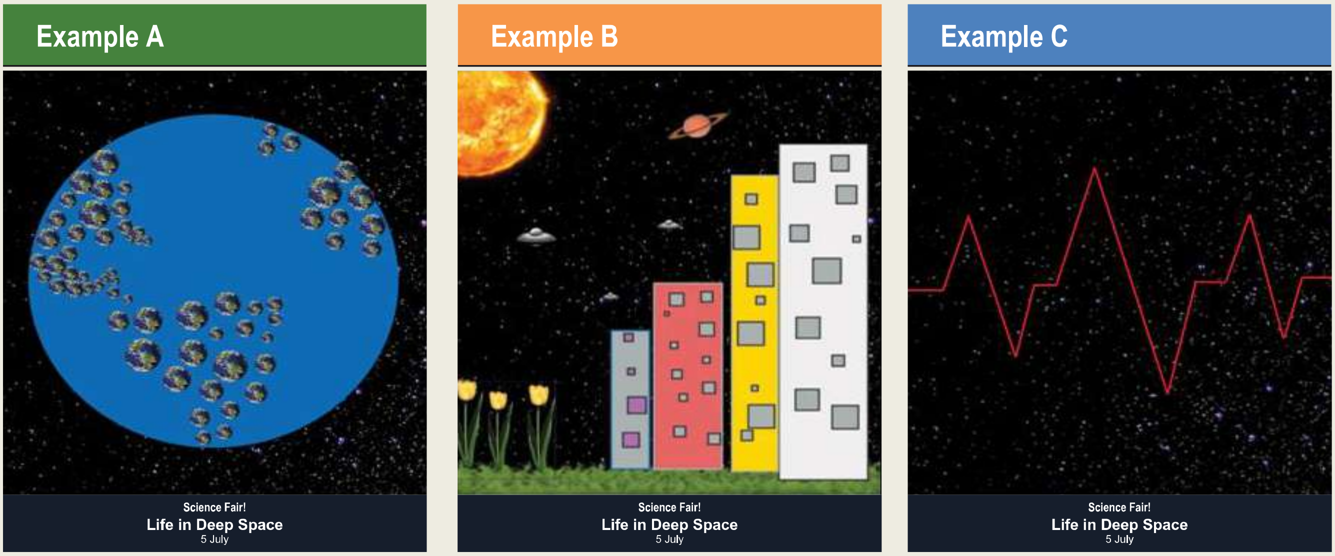
Why is there such a difference in success across the partial credit and full credit only measures? In all visual expression tasks, students were asked to create a simple design: the graphic tool enabled students to add lines and shapes, modify their colour and fill, and add stickers from the tool library. For every task, the stickers in the tool library were relevant to the task scenario, meaning that a simple design with only one or a few stickers might be considered appropriate (albeit unoriginal). Therefore, students who struggled to generate appropriate ideas for tasks in other domains requiring more active idea generation skill could achieve partial credit in visual expression tasks with only a minimum level of engagement. For example, Figure III.4.2 shows three example appropriate responses for Item 1 of the *Science Fair Poster* unit (shown in Figure III.1.9 of Chapter 1). Each example response has been composed of a combination of from the tool library, but the students have not combined these elements in any imaginative or meaningful way to connect to the theme of "Life in Deep Space".

Figure III.4.2. Examples of partial credit responses to a task in the *Science Fair* unit



In contrast, full credit responses required students to integrate stickers within a broader and more complex design, or to combine lines, shapes and colours to create other relevant characters, objects or symbols with significance to the theme of "Life in Deep Space" (see Figure III.4.3 for three examples of full credit responses). This clearly required a greater investment in conceptualising and implementing a design with respect to partial credit responses, as well as potentially drawing on domain readiness (e.g. some graphic design skill).

Figure III.4.3. Examples of full credit responses to a task in the *Science Fair* unit



Unsurprisingly, patterns in success across ideation processes (with respect to the OECD average) are more mixed amongst countries whose overall performance lies around the OECD mean (Table III.4.2). For example, students in Czechia and Germany were less successful in generating diverse ideas than the OECD average but more successful in generating creative ideas and evaluating and improving ideas. In Spain, students were less successful in generating creative ideas than in other OECD countries. This remains true even when including partial credit responses in the percentage correct measure, pointing toward a general difficulty for students in Spain to generate appropriate ideas for such tasks (Table III.B1.4.1). The same general difficulty for generating diverse ideas was also observed for students in Germany (see Box III.4.3).

Table III.4.2. Comparing countries' and economies' performance in creative thinking success by ideation processes and domain contexts

Difference in the average percentage correct (full credit only) with respect to the OECD average

- Statistically significantly **above** the OECD average
- **Not** statistically significantly **different** from the OECD average
- Statistically significantly **below** the OECD average

	Mean score in creative thinking	Full credit						
		Generate diverse ideas (12 items)	Generate creative ideas (11 items)	Evaluate and improve ideas (9 items)	Written expression (12 items)	Visual expression (4 items)	Social problem solving (10 items)	Scientific problem solving (6 items)
Singapore	41.0	Above	Above	Above	Above	Not different	Above	Above
Korea	38.1	Above	Above	Above	Above	Above	Above	Above
Canada*	37.9	Above	Above	Above	Above	Above	Above	Above
Australia*	37.3	Above	Above	Above	Above	Above	Above	Above
New Zealand*	36.4	Above	Above	Above	Above	Above	Above	Above
Estonia	35.9	Above	Above	Above	Above	Above	Above	Above
Finland	35.8	Above	Above	Above	Above	Not different	Above	Above
Denmark*	35.5	Above	Above	Above	Above	Above	Above	Above
Latvia*	35.1	Not different	Above	Above	Above	Above	Above	Not different
Belgium	34.9	Above	Above	Not different	Above	Above	Above	Above
Poland	34.4	Above	Above	Above	Above	Above	Above	Above
Portugal	33.9	Above	Below	Above	Not different	Above	Above	Above
Lithuania	32.9	Not different	Above	Not different	Above	Above	Not different	Not different
Spain	32.8	Above	Below	Above	Below	Not different	Not different	Above
OECD average	32.7							
Czechia	32.6	Below	Above	Above	Above	Above	Below	Not different
Germany	32.5	Below	Above	Above	Below	Above	Not different	Not different
France	32.4	Below	Below	Below	Below	Below	Below	Not different
Netherlands*	32.4	Not different	Below	Below	Below	Below	Not different	Not different
Israel	32.3	Not different	Not different	Above	Below	Not different	Above	Above
Italy	31.4	Not different	Below	Below	Not different	Below	Below	Above
Malta	31.3	Below	Below	Below	Below	Not different	Below	Below
Hungary	30.9	Not different	Below	Below	Below	Below	Below	Below
Chile	30.7	Not different	Below	Below	Not different	Not different	Below	Below
Croatia	30.5	Below	Below	Below	Below	Below	Below	Below
Iceland	30.5	Below	Not different	Below	Not different	Below	Below	Below
Slovenia	30.0	Below	Below	Below	Below	Below	Below	Below
Slovak Republic	29.2	Below	Below	Below	Below	Below	Below	Below
Mexico	29.0	Below	Below	Below	Not different	Above	Below	Below
Serbia	28.7	Below	Not different	Below	Below	Below	Below	Below
Uruguay	28.6	Below	Below	Below	Below	Below	Below	Below
United Arab Emirates	28.4	Below	Below	Below	Below	Below	Below	Below
Qatar	27.7	Below	Below	Not different	Below	Not different	Below	Below
Costa Rica	27.5	Below	Below	Below	Below	Below	Below	Below
Greece	27.0	Below	Below	Below	Below	Below	Below	Below
Romania	26.2	Below	Below	Below	Below	Not different	Below	Below
Colombia	25.6	Below	Below	Below	Below	Below	Below	Below
Jamaica*	25.5	Below	Below	Below	Below	Below	Below	Below

Statistically significantly **above** the OECD average
Not statistically significantly **different** from the OECD average
Statistically significantly **below** the OECD average

	Mean score in creative thinking	Full credit						
		Generate diverse ideas (12 items)	Generate creative ideas (11 items)	Evaluate and improve ideas (9 items)	Written expression (12 items)	Visual expression (4 items)	Social problem solving (10 items)	Scientific problem solving (6 items)
Malaysia	25.1							
Mongolia	24.9							
Moldova	23.9							
Kazakhstan	23.8							
Brunei Darussalam	23.7							
Peru	23.5							
Brazil	23.3							
Saudi Arabia	23.3							
Panama*	23.2							
El Salvador	23.0							
Thailand	20.9							
Bulgaria	20.7							
Jordan	20.2							
North Macedonia	19.1							
Indonesia	19.0							
Dominican Republic**	15.5							
Morocco	15.5							
Uzbekistan	14.5							
Philippines	14.2							
Albania**	13.1							
Chinese Taipei	32.6							
Macao (China)	31.6							
Hong Kong (China)*	31.6							
Ukrainian regions (18 of 27)	26.9							
Baku (Azerbaijan)	22.8							
Palestinian Authority	18.5							

** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Note: Only countries and economies with available data are shown.
Countries and economies are ranked in descending order of the mean performance in creative thinking.
Source: OECD, PISA 2022 Database, Tables III.4.1 and III.B1.4.2. The StatLink URL of this table is available at the end of the chapter.

Box III.4.3. Interpreting differences in success using both percentage correct measures (partial credit and full credit only)

In a few cases, patterns in the success of students (compared to the OECD average) are inverted when considering only full credit responses or when also considering partial credit responses in the measure. In Portugal (generate creative ideas), France (generate creative ideas, evaluate and improve ideas), and Hungary (evaluate and improve ideas), students achieved partial credit more often in a given task subset than on average across OECD countries, but achieved full credit in fewer such tasks than the OECD average (Table III.B1.4.1). This means that students in these countries/economies demonstrated better skills in idea generation (i.e. they suggested appropriate ideas) than most students but not in generating *diverse* or *original* ideas. In general, students who invested a minimum level of effort in a task and who suggested an idea implicitly or explicitly connected to the task stimulus were awarded partial credit.

Contrasting results across percentage correct measures were also observed in some domain contexts (Table III.B1.4.2). For example, in Uruguay, students achieved partial credit in nearly 3 percentage point more items than the OECD average in visual expression tasks but achieved full credit in fewer such tasks than the OECD average. The same pattern was also observed in France in social problem-solving tasks. These patterns can be interpreted in the same way as for the ideation processes: students in these countries/economies demonstrated more success in generating appropriate ideas in these domains but not in generating diverse or original ideas.

Some countries and economies that performed around or below the OECD mean in creative thinking were more successful in certain domains than the OECD average (Table III.4.2). Students in Czechia and Lithuania performed significantly better in written expression tasks than students across OECD countries in general, whereas other countries/economies with similar scores overall (e.g. France, Germany, Israel, the Netherlands* and Spain) performed significantly worse in tasks in the written expression domain. Students in Czechia and Lithuania, as well as Germany, also performed significantly better in visual expression tasks than students in OECD countries, on average – as did students in Mexico despite their overall performance in creative thinking being significantly below the OECD mean. Students in Israel were more successful at applying creative thinking in the social problem-solving domain, along with students in Chinese Taipei, whereas students in France and Czechia were less successful in this domain than on average across OECD countries and economies. Students in Macao (China), Israel, Italy, Spain and Chinese Taipei were also more successful in the scientific problem-solving domain than on average across OECD, unlike other countries who performed around or below the OECD mean.

Relative strengths and weaknesses within countries and economies

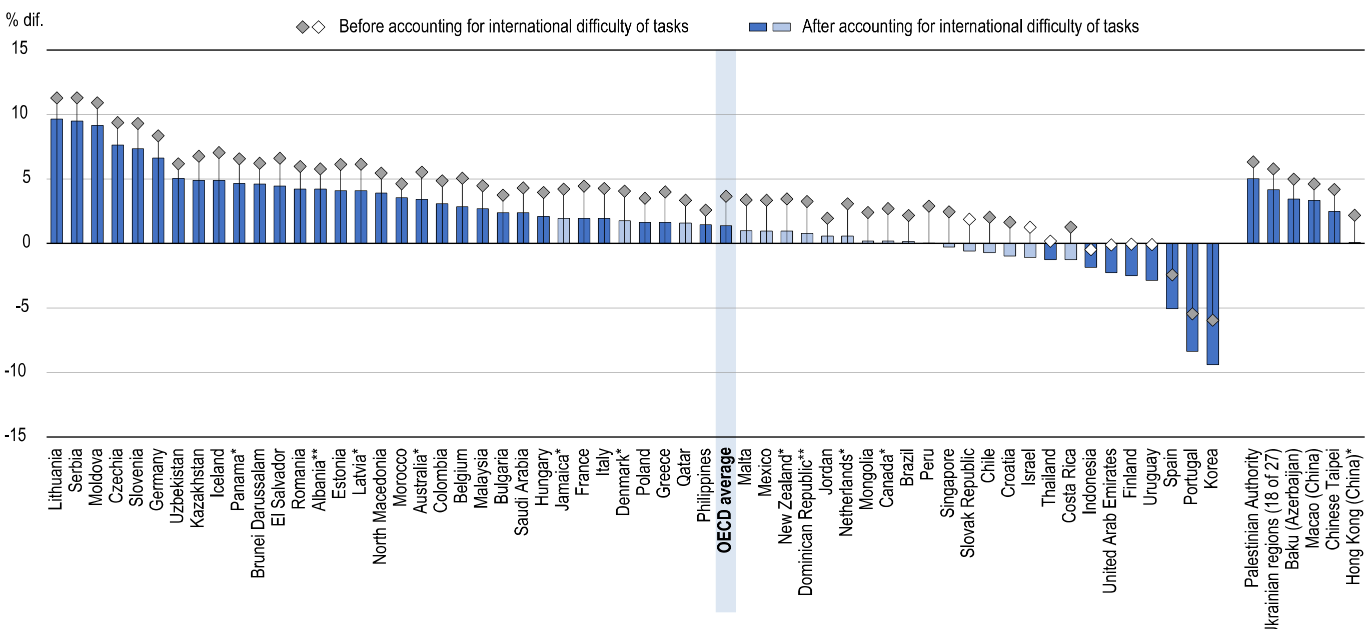
In the PISA 2022 Creative Thinking test, some subsets of items were more difficult than others across countries and economies. How did performance patterns across countries and economies change after accounting for the international difficulty of the items? Within each country/economy, were students more successful in particular tasks compared to their performance on all other tasks? In the two sections that follow on relative strengths and weakness in performance, "relative performance" refers to students' success within a country/economy in a particular subset of tasks compared to their performance on all other tasks in that country/economy. These analyses are useful for making within-country comparisons to identify relative strengths and weaknesses in students' performance. However, when interpreting relative performance results within a country/economy, it is important to keep in mind that country/economy's overall performance in creative thinking.[1]

Relative performance in creative thinking by ideation processes

After accounting for the international difficulty of items across task groupings (i.e. that students were less successful in general in some items than others), students in Lithuania, Serbia and Moldova, in descending order, showed a particular relative strength in "generate creative ideas" tasks, achieving full credit in over 9 percentage point more of these tasks than all other tasks (Figure III.4.4). Students in Czechia, Slovenia and Germany also demonstrated a relative strength in generating creative ideas compared to other countries and economies. Countries with the weakest relative performance in generating creative ideas were Portugal and Korea, achieving full credit in around 8 and 9 percentage point less items targeting this ideation process, respectively, than others. However, both Portugal and Korea performed above the OECD average in creative thinking overall.

Figure III.4.4. Relative performance in "generate creative ideas" tasks

Difference in the average percentage correct (full credit only) between "generate creative ideas" items and all other items



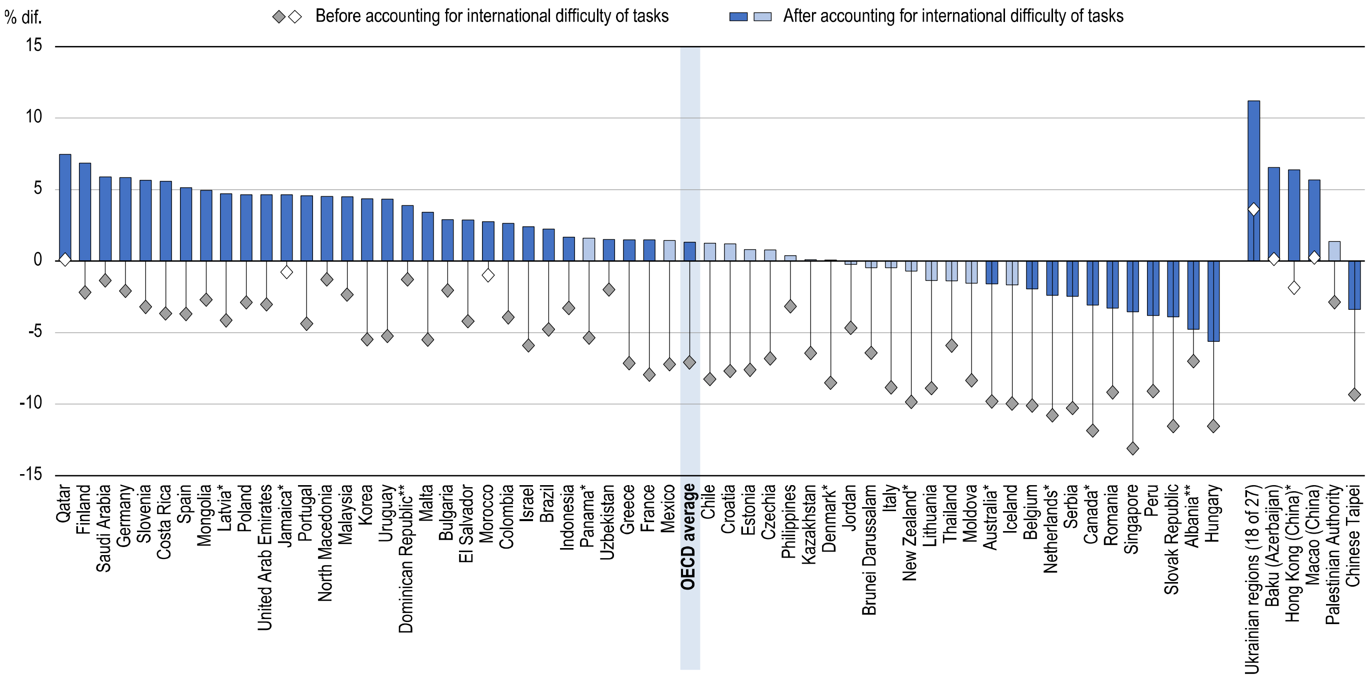
** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown.
Statistically significant differences are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of the relative performance in generate diverse ideas tasks.
Source: OECD, PISA 2022 Database, Table III.B1.4.3. The StatLink URL of this figure is available at the end of the chapter.

For "evaluate and improve ideas" items, students in the Ukrainian regions (18 of 27) demonstrated the strongest relative performance by far – achieving full credit in over 11 percentage point more of these items compared to other types of tasks (and after accounting for the difficulty of the items) (Figure III.4.5). Students in Qatar, Finland, Baku (Azerbaijan) and Hong Kong (China)* also achieved full credit in over 6 percentage point more "evaluate and improve" items than those corresponding to other ideation processes. Students in Albania** and Hungary demonstrated the weakest relative performance in items asking them to iterate on an idea to achieve a creative outcome (achieving full credit in around 5 percentage point less items).

Students in Korea, Portugal, the Slovak Republic and Singapore and Peru (in descending order) demonstrated a moderate to small relative strength in "generate diverse ideas" tasks (achieving full credit in between 3 and just over 5 percentage point more of these items), but many more countries demonstrated a relative weakness in this type of task after accounting for the international difficulty of the items (Figure III.4.6). In Germany, Slovenia and Ukrainian regions (18 of 27) this relative weakness was particularly large, with students achieving full credit on over 11 percentage point less items asking them to generate diverse ideas in different contexts.

Figure III.4.5. Relative performance in "evaluate and improve ideas" tasks

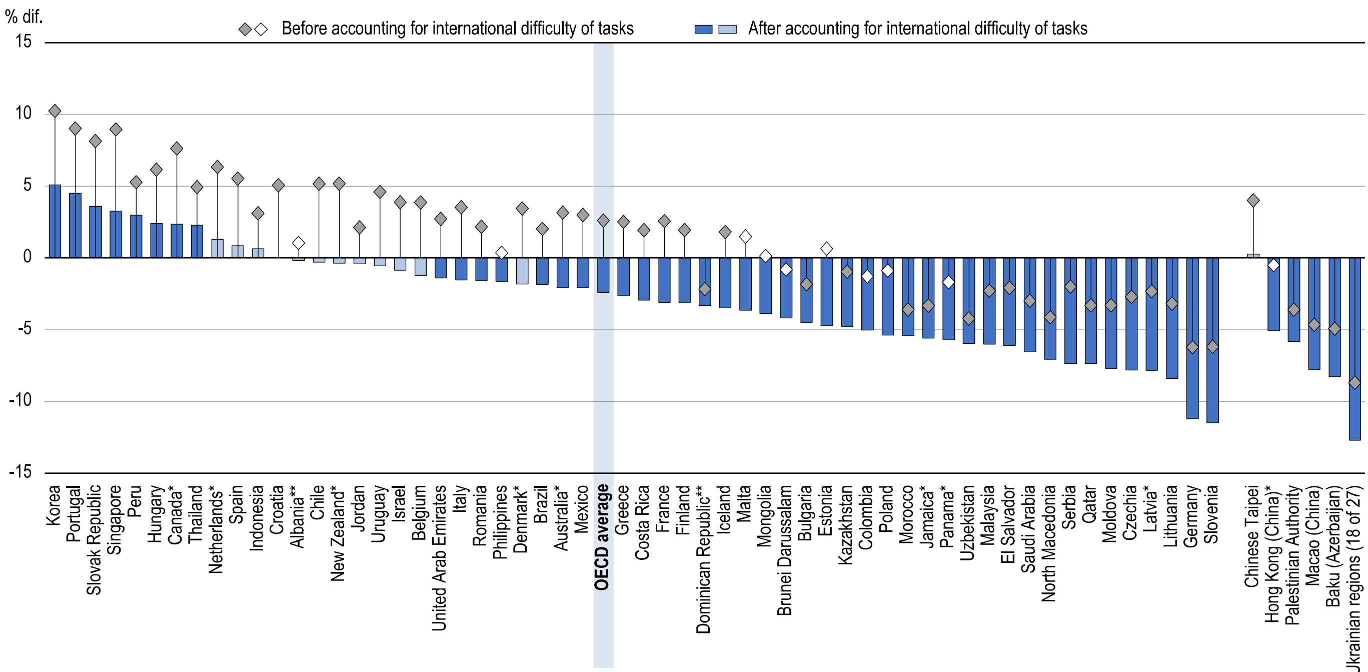
Difference in the average percentage correct (full credit only) between "evaluate and improve ideas" items and all other items



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown. Statistically significant differences are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of the relative performance in generate creative ideas tasks.
Source: OECD, PISA 2022 Database, Table III.B1.4.3. The StatLink URL of this figure is available at the end of the chapter.

Figure III.4.6. Relative performance in “generate diverse ideas” tasks

Difference in the average percentage correct (full credit only) between “generate diverse ideas” items and all other items



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown. Statistically significant differences are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of the relative performance in evaluate and improve ideas tasks.
Source: OECD, PISA 2022 Database, Table III.B1.4.3. The StatLink URL of this figure is available at the end of the chapter.

Relative performance in creative thinking by domain contexts

Relative strengths and weaknesses can also be examined across tasks in different contexts. Situating test items in different domain contexts acknowledges that creative thinking is to some extent facilitated by domain readiness (see Box III.4.4). In some countries and economies, are students relatively more successful in demonstrating creative thinking in problem-solving contexts, for example, than those that require them to express their imagination?

Box III.4.4. Is creativity domain-general or domain-specific? Implications for education

Researchers in the field have long debated whether individuals are creative in everything they do or only in certain domains (i.e. a specific area of knowledge or practice). Early theories and tests of creativity focused on general and enduring attributes believed to influence creative endeavours of all kinds, reflecting the notion that an individual's capacity to be creative in one domain would readily transfer to another (Torrance, 1988[1]). However, researchers now recognise that, to some extent, the internal resources needed to engage in creative work differ by domain (Baer, 2011[2]; Baer and Kaufman, 2005[3]). As such, the PISA 2022 Creative Thinking framework recognises domain readiness as an internal resource that can influence creative thinking performance in the PISA test (OECD, 2023[4]). While defining the boundaries of distinct "domains of creativity" remains an open research question, researchers tend to agree that the capacity to engage creatively in the arts and in maths/scientific domains, respectively, draws upon a different set of internal resources (e.g. knowledge, skills, and attributes) (Runco and Bahleda, 1986[5]; Kaufman and Baer, 2004[6]; Kaufman, 2006[7]; Kaufman, 2012[8]; Kaufman et al., 2010[9]; Kaufman et al., 2015[10]; Chen et al., 2006[11]; Julmi and Scherm, 2016[12])

Embedding creative thinking into the curriculum: Approaches across countries and economies

Creative thought and work draw upon domain-specific knowledge and skills that students may benefit from practicing in the context of specific curricular areas (Vincent-Lancrin et al., 2019[13]). In this sense, if the job of teachers is to design opportunities to integrate creative thinking into the discipline(s) they teach, the job of curriculum designers consists of clearly mapping the opportunities to embed creative thinking across curricular areas – a process that Lucas and Spencer as "split-screen thinking" (2017[14]).

Most jurisdictions acknowledge creative thinking in the curriculum as an interdisciplinary competence…

Virtually all system-level curricula or learning standards reference creative thinking as an educational goal – usually as a cross-cutting theme or competency (70% of PISA-participating systems) or as part of a larger set of transversal competencies, such as critical thinking or social-emotional skills (45% of participating systems) (OECD, 2023[15]). Examples of curriculum reform identifying creative thinking as a desired learning outcome abound: in **Australia**, **Brazil, Canada** and **Iceland**, amongst others, creative thinking (sometimes with critical thinking or entrepreneurship) is seen as one of several competencies that intersect with subjects or learning areas in the curriculum, and in **Singapore**, a "creative and inquiring mind" is one of the desired outcomes of the competence-based curriculum.

… but its practical integration tends to be limited to certain subject areas…

Despite most systems acknowledging developing creative thinkers as a key goal of education, only about half (53%) report that creative thinking is referenced in specific disciplinary contexts within the curriculum ((OECD, 2023[15]). Most often, creativity and creative thinking are targeted within the broader arts subjects (e.g. visual arts, performance arts) (see Figure III.1.1, Chapter 1). In some countries, national Arts Councils (or equivalent bodies) have been tasked with promoting the development of creative thinkers through arts education. For example, in **Sweden**, the Swedish Arts Council has worked with the government since 2008 to run the *Creative Schools* initiative aiming to strengthen the artistic and cultural offerings of schools: since 2013, the initiative has been rolled out to cover all years of compulsory schooling and both state and independent schools. In other Nordic countries, including **Norway** and **Denmark,** reforms have focused on strengthening opportunities for students to engage in practical creative work (see Box II.2.2 in Chapter 2). One concrete way this has been implemented in **Denmark** is by introducing a two-year practical/musical subject as a compulsory element of the curriculum that must be completed with an exam.

Other jurisdictions have focused on strengthening the link between STEM disciplines (science, technology, engineering and mathematics) and arts education – the so-called STEAM approach. In **Ireland**, various initiatives targeting design, creativity and innovation skills are underway: for instance, the *Sc!ence Blast* initiative encourages students to think, create, design, explore and learn new skills by partnering organisations with primary school classrooms and asking them to investigate a question they are curious about, ending with presenting their findings to a STEM judge (*móltóir*) who provides students with constructive feedback.[2] In **Korea**, STEAM education is led by the Korea Foundation for the Advancement of Science and Creativity, a quasi-governmental organisation in charge of science and ICT that aims to foster creative technical talents.

… or to subject-independent modules or initiatives

Some countries integrated opportunities to develop creative thinking in their curriculum by introducing dedicated interdisciplinary or "subject-free" modules. The national curriculum introduced in **Finland** in 2014 has required Finnish schools to teach at least one inter-disciplinary module a year. This simple strategy both requires and enables teachers to work in ways likely to foster creativity, as creative thinking invites teachers and their students to look across disciplines (West, 2016[16]). This strategy can optimise instruction time and content coverage by emphasising connections across knowledge domains, because in interdisciplinary learning, the content and skills that learners practice are defined by the questions or themes that they work on rather than a strict separation of disciplines or subjects. Greater interdisciplinarity allows for the articulation of pedagogy around more contextualised and authentic problems, providing opportunities for less fragmented and more meaningful learning experiences for students as well as increasing educators' professional learning and accountability through collaborative planning and teaching (OECD, 2013[17]).

In **Singapore**, an elective course in secondary education, the *Applied Learning Programme*, emphasises interdisciplinary learning and provides opportunities for students to develop creative thinking by generating relatively novel and appropriate ideas or products in authentic society and industry settings. The programme can also be applied to more specific thematic areas (e.g. STEM, language). An alternative course, the *Learning for Life Programme*, provides opportunities for students to creatively design activities and programmes (among other outputs) for the benefit of their communities.[3]

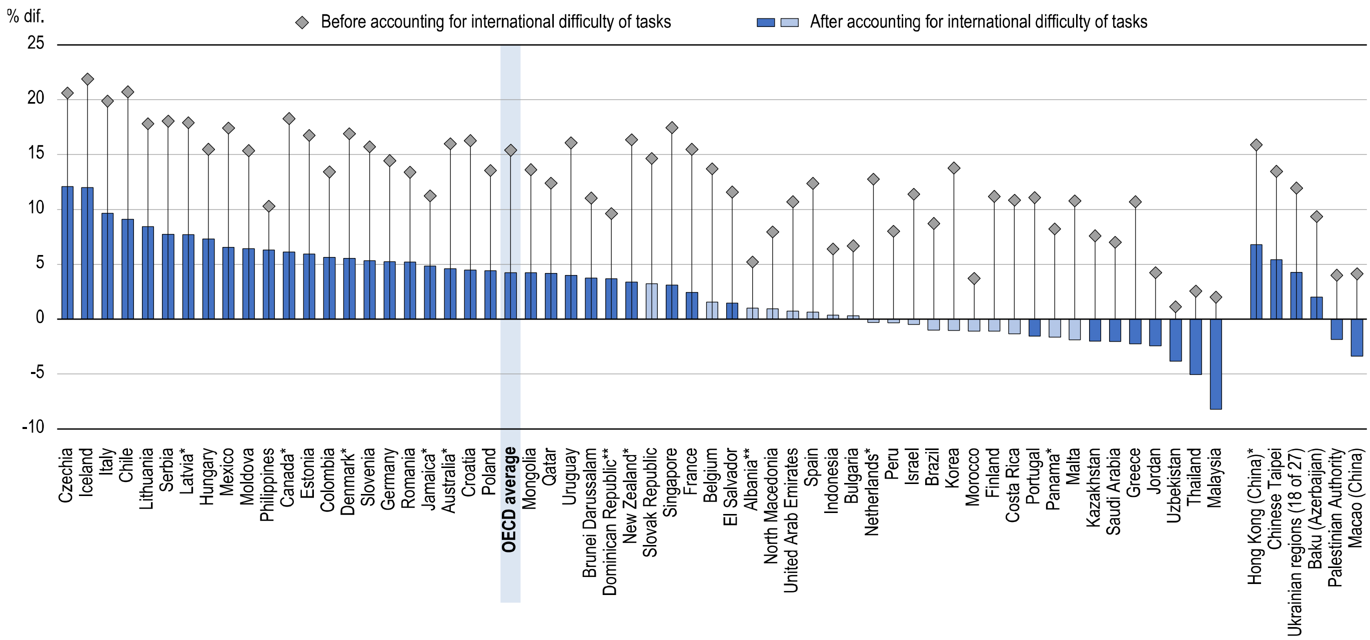
Finally in **Ireland**, to combat the potentially negative pressures of standardised assessment regimes on creative thinking in schools, students can opt to undertake a "transition year" that bridges the country's junior and senior education cycles. The one-year programme allows students to focus on their personal, social and vocational development in the extended absence of examination pressures. Approximately 75% of schools in the country offered the programme in 2022.[4] As part of their transition year, students can participate in different initiatives, such as *The B!G iDEA*, which aims to put creative thinking at the centre of Ireland's secondary education system through experiential learning and mentorship. Supported by the broader *Creative Ireland* programme and industry partners, the B!G iDEA is a 15-week, practically-oriented programme developed to empower students to use their creativity to tackle society's biggest challenges.

Source: OECD (2023[15]), *Supporting Students to Think Creatively: What Education Policy Can Do* and Bill Lucas (2022[18]), *Creative thinking in schools across the world: A snapshot of progress in 2022*.

Prior to accounting for the difficulty of tasks, students in nearly all countries and economies demonstrated a considerable relative strength in written expression tasks (Table III.B1.4.4) – largely since students, on average, were most successful, in written expression tasks. Even after accounting for the difficultly of the items, the relative success of students in this domain remains positive and significant in over half of all countries/economies (Figure III.4.7). In descending order, students in Czechia and Iceland (12 percentage points difference), Italy (around 10 percentage points) and Lithuania (over 8 percentage points) demonstrated the greatest relative performance in written expression items compared to tasks in other domains. After accounting for the (lack of) difficulty of tasks in this domain, the countries with the weakest relative performance in written expression by some margin were Malaysia (more than 8 percentage points difference) and Thailand (5 percentage points difference).

Figure III.4.7. Relative performance in written expression tasks

Difference in the average percentage correct (full credit only) between items in the written expression domain and all other items

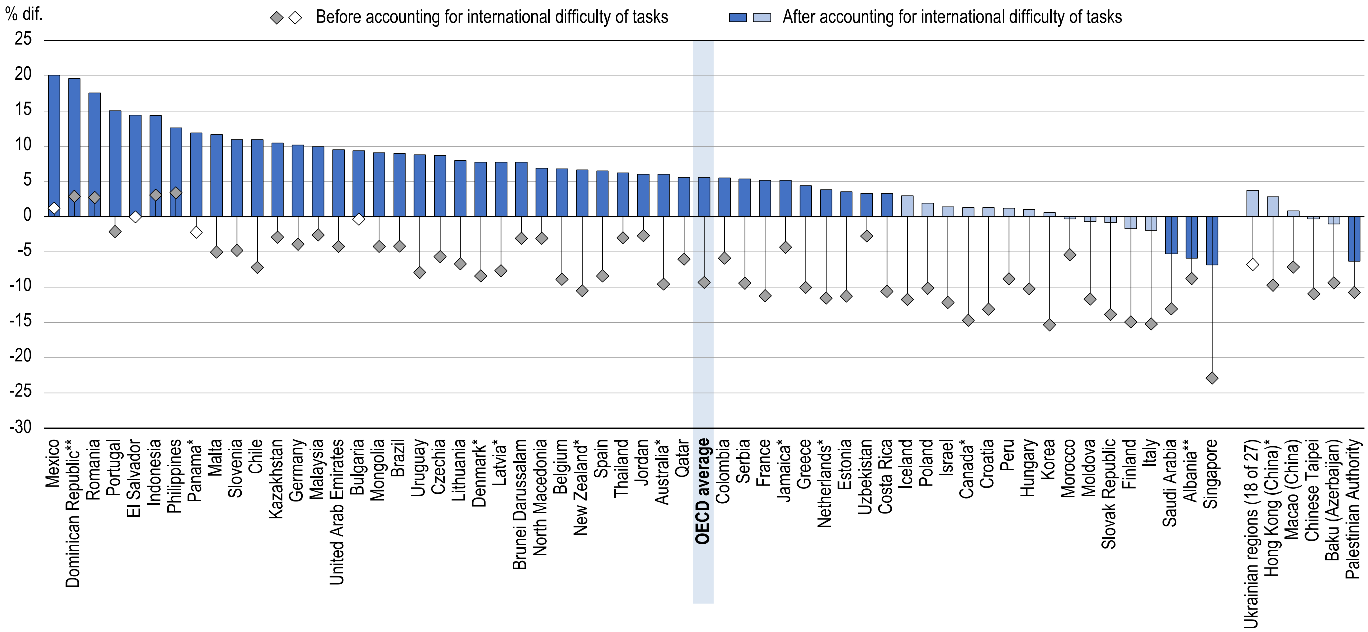


** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown.
Statistically significant differences are shown in a darker tone (see Annex A3).
All percentage differences before accounting for international difficulty of tasks are statistically significant.
Countries and economies are ranked in descending order of the relative performance in tasks in the written expression.
Source: OECD, PISA 2022 Database, Table III.B1.4.4. The StatLink URL of this figure is available at the end of the chapter.

Students performed the strongest in the visual domain relative to their performance in other tasks on average across the OECD (after accounting for the difficulty of items). In 13 countries and economies this relative strength is large (a difference in success of 10 percentage points or more), and in Mexico, the Dominican Republic** and Romania, this relative performance difference was extremely large (a difference of between 17 and 20 percentage points) (Figure III.4.8). Countries with a relative strength in visual expression tasks include high-performing systems (e.g. Portugal) and very low-performing systems (e.g. the Dominican Republic**, Indonesia, the Philippines), as well as those that perform around or just below the OECD average (e.g. Chile, Germany, Malta). Similarly, students in both high-performing countries (e.g. Singapore) and low-performing countries (e.g. Albania**, the Palestinian Authority, Saudi Arabia) demonstrated the greatest overall weaknesses in visual expression tasks relative to their performance in tasks in the other domain contexts and compared to other countries/economies.

Figure III.4.8. Relative performance in visual expression tasks

Difference in the average percentage correct (full credit only) between items in the visual expression domain and all other items

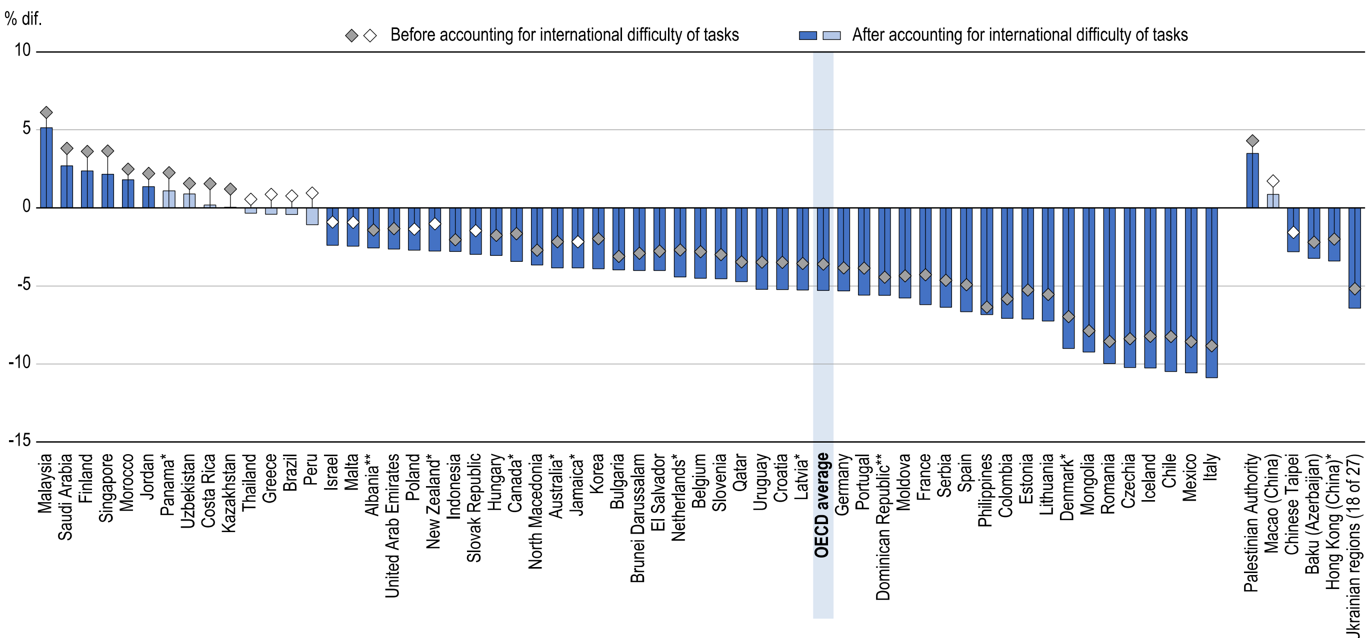


** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown.
Statistically significant differences are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of the relative performance in tasks in the visual expression.
Source: OECD, PISA 2022 Database, Table III.B1.4.4. The StatLink URL of this figure is available at the end of the chapter.

On average across OECD countries, students showed a moderate relative weakness in social problem solving (a difference in success of around -4 percentage points), with several countries/economies demonstrating larger relative weaknesses in this domain after accounting for the difficulty of the items (Figure III.4.9). Students in Italy, Mexico, Chile, Iceland and Czechia (in descending order) were all less successful in applying creative thinking to social problem-solving tasks than tasks across the other domains by around -10 to -11 percentage points. Only students in Malaysia were successful in 5 percentage points more items in social problem-solving than items across all the other domains, on average.

Figure III.4.9. Relative performance in social problem-solving tasks

Difference in the average percentage correct (full credit only) between items in the social problem-solving domain and all other items



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown.

Statistically significant differences are shown in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the relative performance in tasks in the social problem solving.

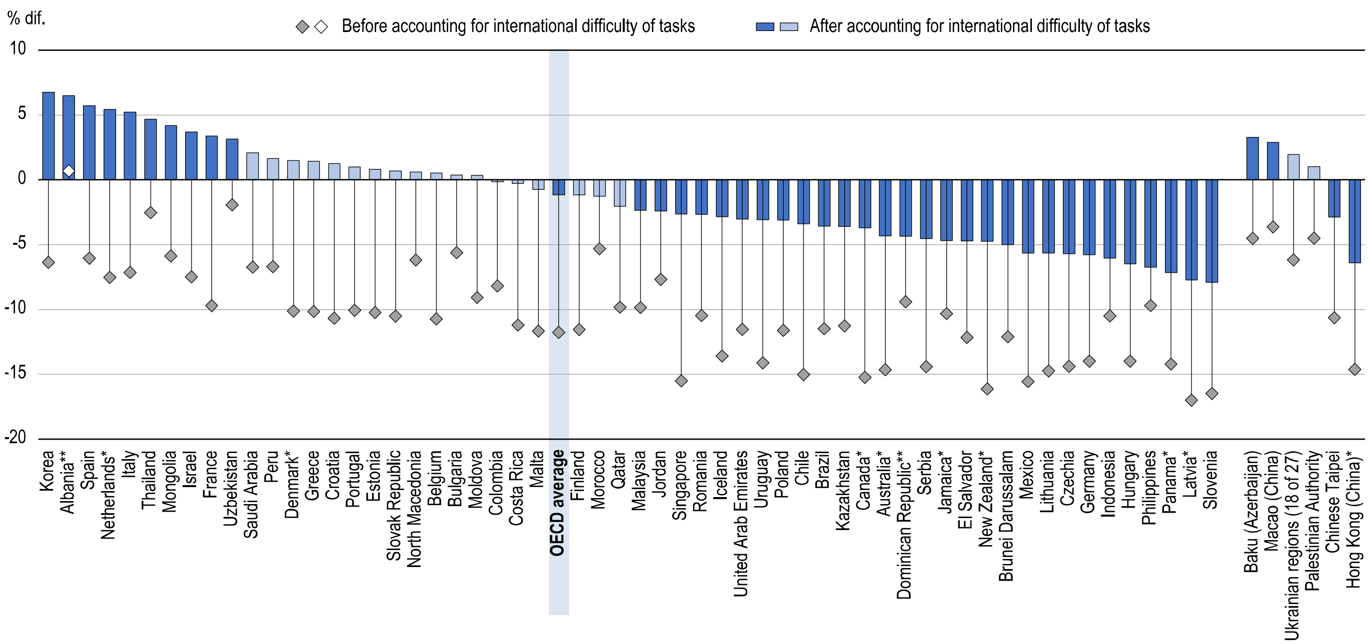
Source: OECD, PISA 2022 Database, Table III.B1.4.4. The StatLink URL of this figure is available at the end of the chapter.

In Korea, Albania**, Spain, the Netherlands* and Italy (in descending order), students demonstrated a moderate relative strength in scientific problem-solving contexts after accounting for the relative difficulty of the tasks, achieving full credit in between 5 and 7 percentage point more items in this domain context compared to tasks across all others (Figure III.4.10). However, in general, like relative performance in social problem-solving tasks, students across OECD countries and economies exhibited a relative weakness in applying creative thinking to scientific problem-solving contexts. Students in Slovenia, Latvia* and Panama* demonstrated the weakest relative performance in scientific problem-solving tasks across countries and economies (a difference of between -7 and -8 percentage points).

In general, within-country strengths and weaknesses tend to converge around the more expressive and imaginative tasks, on the one hand, and the more functional problem-solving tasks on the other hand. On average across OECD countries, students performed relatively better in tasks in the written and visual expression domains, and relatively weaker in the two problem-solving domains. This might be expected, given that appropriate, diverse, and original ideas in problem-solving contexts are somewhat more constrained by practical considerations.

Figure III.4.10. Relative performance in scientific problem-solving tasks

Difference in the average percentage correct (full credit only) between items in the social problem-solving domain and all other items



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown.
Statistically significant differences are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of the relative performance in tasks in the scientific problem solving.
Source: OECD, PISA 2022 Database, Table III.B1.4.4. The StatLink URL of this figure is available at the end of the chapter.

Strengths and weaknesses across task types by gender

In Chapter 3, large differences in creative thinking performance were observed between boys and girls in most countries and economies. Are similar gender differences observed across different subsets of items? Table III.4.3 shows that, in nearly all countries and economies, girls performed equally to or outperformed boys, on average, in tasks in all domains and in all ideation processes. In other words, gender differences in performance in favour of girls persist across different groupings of tasks. The only exception is in Mexico, where boys were more successful in scientific problem-solving tasks than girls. In Finland – the country with the largest gender gap in performance overall – girls performed much better than boys in nearly every subset of items. Here, “much better” is defined as a difference of at least 10 percentage points in the success of boys and girls in a given task subset.

Table III.4.3. Gender differences in performance by ideation processes and domain contexts

Differences in the average percentage correct (full credit responses) by task grouping (ideation processes and domain contexts)

- Girls perform much better than boys
- Girls perform better than boys
- No gender differences
- Boys perform better than girls
- Boys perform much better than girls

	All items (32 items)	Full credit: Generate diverse ideas (12 items)	Full credit: Generate creative ideas (11 items)	Full credit: Evaluate and improve ideas (9 items)	Full credit: Written expression (12 items)	Full credit: Visual expression (4 items)	Full credit: Social problem solving (10 items)	Full credit: Scientific problem solving (6 items)
Mexico	-0.5	No gender differences	No gender differences	No gender differences	No gender differences	No gender differences	No gender differences	Boys perform better than girls
Chile	-1.4	No gender differences	No gender differences	Girls perform better than boys	No gender differences	Girls perform better than boys	No gender differences	No gender differences
Indonesia	-1.5	No gender differences	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences	No gender differences
Peru	-1.5	No gender differences	No gender differences	Girls perform better than boys	No gender differences	No gender differences	Girls perform better than boys	No gender differences
Uzbekistan	-1.8	No gender differences	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	Girls perform better than boys	No gender differences
Colombia	-2.0	No gender differences	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences	No gender differences
Dominican Republic**	-2.1	No gender differences	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences	No gender differences
Albania**	-2.2	Girls perform better than boys	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Uruguay	-2.2	Girls perform better than boys	No gender differences	No gender differences	Girls perform better than boys	No gender differences	No gender differences	No gender differences
Costa Rica	-2.3	Girls perform better than boys	No gender differences	No gender differences	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences
El Salvador	-2.4	No gender differences	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences	No gender differences
Panama*	-2.5	No gender differences	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Italy	-2.7	No gender differences	No gender differences	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Thailand	-3.0	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	Girls perform better than boys	No gender differences
Singapore	-3.2	No gender differences	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Morocco	-3.2	No gender differences	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences	Girls perform better than boys	No gender differences
Brazil	-3.3	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Spain	-3.6	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences
France	-3.6	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Belgium	-3.7	Girls perform better than boys	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Portugal	-3.8	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences
Kazakhstan	-4.0	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences
Romania	-4.1	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform much better than boys	No gender differences	No gender differences
Hungary	-4.3	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences
North Macedonia	-4.3	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Netherlands*	-4.5	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences
Australia*	-4.5	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences
Moldova	-4.6	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences
Greece	-4.6	Girls perform better than boys	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences
Philippines	-4.6	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys
Malaysia	-4.7	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys
Israel	-4.8	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform much better than boys	No gender differences	No gender differences
Slovak Republic	-4.9	Girls perform better than boys	No gender differences	Girls perform better than boys	Girls perform better than boys	No gender differences	No gender differences	No gender differences
Serbia	-4.9	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences
Czechia	-4.9	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	Girls perform better than boys	No gender differences

- Girls perform much better than boys
- Girls perform better than boys
- No gender differences
- Boys perform better than girls
- Boys perform much better than girls

	All items (32 items)	Full credit: Generate diverse ideas (12 items)	Full credit: Generate creative ideas (11 items)	Full credit: Evaluate and improve ideas (9 items)	Full credit: Written expression (12 items)	Full credit: Visual expression (4 items)	Full credit: Social problem solving (10 items)	Full credit: Scientific problem solving (6 items)
Poland	-4.9	Girls better	Girls better	Girls better	Girls better	Girls better	No difference	No difference
Croatia	-5.0	Girls better	Girls better	Girls better	Girls better	No difference	Girls better	Girls better
Brunei Darussalam	-5.0	Girls better	Girls better	Girls better	Girls better	Girls better	No difference	No difference
OECD average	-5.0	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better
Canada*	-5.2	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Mongolia	-5.3	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Germany	-5.4	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Korea	-5.4	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Bulgaria	-6.0	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better
New Zealand*	-6.1	Girls better	Girls better	Girls better	Girls better	No difference	Girls better	No difference
Lithuania	-6.2	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Latvia*	-6.7	Girls better	Girls better	Girls better	Girls better	Girls much better	Girls better	No difference
Saudi Arabia	-6.8	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better
Slovenia	-6.9	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Denmark*	-7.3	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better
Estonia	-7.4	Girls better	Girls better	Girls better	Girls better	Girls much better	Girls better	No difference
United Arab Emirates	-7.7	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better
Malta	-7.8	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Jamaica*	-7.8	Girls better	Girls better	Girls better	Girls better	Girls better	No difference	No difference
Jordan	-8.5	Girls better	Girls better	Girls better	Girls much better	Girls better	Girls better	Girls better
Qatar	-8.6	Girls better	Girls better	Girls better	Girls much better	Girls better	Girls better	Girls better
Iceland	-9.5	Girls much better	Girls better	Girls better	Girls much better	Girls much better	Girls better	Girls better
Finland	-13.2	Girls much better	Girls much better	Girls much better	Girls much better	Girls better	Girls much better	Girls better
Ukrainian regions (18 of 27)	-3.1	No difference	Girls better	Girls better	Girls better	Girls better	No difference	No difference
Macao (China)	-5.5	Girls better	Girls better	Girls better	Girls better	No difference	Girls better	No difference
Chinese Taipei	-6.0	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Baku (Azerbaijan)	-6.2	Girls better	Girls better	Girls better	Girls better	Girls better	Girls better	No difference
Hong Kong (China)*	-6.4	Girls better	Girls better	Girls better	Girls better	Girls much better	Girls better	No difference
Palestinian Authority	-7.3	Girls better	Girls better	Girls better	Girls better	No difference	Girls better	Girls better

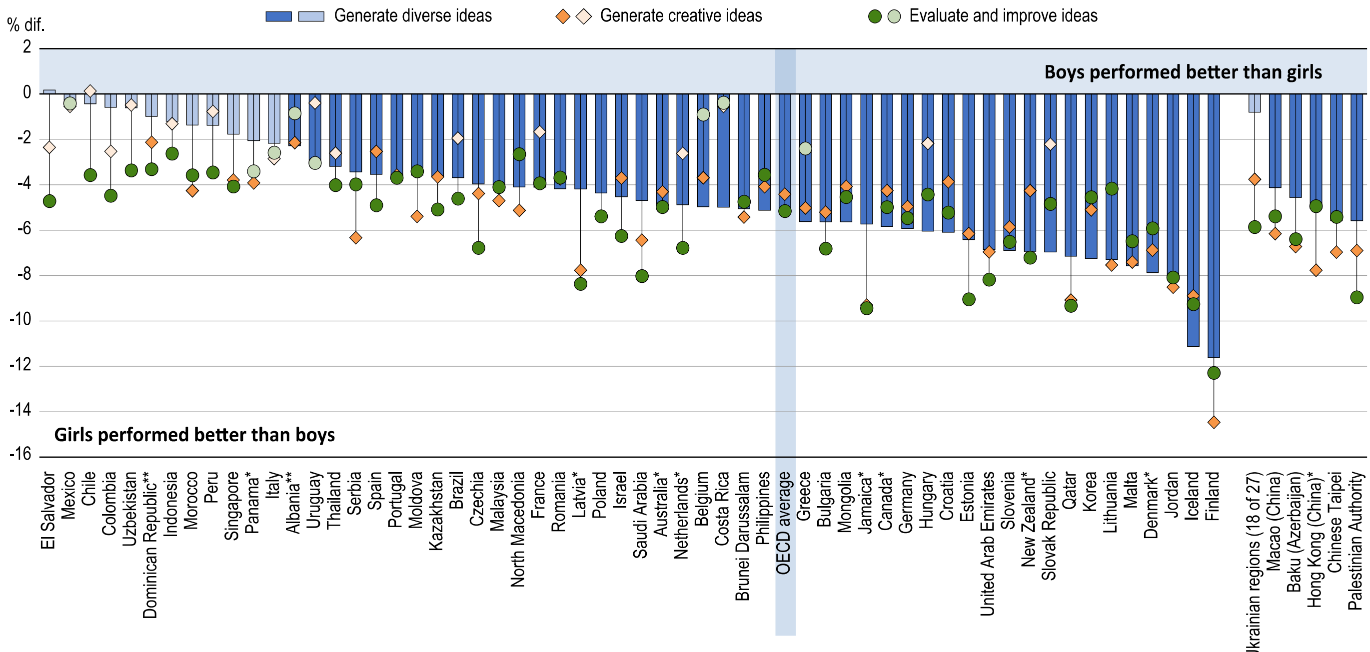
** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Note: Only countries and economies with available data are shown. *Countries and economies are ranked in descending order of the mean performance in creative thinking.*
Source: OECD, PISA 2022 Database, Tables III.B1.4.5 and III.B1.4.6. The StatLink URL of this figure is available at the end of the chapter.

Gender differences in success by ideation process

While boys were less successful than girls across all task types, girls had the greatest success compared to boys in tasks requiring them to build on others' ideas to reach a creative solution or outcome ("evaluate and improve ideas" items). In all but eight countries and economies, girls outperformed boys in these tasks (Figure III.4.11). In only a few countries/economies were gender differences in success smaller for "evaluate and improve ideas" items than for the other two ideation processes. Girls also had a bigger advantage over boys in "generate diverse ideas" items, in general, compared to their advantage in "generate creative ideas" items. In Finland and Iceland, girls were much better at generating diverse ideas than boys. Overall, across countries and economies, girls were the most successful compared to boys in the two ideation processes in which students were least successful at the international level ("evaluate and improve ideas" items and "generate diverse ideas" items).

Figure III.4.11. Gender differences in success across ideation processes

Average percentage correct (full credit responses)



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. Statistically significant differences are shown in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the success in generate diverse ideas tasks related to gender (boys minus girls).

Source: OECD, PISA 2022 Database, Table III.B1.4.5. The StatLink URL of this figure is available at the end of the chapter.

Gender differences in performance remain significant across tasks in all the three ideation processes after accounting for the performance of boys and girls in the core PISA domains. On average across OECD countries, the difference in the success of boys and girls after accounting for mathematics and reading performance lies between 4 and 5.5 percentage points in the three task groupings. Girls are considerably more successful in "generate creative ideas" tasks in Finland (a difference of 12 percentage points) as well as in Hong Kong (China)*, Latvia* and Macao (China) (around 8 percentage points) after accounting for mathematics and reading performance (Table III.B1.4.7). Similarly, girls had a large performance advantage after accounting for mathematics and reading in "evaluate and improve ideas" tasks in the Ukrainian regions (18 of 27) (around 14 percentage points) and Finland and Jamaica* (over 10 percentage points). Gender differences in "generate diverse ideas" tasks also remain significant on average across OECD countries (around 5.5 percentage points), but in 19 countries/economies, there are no significant differences between boys and girls in these tasks after accounting for mathematics and reading performance.

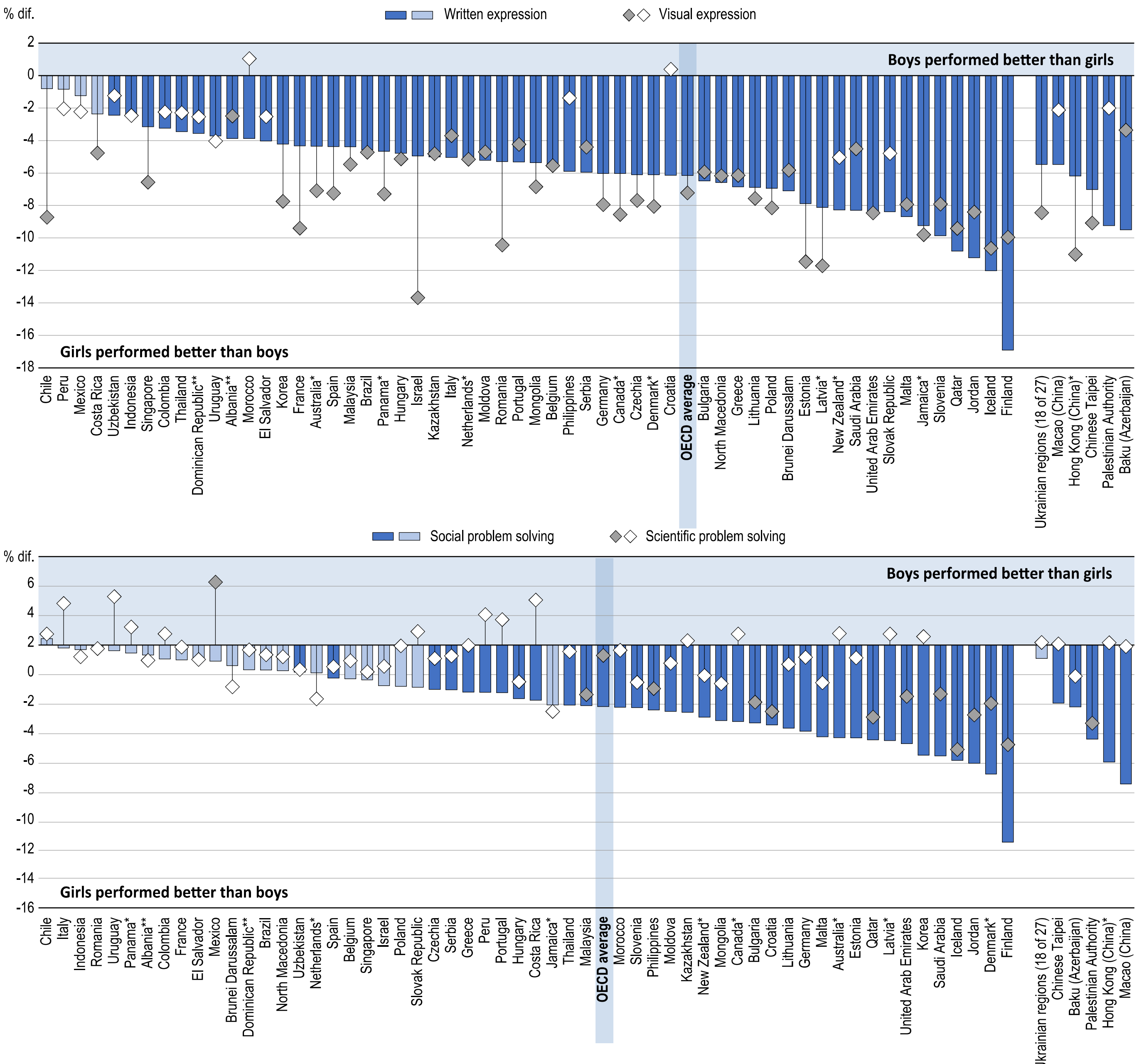
Gender differences in success by domain context

Performance patterns by gender across domain contexts are more nuanced than by ideation process – in part driven by gender differences in engagement with the test (see Box III.4.5). Girls had the biggest performance advantage in the written expression domain: in only four countries and economies – Chile, Costa Rica, Mexico and Peru – are there no significant differences between the performance of boys and girls in these tasks. Girls in Finland, Iceland, Jordan and Qatar (in descending order) performed much better than boys, achieving full credit in over 10 percentage point more tasks in this domain (rising to a difference of nearly 17 percentage points in Finland) (Figure III.4.12). Even when comparing students with similar mathematics and reading scores, gender differences remain quite large in written expression tasks, on average across OECD countries (over 6 percentage points), and girls in Finland and Iceland still achieve full credit in over 10 percentage point more tasks than boys in this domain (Table III.B1.4.8).

In the visual expression domain, girls also outperformed boys in most countries and economies, and performed much better than boys (achieving full credit in over 10 percentage point more items) in Israel, Latvia*, Estonia, Hong Kong (China)*, Iceland and Romania (in descending order) (Figure III.4.12). In Chile, girls were successful in nearly 9 percentage point more tasks in the visual expression domain despite gender differences being insignificant in all domains groupings. In Croatia, the Palestinian Authority and the Philippines, the opposite was true: there were no significant differences in the success of boys and girls in the visual domain despite girls outperforming boys on all other task context groupings. On average across OECD countries, gender differences in visual expression tasks remain significant and large after accounting for mathematics and reading performance (7 percentage points) (Table III.B1.4.8).

Figure III.4.12. Gender differences in success across domain contexts

Average percentage correct (full credit responses)



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. Statistically significant differences are shown in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the success in written expression and social problem-solving items tasks related to gender (boys minus girls).

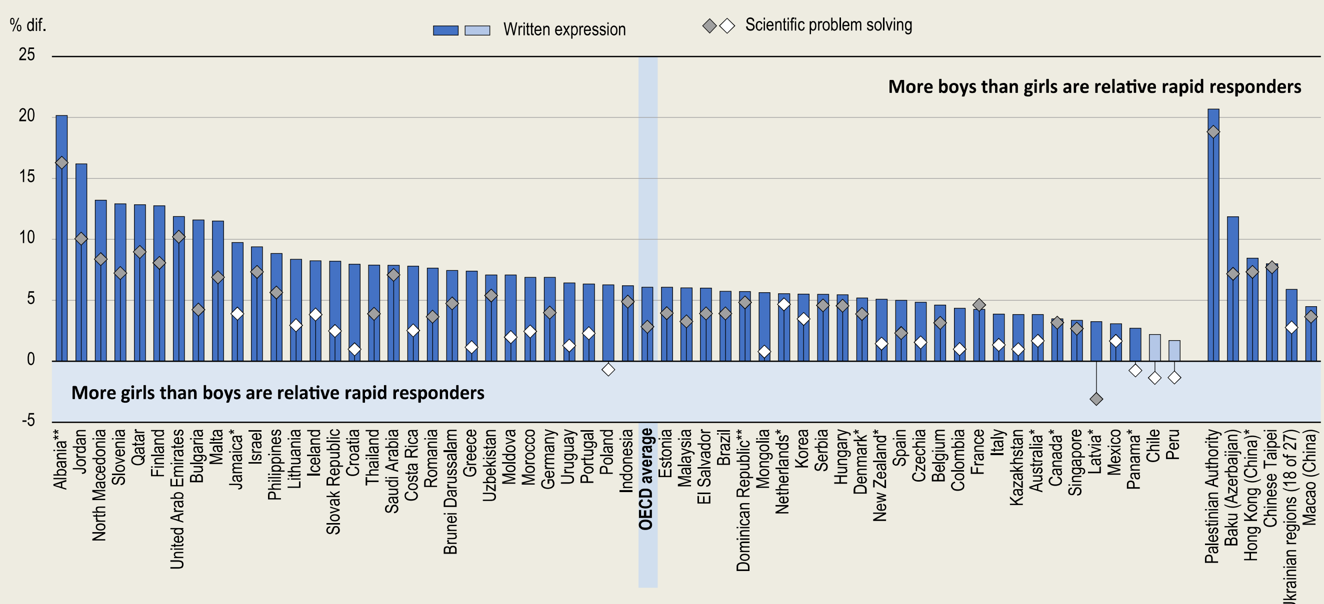
Source: OECD, PISA 2022 Database, Table III.B1.4.6. The StatLink URL of this figure is available at the end of the chapter.

Significant gender differences were observed less frequently in the problem-solving domains than the creative expression domains, although girls still significantly outperformed boys in social problem-solving tasks in just under two-thirds of all countries and economies (Figure III.4.12). Girls were considerably more successful in social problem-solving tasks in Finland (a difference of 13 percentage points), Denmark* and Macao (China) (around 9 percentage points), and Jordan, Hong Kong (China)* Iceland and Saudi Arabia (8 percentage points). In Peru, social problem solving was the only domain context in which girls significantly outperformed boys in creative thinking (by 3 percentage points). In some countries/economies, in particular in Finland and Macao (China), gender differences in success are above 10 percentage points even after accounting for mathematics and reading performance (Table III.B1.4.8). In contrast to the other three domain contexts, girls significantly outperformed boys in scientific problem-solving contexts in only 13 countries and economies – and performed significantly worse than boys in Mexico in these tasks. After accounting for mathematics and reading performance, girls outperformed boys in only 9 countries/economies and achieved full credit in only 2 percentage point more items than boys (Table III.B1.4.8).

Box III.4.5. Differences between boys and girls in engagement with tasks across domain contexts

Gender differences in engagement across tasks in the four domain contexts of creative thinking mirror gender differences in engagement with the test overall – that is, boys show more disengaged behaviours in all types of tasks. Figure III.4.13 shows that the difference between boys and girls in relatively rapid responses is greater in the written domain (around 6 percentage points) and similar in the other domains (between 3 and 4 percentage points). Gender differences in this indicator of disengagement are the largest (over 10 percentage points) in Albania**, Jordan, the Palestinian Authority, Qatar and the United Arab Emirates.

Figure III.4.13. Gender differences in task disengagement across domain contexts



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).
Notes: Only countries and economies with available data are shown.
Relative rapid responders" refers to students in the bottom quarter of time spent on task (i.e. those in the bottom 25% of the time-on-task distribution)
Countries and economies are ranked in ascending order of the percentage of relative rapid responders in written expression.
Source: OECD, PISA 2022 Database, Table III.A6.6. The StatLink URL of this figure is available at the end of the chapter.

During adolescence, gender differences in attitudes towards school and learning become more evident (OECD, 2015[19]). Research suggests that these attitudes are related to how girls and boys have absorbed society's notions of "masculine" and "feminine" behaviour. Social pressures, together with possible gender differences in general personality traits like conscientiousness (Costa, Terracciano and McCrae, 2001[20]), might drive differences in the effort girls and boys exert on the PISA test as a whole and across different types of tasks.

Expectancy value theory (Eccles and Wigfield, 2002[21]) might provide another hypothesis: the theory posits that students are more likely to pursue an activity if they expect to do well and if they value the activity. Task value can be broken into four components: *attainment value* (i.e. importance of doing well), *intrinsic value* (i.e. personal enjoyment), *utility value* (i.e. perceived usefulness for future goals), and *cost* (i.e. competition with other goals). It is possible that societal notions or pressures influence boys and girls to perceive the potential value of certain activities differently and thus influence their levels of engagement in different domains. Differences in performance across student groups are likely to reflect all these drivers of engagement, that are in turn influenced by cultural values and peer pressures.

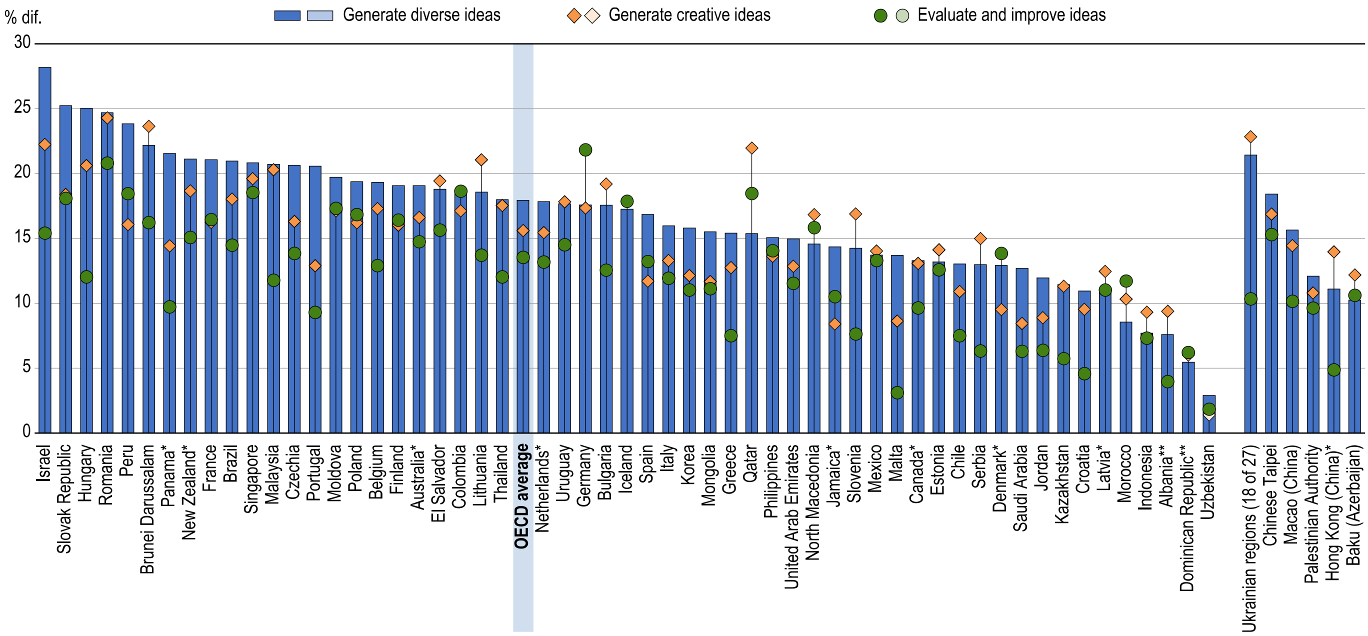
Strengths and weaknesses across task types by socio-economic background

In the same way that performance differences across subsets of items can be examined by gender, differences can also be observed between students from advantaged and disadvantaged backgrounds (i.e. students in the top quarter and the bottom quarter of the PISA index of ESCS). Chapter 3 established that advantaged students across all countries and economies significantly outperformed disadvantaged students in the creative thinking test. Does this association hold true across all subsets of items? In general, advantaged students maintain a large performance advantage over their disadvantaged peers across all task groupings (Table III.B1.4.9 and Table III.B1.4.10). Given the strength of the relationship between socio-economic background and creative thinking performance overall, this result is not surprising – however, interesting differences in patterns of success by task grouping can be observed across countries and economies.

Differences in success of advantaged and disadvantaged students by ideation process

Advantaged students had the largest difference in success compared to disadvantaged students in “generate diverse ideas” items (19 percentage points on average across OECD countries) and the smallest in “evaluate and improve ideas” tasks (close to 15 percentage points difference) (Figure III.4.14). Advantaged students performed significantly better in every country/economy in “generate diverse ideas” items, and considerably so in Israel, the Slovak Republic, Hungary and Romania (in descending order, achieving full credit in around 25 percentage points or more items) compared to other countries/economies. While performance differences between advantaged and disadvantaged students were significant and, in most cases, large across countries and economies in “generate creative ideas” items, disadvantaged students performed relatively closer to their advantaged peers in Denmark, Jamaica* and Spain in these tasks than in other types of tasks (unlike students in other countries). In Croatia, Hong Kong (China)*, Malta and Uzbekistan, differences in the performance of advantaged and disadvantaged students were non-significant in “evaluate and improve ideas” tasks (and “generate creative ideas” tasks in Uzbekistan). It may be that the additional constraints inherent to “evaluate and improve ideas” items (where students must build on an already-provided idea) weaken some of the performance differences otherwise observed between advantaged and disadvantaged students in task types that are more open and, perhaps, influenced by students’ prior knowledge and experiences (see Box III.4.6).

Figure III.4.14. Differences in success across ideation processes related to students' socio-economic status



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. Statistically significant differences are shown in a darker tone (see Annex A3).

The socio-economic status of students is measured by the PISA index of economic, social and cultural status.

Countries and economies are ranked in descending order of the success in generate diverse ideas tasks related to socio-economic status (advantaged minus disadvantaged students).

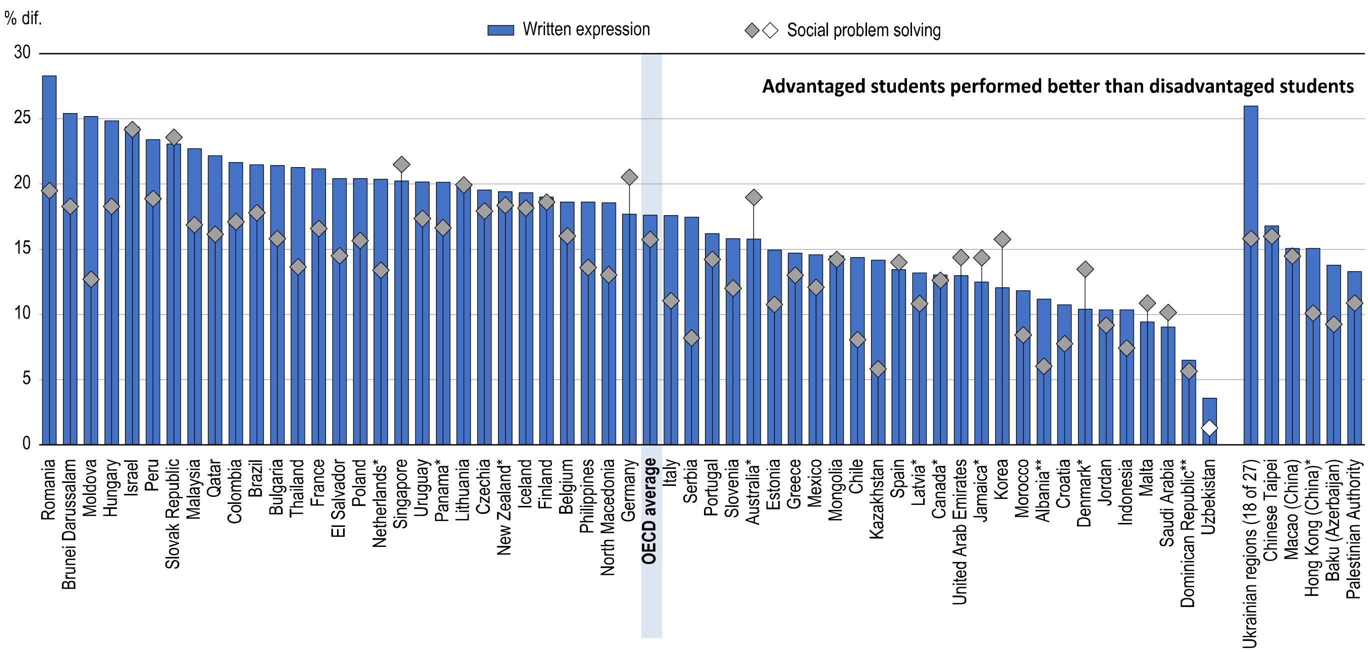
Source: OECD, PISA 2022 Database, Table III.B1.4.9. The StatLink URL of this figure is available at the end of the chapter.

Differences in task success between students with different socio-economic backgrounds generally remain significant after accounting for mathematics and reading scores – albeit the magnitude of difference is largely reduced. On average across OECD countries, advantaged students achieved full credit in around 6 percentage point more "generate diverse ideas" tasks than their disadvantaged peers, after accounting for mathematics and reading performance, and around 4 percentage point more "generate creative ideas" and "evaluate and improve ideas" tasks respectively (Table III.B1.4.11). However, in Peru and Panama*, disadvantaged students were still less successful in two of the three ideation processes by over 10 percentage points compared to their advantaged peers after accounting for mathematics and reading performance. Disadvantaged students were less successful by a similar margin in Israel and New Zealand* in "generate diverse ideas" tasks, in El Salvador, Lithuania, Macao (China), Qatar, Romania and the Ukrainian regions (18 of 27) in "generate creative ideas" tasks) and in Germany in "evaluate and improve ideas" tasks.

Differences in success of advantaged and disadvantaged students by domain context

What about differences in success between advantaged and disadvantaged students across domain contexts? The association between socio-economic advantage and task success is strongest in written expression tasks, in general, and weakest in visual expression tasks (Table III.B1.4.10). In over one-third of all countries and economies, the performance gap between advantaged and disadvantaged students in written expression tasks is very large at over 20 percentage points, and in Romania, the Ukrainian regions (18 of 27), Brunei Darussalam, Moldova and Hungary (in descending order), this difference is around 25 percentage points or more (Figure III.4.15). These considerable differences especially in the written domain may be influenced, in part, by the likely greater cultural wealth of advantaged students (e.g. more books at home) as well as their overall stronger proficiency in basic literacies. After accounting for the mathematics and reading performance of students, differences in success between advantaged and disadvantaged students remain significant but much smaller across all domains (between 4 and 5 percentage points, on average across OECD countries) (Table III.B1.4.12).

Figure III.4.15. Differences in success across written expression and social problem-solving tasks related to socio-economic status



** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

Notes: Only countries and economies with available data are shown. Statistically significant differences are shown in a darker tone (see Annex A3).

The socio-economic status of students is measured by the PISA index of economic, social and cultural status.

Countries and economies are ranked in descending order of the success in written expression items tasks related to socio-economic status (advantaged minus disadvantaged students).

Source: OECD, PISA 2022 Database, Table III.B1.4.10. The StatLink URL of this figure is available at the end of the chapter.

In visual expression tasks – where writing skills are less likely to influence students' capacity to design visual outputs – there are no significant differences observed in the performance of advantaged and disadvantaged students in six countries and economies (Croatia, Jordan, Macao [China], Malta, the Palestinian Authority and Uzbekistan). In over half of all participating countries and economies, differences in success between advantaged and disadvantaged students are the smallest in the visual expression domain compared to the other three domain contexts, and after accounting for students' mathematics and reading performance, performance differences between advantaged and disadvantaged students become insignificant in around two-thirds of all countries and economies – supporting the notion that such differences are largely derived from students' overall basic literacies in task comprehension rather than mathematics/reading skills further inhibiting students' capacity to express their ideas in visual tasks (Table III.B1.4.12) (see Box III.4.6).

Advantaged students significantly outperformed disadvantaged students in all but one country in social problem-solving contexts (Uzbekistan) and all but four countries/economies in scientific problem-solving contexts (Baku [Azerbaijan], Hong Kong [China]*, Jamaica* and Uzbekistan). Large performance differences (around 20 percentage points or more) between advantaged and disadvantaged students in social problem-solving tasks were observed in Israel, the Slovak Republic, Singapore, Germany and Lithuania (in descending order) and in scientific problem-solving tasks in New Zealand*, Romania, and Israel. When comparing students with similar mathematics and reading scores, performance differences remain significant in around half of all countries/economies in social problem-solving contexts (7.5 percentage points, OECD average) and in around one-third of all countries/economies in scientific problem-solving contexts (around 3 percentage points, OECD average). After accounting for mathematics and reading, advantaged students are still considerably more successful in social problem-solving tasks in Panama*, Macao (China), Lithuania (differences of between 10 and 18 percentage points) and in scientific problem-solving tasks in New Zealand* and Malaysia (over 10 percentage points) (Table III.B1.4.12).

Box III.4.6. Socio-economic background, writing proficiency and success in creative thinking tasks

Many renowned artists, scientists and inventors, like David Bowie, members of The Beatles and Queen, Vincent van Gogh, Henri Matisse, Marie Curie, and Jan Koum (the creator of WhatsApp), came from humble beginnings. Their successes across different fields highlight that creative potential is not limited by economic background: every child, regardless of their family's financial status, has the potential to excel in creative thinking. Encouraging all students to think creatively is crucial for countries to unlock their full talent pool and foster social mobility.

Unfortunately, unequal access to foundational literacies can hinder the development of creative potential; as shown in this and the previous chapter, disadvantaged students face greater challenges in generating, evaluating and improving original ideas and diverse ideas. Analysing how advantaged and disadvantaged students perform on specific items reveals further insights as to what these challenges might be. Disadvantaged students performed notably worse than advantaged students in tasks requiring extended written responses. For example, in the unit *Robot Story* – where students must describe two different ideas for a movie (see Figure III.1.5 in Chapter 1) – the difference in success between advantaged and disadvantaged students is nearly 23 percentage points. The equivalent gap in item success is much lower (only 11 percentage points) in the *Space Comic* unit, another written expression task in which students must create a short fictional dialogue between the Earth and the Sun (see Figure III.1.6). In this item, students were able to respond effectively using only a few words. These comparisons suggest that limited writing skills, and possibly less familiarity with typing on computers, may contribute to the socio-economic gaps observed in performance.

Similar patterns can be observed in other domain contexts that require written responses. In the unit *Save the River* (scientific problem solving), advantaged students were 19 percentage points more successful in the first item (Figure III.1.19) that asked students to elaborate two different reasons as to why there might be a problem with frogs in a particular part of the river; this gap narrowed to 8 percentage points in the second item of the unit in which students must suggest how to change an experiment (possibly using only a few words) (see Figures III.1.20-21 and Box III.1.8 in Chapter 1). Similarly, in the unit *Library Accessibility* (social problem solving), the performance gap between advantaged and disadvantaged students was much greater in the first item that required three different ideas (18 percentage points) than in the second item where only a short response was sufficient (5 percentage points) (see Figures III.1.13-16 and Box III.1.7 in Chapter 1).

In contrast, differences in success between advantaged and disadvantaged students in visual expression tasks were relatively small and more akin to those observed in other short, written constructed response items. For example, in the two tasks included in the *Science Fair Poster* unit (see Figures III.1.9-12 and Box III.1.6 in Chapter 1), advantaged students were 7 and 13 percentage points more successful, respectively, than disadvantaged students. These item-level patterns in success suggest that disadvantaged students may struggle to fully express their creative potential when tasks demand more than simple written responses (e.g. a few words). Addressing students' basic writing skills could therefore help close some of the observed gap in creative thinking performance between advantaged and disadvantaged students across domain contexts.

Examples of initiatives to promote creative skills amongst disadvantaged students

In a few countries, initiatives to promote creative thinking have been explicitly targeted towards engaging students from disadvantaged backgrounds. For example, in **Sweden**, the *Berattarministeriet* (or "Ministry of Storytelling") is a non-profit organisation that has supported teachers to nurture creativity in children in primary schools since 2011, targeting disadvantaged communities and focusing on the practice of storytelling.[5] The organisation provides free school programmes, implemented in the classroom and based on the curriculum, that entice students, regardless of their level of knowledge, to "conquer the written word" in a fun and creative way. The teachers are at the same time given tools and support in their professional learning, hence theory and practice are interlaced (Berättarministeriet, Forthcoming[22]).

In **England (United Kingdom)**, the *Creative Partnerships* programme (funded primarily by the Department for Culture, Media and Sport (DCMS), and managed by Arts Council England) was rolled out from 2002 to 2009 in 36 of the most disadvantaged areas in England. The programme paired schools with creative professionals from all fields, including architects, artists and scientists, to develop joint solutions to an identified issue or priority improvement area in the school (House of Commons, 2007[23]). The programme resulted in more than 8 000 projects in over 2 400 schools, reaching around 1 million children and more than 90 000 teachers.

Table III.4.4. Student performance in creative thinking: Chapter 4 figures and tables

StatLink https://stat.link/wk20gv

Notes

[1] Within-country relative strengths and weaknesses should be interpreted with caution when used for comparisons across countries, given the way in which relative performance is derived (i.e. average percentage correct in a subset of tasks compared to the average percentage correct on all other tasks). A large positive relative performance result in certain process(es)/context(s) will necessarily be accompanied by a large negative relative performance in the other process(es)/context(s). However, large positive or negative relative performance results are not necessarily reflective of strong or weak overall success in certain processes or domain contexts. When interpreting relative performance results within a country/economy, that country/economy's overall performance in creative thinking should be kept in mind.

[2] For more information about the *Sc!ence Blast* initiative in Ireland, see: https://www.esbscienceblast.com/about/ (accessed 24 May 2024).

[3] For more information about the Applied Learning Programme and the Learning for Life Programme offered to secondary school students in Singapore, see: https://www.moe.gov.sg/secondary/courses/express/electives/ (accessed 24 May 2024).

[4] For more information about Ireland's "Transition Year" option, see: https://ncca.ie/en/senior-cycle/programmes-and-key-skills/transition-year/ (accessed 24 May 2024). Further information about "The B!G iDEA" project can also be found at the above link, or at the following dedicated website: https://thebigidea.ie/ (accessed 24 May 2024).

[5] For more information about the "Ministry of Storytelling" in Sweden, see: https://www.berattarministeriet.se/om-oss-berattarministeriet-2/. (accessed 24 May 2024).

References

Baer, J. (2011), "Domains of Creativity", in *Encyclopedia of Creativity*, Elsevier, https://doi.org/10.1016/b978-0-12-375038-9.00079-0. [2]

Baer, J. and J. Kaufman (2005), "Bridging generality and specificity: The amusement park theoretical (APT) model of creativity", *Roeper Review*, Vol. 27/3, pp. 158-163, https://doi.org/10.1080/02783190509554310. [3]

Berättarministeriet (Forthcoming), *Fostering Creativity in Teaching Enhances Students' Learning*, Swedish Study on Creativity in Education, Berättarministeriet. [22]

Chen, C. et al. (2006), "Boundless Creativity: Evidence for the Domain Generality of Individual Differences in Creativity", *The Journal of Creative Behavior*, Vol. 40/3, pp. 179-199, https://doi.org/10.1002/j.2162-6057.2006.tb01272.x. [11]

Costa, P., A. Terracciano and R. McCrae (2001), "Gender differences in personality traits across cultures: Robust and surprising findings.", *Journal of Personality and Social Psychology*, Vol. 81/2, pp. 322-331, https://doi.org/10.1037/0022-3514.81.2.322. [20]

Eccles, J. and A. Wigfield (2002), "Motivational Beliefs, Values, and Goals", *Annual Review of Psychology*, Vol. 53/1, pp. 109-132, https://doi.org/10.1146/annurev.psych.53.100901.135153. [21]

House of Commons (2007), *Creative Partnerships and the Curriculum*, House of Commons London: The Stationary Office Limited, https://publications.parliament.uk/pa/cm200607/cmselect/cmeduski/1034/1034.pdf. [23]

Julmi, C. and E. Scherm (2016), "Measuring the domain-specificity of creativity", *Fakultät für Wirtschaftswissenschaft der FernUniversität in Hagen* No. 502, https://www.fernuni-hagen.de/imperia/md/images/fakultaetwirtschaftswissenschaft/db-502.pdf. [12]

Kaufman, J. (2012), "Counting the muses: Development of the Kaufman Domains of Creativity Scale (K-DOCS).", *Psychology of Aesthetics, Creativity, and the Arts*, Vol. 6/4, pp. 298-308, https://doi.org/10.1037/a0029751. [8]

Kaufman, J. (2006), "Self-reported differences in creativity by ethnicity and gender", *Applied Cognitive Psychology*, Vol. 20/8, pp. 1065-1082, https://doi.org/10.1002/acp.1255. [7]

Kaufman, J. and J. Baer (2004), ""Sure, I'm creative -- but not in mathematics!": Self-reported creativity in diverse domains", *Empirical Studies of the Arts*, Vol. Vol. 22/2, pp. pp. 143-155, http://journals.sagepub.com/doi/pdf/10.2190/26HQ-VHE8-GTLN-BJJM. [6]

Kaufman, J. et al. (2010), "Personality and Self-Perceptions of Creativity across Domains", *Imagination, Cognition and Personality*, Vol. 29/3, pp. 193-209, https://doi.org/10.2190/ic.29.3.c. [9]

Kaufman, S. et al. (2015), "Openness to Experience and Intellect Differentially Predict Creative Achievement in the Arts and Sciences", *Journal of Personality*, Vol. 84/2, pp. 248-258, https://doi.org/10.1111/jopy.12156. [10]

Lucas, B. (2022), *Creative thinking in schools across the world: A snapshot of progress in 2022.* [18]

Lucas, B. and E. Spencer (2017), *Teaching Creative Thinking: Developing Learners Who Generate Ideas and Can Think Critically*, Crown House Publishing, https://bookshop.canterbury.ac.uk/Teaching-Creative-Thinking-Developing-learners-who-generate-ideas-and-can-think-critically_9781785832369. [14]

OECD (2023), *PISA 2022 Creative Thinking Framework*, OECD Publishing, Paris, https://doi.org/10.1787/dfe0bf9c-en. [4]

OECD (2023), *Supporting Students to Think Creatively: What Education Policy Can Do*, OECD Publishing, Paris, https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1_?fr=sMGE0ZjYxMjMxNTE. [15]

OECD (2015), *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/9789264229945-en. [19]

OECD (2013), *Innovative Learning Environments*, Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/9789264203488-en. [17]

Runco, M. and M. Bahleda (1986), "Implicit Theories of Artistic, Scientific, and Everyday Creativity*", *The Journal of Creative Behavior*, Vol. 20/2, pp. 93-98, https://doi.org/10.1002/j.2162-6057.1986.tb00423.x. [5]

Sternberg, R. (ed.) (1988), *The nature of creativity as manifest in its testing"*, Cambridge University Press, New York, NY, http://psycnet.apa.org/record/1988-98009-002. [1]

Vincent-Lancrin, S. et al. (2019), *Fostering Students' Creativity and Critical Thinking: What it Means in School*, Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/62212c37-en. [13]

West, R. (2016), "Breaking Down Walls to Creativity through Interdisciplinary Design", *Educational Technology*, Vol. 56(6-), pp. 47–52. [16]

5 Student beliefs and attitudes towards creative thinking

This chapter explores what 15-year-old students believe about the nature of creativity and their own creative potential, and examines how these beliefs relate to their creative thinking proficiency. Beyond beliefs, the chapter reports on a range of attitudes and dispositions identified by research as directly or indirectly involved in the creative thinking process, such as self-efficacy, openness, imagination, curiosity and perspective taking. It investigates whether and how these attitudes relate to students' creative thinking performance, and showcases initiatives implemented in schools to nurture the internal resources needed to think creatively. Finally, the chapter explores how students' goal setting and aspirations for their future study and career relate to their creative thinking proficiency.

For Australia*, Canada*, Denmark*, Hong Kong (China)*, Ireland*, Jamaica*, Latvia*, the Netherlands*, New Zealand*, Panama*, and the United Kingdom* caution is advised when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).

For Albania** and the Dominican Republic**, caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

"Creativity is a wild mind and a disciplined eye."

Dorothy Parker

How do 15-year-old students perceive creativity and their creative potential, and does it make a difference to their creative thinking proficiency? Are there individual attitudes, mindsets, dispositions or personality traits that help demonstrate stronger creative thinking? And if so, what can schools and policy makers do to nurture more favourable attitudes towards creative thinking in their students?

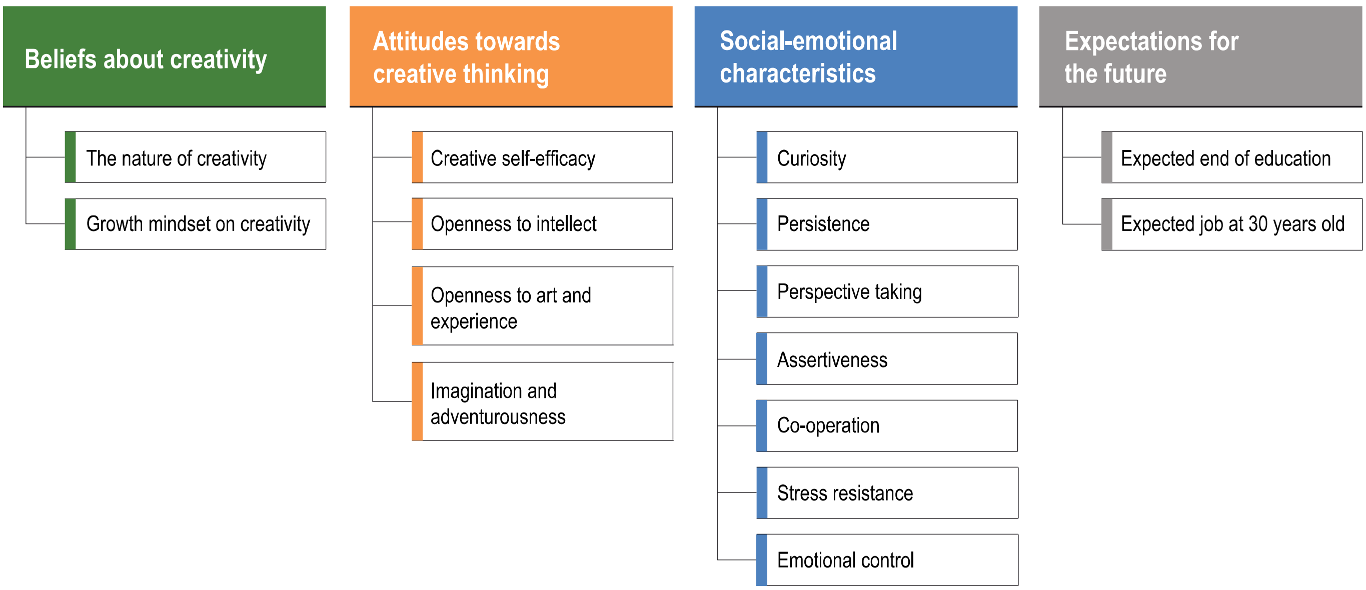
Previous chapters in this volume focused on reporting on the international results of student performance in the PISA 2022 Creative Thinking assessment. Students' performance overall (i.e. their test score), across contexts (the four domains), and across ideation processes (the three facets) was analysed in relation to students' mathematics, reading and science proficiency, as well as in relation to a range of socio-economic characteristics. This chapter analyses how student performance in creative thinking relates to student beliefs about creativity and attitudes towards creative thinking.

What the data tell us

- On average across OECD countries, around 7 out of 10 students believe that creativity is not exclusive to the arts, and 8 out of 10 believe that it is possible to be creative in nearly any subject; in Chinese Taipei and Portugal, this number is closer to 9 out of 10 students. Students who hold these beliefs about creativity tended to score around 3 points higher than their peers on the creative thinking scale on average, and up to 7 points higher in the United Arab Emirates and Israel, after accounting for students' and school's characteristics.
- On average across OECD countries, only about half of the student population thinks that their creativity is something about them that they can change. Students who hold this growth mindset on creativity scored about 1 point higher than their peers. While large percentages of students with a growth mindset on creativity can be found in both high-performing (e.g. Latvia*, Estonia, Denmark*) and mid- or low-performing countries and economies (e.g. Kazakhstan, Brazil), those where most students have a fixed mindset (i.e. non-growth mindset) tend to be low-performing countries (e.g. Albania**, Philippines, Morocco).
- Students tend to believe they are more capable of creative thinking when prompted to think about solving broad, real-life problems, rather than when working on school tasks.
- Several attitudes towards creative thinking relate positively to student performance. These include students' imagination and adventurousness, openness to intellect, openness to art and experience, and creative self-efficacy. Several social-emotional characteristics, such as curiosity, perspective taking and persistence were also identified as distinctive of creative thinkers.
- In nearly every participating country and economy, girls reported more favourable beliefs and attitudes related to creative thinking than boys. Similarly, socio-economically advantaged students, as well as students in socio-economically advantaged schools, consistently reported more positive dispositions towards creative thinking.
- On average across OECD countries, the 7 out of 10 students who expect to complete at least a certain degree of higher education demonstrated more creative thinking proficiency than those who have lower education expectations, even after accounting for mathematics and reading performance, as well as gender and socio-economic profiles. Accounting for the same factors, students who expect to work a job in the creative and cultural sectors at 30 years old also showed stronger creative thinking proficiency at 15 years old – stronger than those, for instance, who expect to work as managers or professionals.
- While, within countries and economies, there is a positive relationship at the student level between more open attitudes and creative thinking performance, at the system level the association tends to be negative. Countries and economies where students, on average, reported the most favourable attitudes towards creative thinking (e.g. Latin American countries) are rather mid- or low-performing countries, and vice-

versa: top-performing jurisdictions, on average, displayed less open attitudes towards creative thinking (e.g. European countries). Notable exceptions are high-performing South-East Asian jurisdictions (e.g. Singapore, Korea, Chinese Taipei) and, to a lesser extent, Canada*, Australia* and New Zealand*.

Figure III.5.1. PISA 2022 coverage of student beliefs, attitudes and expectations related to creative thinking



Beliefs about creativity and attitudes towards creative thinking

This section examines the beliefs of 15-year-old students about the nature of creativity and their attitudes towards creative thinking, and analyses the relationship between these beliefs and attitudes with creative thinking proficiency. “Beliefs about the nature of creativity” refer to how students perceive creativity, in general and in relation to themselves. “Attitudes towards creative thinking” refer to students’ engagement with specific thought processes, activities and tasks that support or contribute to one’s capacity to engage in creative thinking, as defined by the PISA 2022 Creative Thinking framework (OECD, 2023[1]). These attitudes encompass four key constructs in the research literature around creative thinking: creative self-efficacy, openness to intellect, openness to art and experience, and imagination and adventurousness.

Beliefs about creativity

Do 15-year-old students across the world believe that creativity is simply an innate talent or rather a skill they can develop through practice? Do they believe it belongs only in the arts or that it can be applied to many different contexts?

The nature of creativity

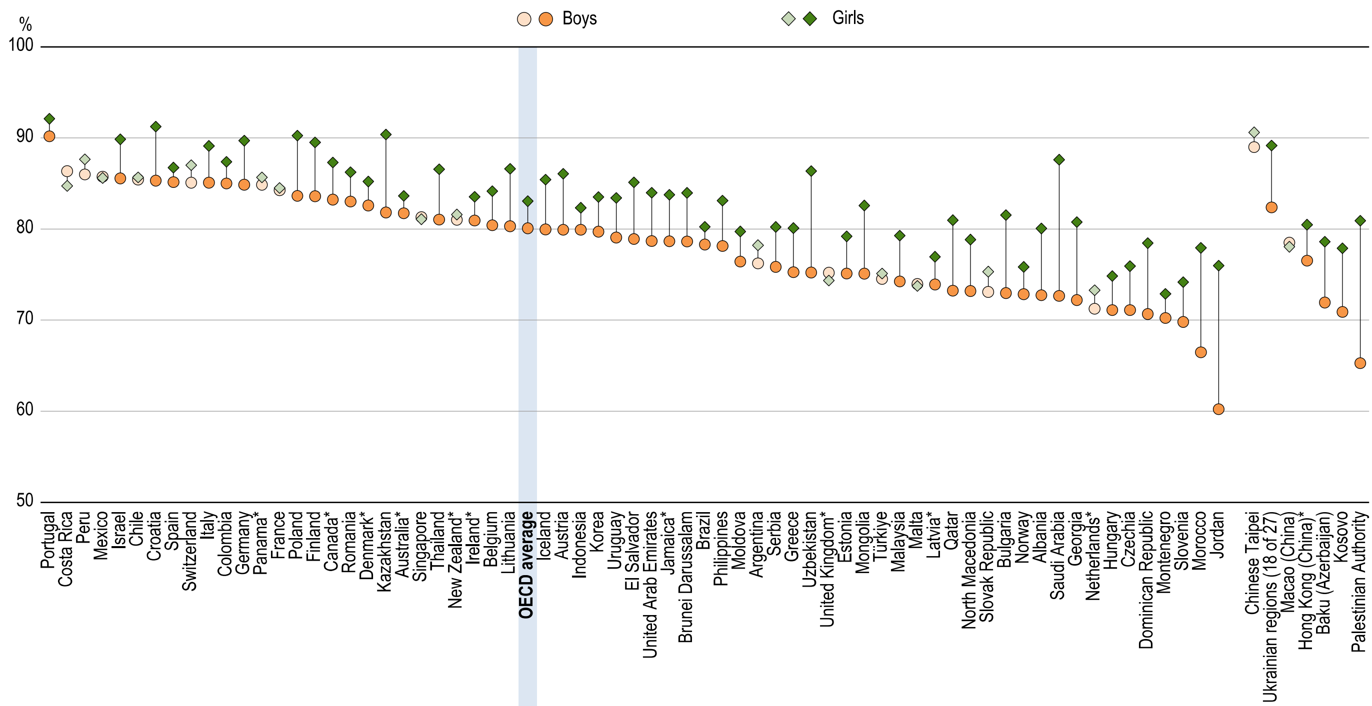
On average across OECD countries, 71% of 15-year-old students disagreed or strongly disagreed that creativity can only be expressed through the arts, and 82% reported believing that it is possible to be creative in nearly any subject (Table III.B1.5.1). In Portugal and Chinese Taipei, around 90% of students agreed or strongly agreed that it is possible to be creative across subject areas; in contrast, in Jordan and Morocco, just over 69% of students felt the same way about creativity. Nonetheless, in general, students tend to recognise that creativity extends to other contexts than just the arts.

Do boys and girls share different opinions about the nature of creativity? On average across OECD countries, more girls than boys reported believing that creativity extends beyond the arts; this gender gap in favour of girls is statistically significant in 24 countries and economies (Figure III.5.2). Girls also believed that it is possible to be creative in nearly any subject more often than boys did. This gender gap in beliefs aligns with the PISA 2022 findings that girls consistently outperformed boys in the creative thinking assessment across countries and economies (Table III.B1.3.4). However, in the United Kingdom*, Malaysia, Uzbekistan, Mongolia, Argentina, Kosovo, Albania** and Greece, more boys than girls believed that creativity extends beyond the arts.

Both socio-economically advantaged students and students in socio-economically advantaged schools were more likely to believe that creativity is not exclusive to the arts and that one can be creative in nearly any subject. This aligns with the socio-economic gap in creative thinking performance reported in Chapter 3.

Figure III.5.2. Student beliefs about the nature of creativity

Percentage of students who agree/strongly agree that it is possible to be creative in nearly any subject, by gender

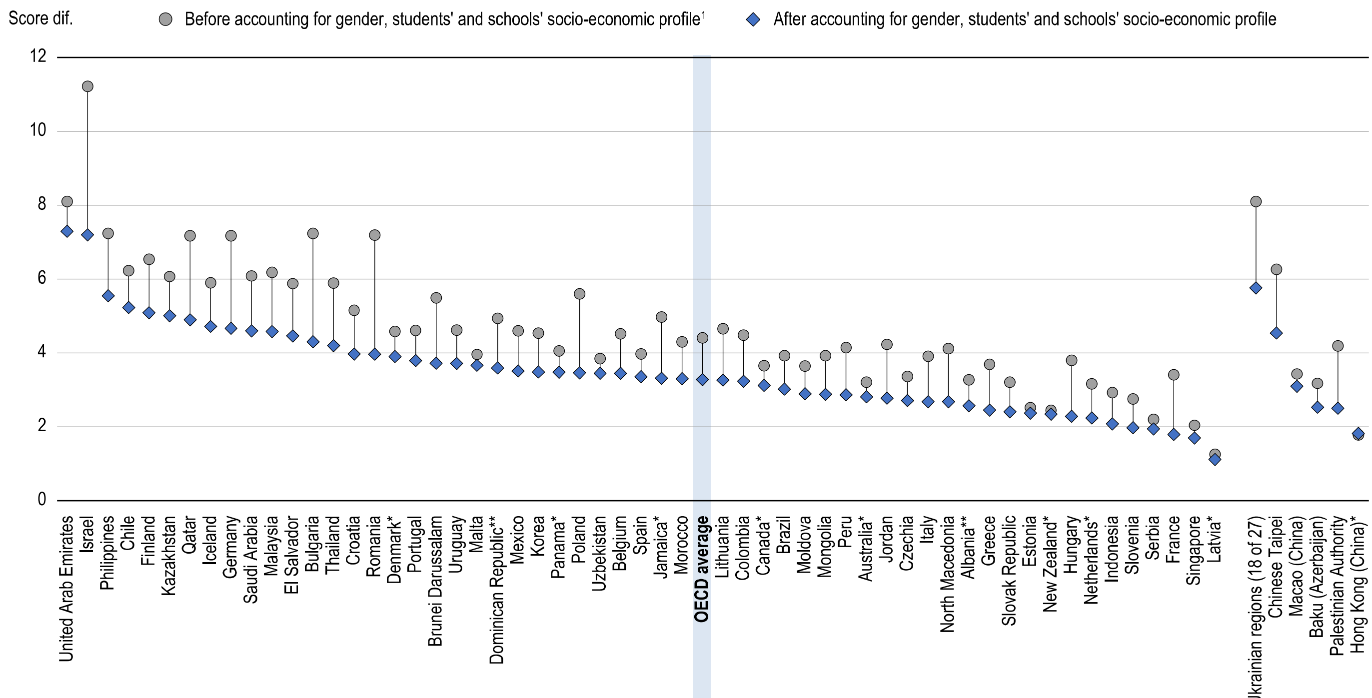


Notes: Only countries and economies with available data are shown.
Statistically significant differences between boys and girls are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of the percentage of boys.
Source: OECD, PISA 2022 Database, Table III.B1.5.2. The StatLink URL of this figure is available at the end of the chapter.

Students who believe that it is possible to be creative in nearly any subject show higher creative thinking proficiency than their peers; on average across OECD countries, students who agreed or strongly agreed scored over 3 points higher in creative thinking (on a scale that counts 60 points) than those who disagreed or strongly disagreed, after accounting for students' gender and students' and schools' socio-economic profile (Figure III.5.3). This represents a large difference in performance between students who do and do not hold positive beliefs about the nature of creativity (about one-third of the OECD standard deviation in performance), and this positive relationship holds across all countries and economies. In the United Arab Emirates, Israel, Finland, the Philippines, Kazakhstan, Chile, and in the Ukrainian regions (18 of 27) (in descending order), the average difference exceeded 5 score points. Across participating countries and economies, a similar performance difference was observed between students who think that creativity can be expressed outside of the arts and those who do not.

Figure III.5.3. Change in creative thinking performance associated with more open beliefs about the nature of creativity

Score point difference between students who agree/strongly agree that it is possible to be creative in nearly any subject and those who disagree/strongly disagree, before and after accounting for gender and students' and schools' socio-economic status



1. Socio-economic status is measured by the PISA index of economic, social and cultural status (ESCS).
Notes: Only countries and economies with available data are shown.
All score-point differences are statistically significant (see Annex A3).
Countries and economies are ranked in descending order of score-point difference in creative thinking, after accounting for gender, students' and schools' socio-economic status.
Source: OECD, PISA 2022 Database, Table III.B1.5.3. The StatLink URL of this figure is available at the end of the chapter.

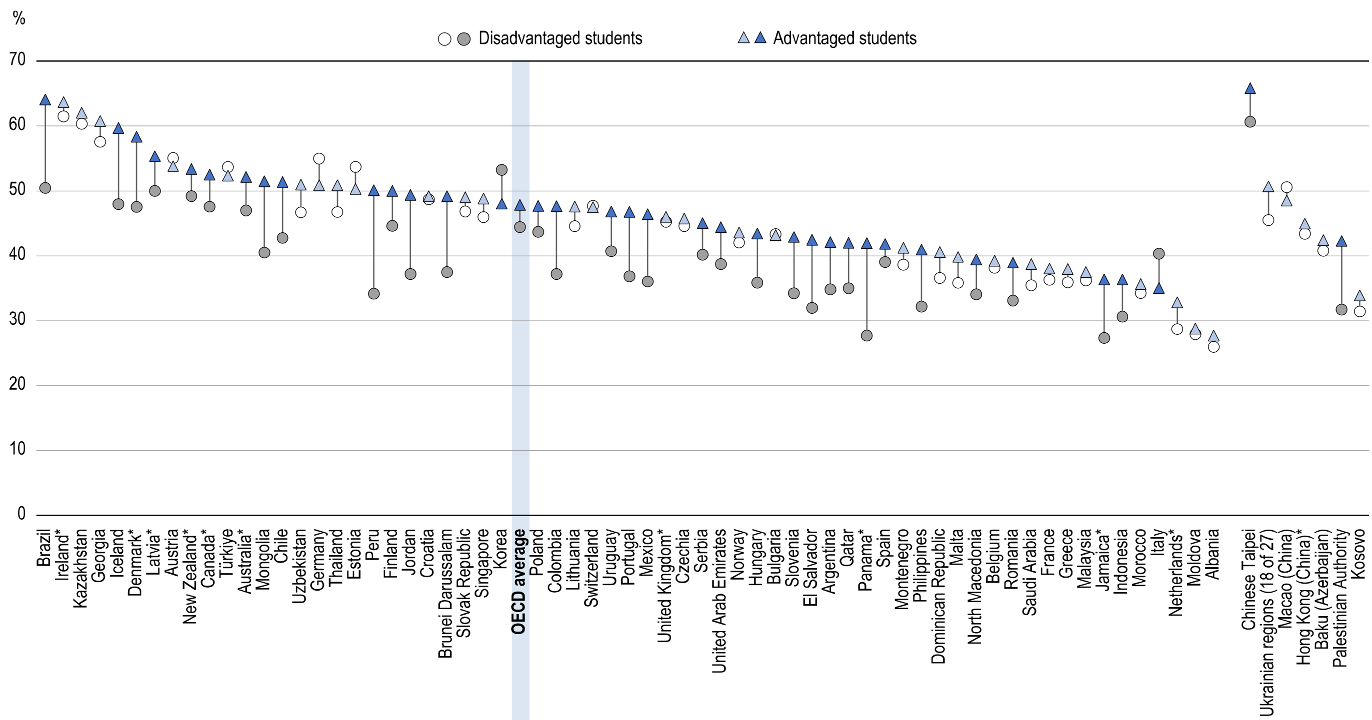
Growth mindset on creativity

Holding a more open view of the nature of creativity is associated with stronger performance in creative thinking, but what about the beliefs about one's creativity? On average across OECD countries, 47% of students disagreed or strongly disagreed that their creativity is something about them that they cannot change much (that is, 46% hold a growth mindset on creativity); up to 57% when it comes to their intelligence (Table III.B1.5.4). For many thus, creativity and, to a lesser extent, intelligence, are akin to innate talents, non-malleable competencies that are closer to personality traits that no education, training or experience can improve (i.e. fixed mindset). Students' mindsets related to their own capacity for creativity appear largely uncorrelated to their beliefs about the nature of creativity in general: those who think it is possible to be creative in nearly any subject are neither more nor less prone than others to hold a growth versus fixed mindset on creativity (r = 0.04 on average across OECD countries).

Socio-economically disadvantaged students are more likely to hold a fixed mindset. Across most countries and economies, and often by a significant degree, larger proportions of socio-economically disadvantaged students think that their creativity is something about them that they cannot change much. On average across OECD countries, there were 3.4 percentage points more disadvantaged than advantaged students with a fixed mindset on creativity (Figure III.5.4). This difference rose to around 14 percentage points in Brazil and Panama*, and 16 percentage points in Peru. In only two countries (Korea and Italy) was the opposite observed, with disadvantaged students more likely to hold a growth mindset on creativity than their peers.

Figure III.5.4. Students with a growth mindset on creativity, by socio-economic status

Percentage of students who disagree/strongly disagree with the statement "creativity is something about you that you cannot change very much"

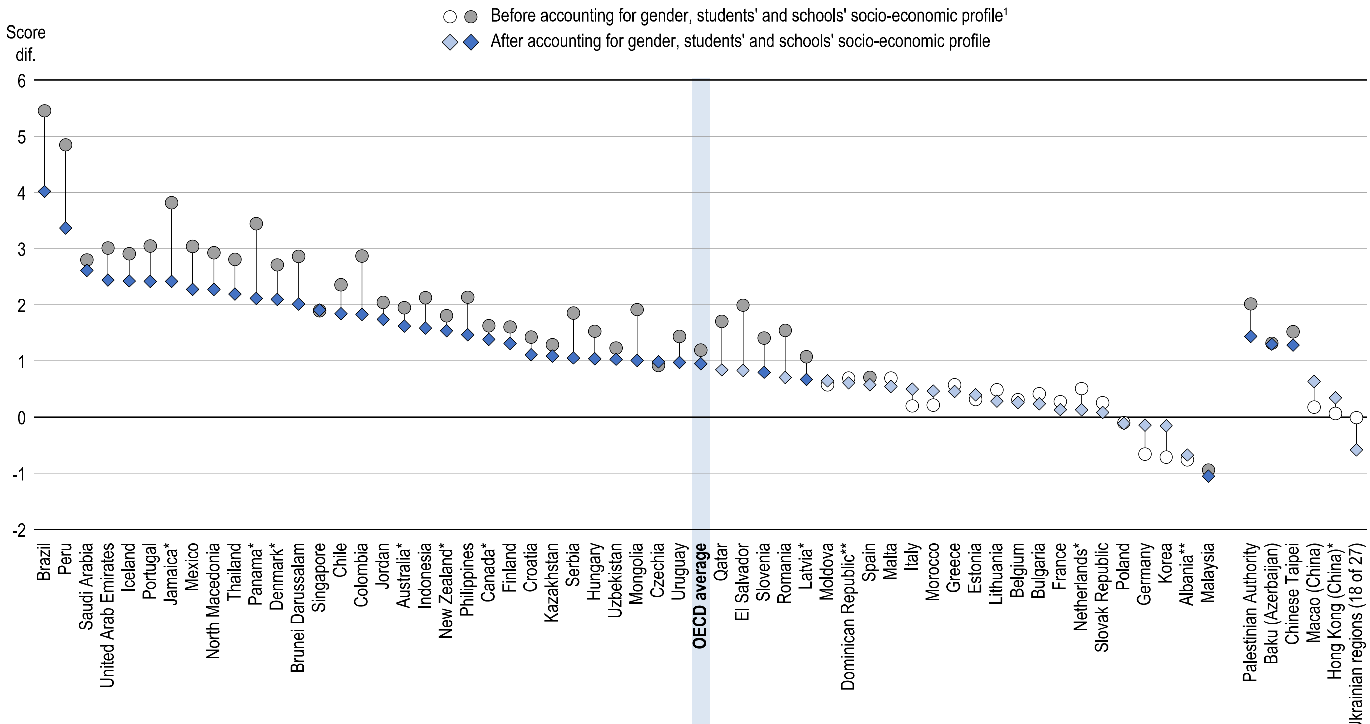


Notes: Only countries and economies with available data are shown.
Socio-economic status is measured by the PISA index of economic, social and cultural status (ESCS).
Statistically significant differences between advantaged and disadvantaged students are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of the percentage of advantaged students.
Source: OECD, PISA 2022 Database, Table III.B1.5.5. The StatLink URL of this figure is available at the end of the chapter.

Students who think their creativity is something about them that they can change scored better than those who don't hold a growth mindset (around 1 score point higher, OECD average) (Table III.B1.5.6). This moderate but statistically significant difference accounts for students' and schools' socio-economic characteristics, and it holds in most countries and economies – only in Malaysia is the relationship significantly inverted (Figure III.5.5). By comparison, students who believe their intelligence is something about them that they can change scored around 2 points higher than their peers, on average across OECD countries.

Figure III.5.5. Change in creative thinking performance associated with a growth mindset on creativity

Score point difference between students who disagree/strongly disagree with the statement "Your creativity is something about you that you cannot change very much" and those who agree/strongly agree, before and after accounting for gender and students' and schools' socio-economic status



1. The socio-economic profile is measured by the PISA index of economic, social and cultural status (ESCS).
Notes: Only countries and economies with available data are shown.
Statistically significant score-point differences are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of the score-point difference in creative thinking, after accounting for gender, students' and schools' socio-economic status.
Source: OECD, PISA 2022 Database, Table III.B1.5.6. The StatLink URL of this figure is available at the end of the chapter.

In sum, on average across OECD countries, holding a growth mindset on creativity was positively associated with creative thinking performance, but less so than thinking that it is possible to be creative in nearly any subject or that creativity can be expressed outside the arts. It appears that broadening students' beliefs about the nature of creativity – how it can be expressed and its relevancy in many contexts – is more closely associated with their performance than their own beliefs about their capacity to change their creativity.

Attitudes towards creative thinking

Four attitudes commonly support or contribute to an individual's capacity to engage in a creative thinking process: creative self-efficacy, openness to intellect, openness to art and experience, and imagination and adventurousness (Box III.5.1). The PISA 2022 Creative Thinking framework constructed four distinct indices to analyse and compare these four attitudes (see Annex A1).

Box III.5.1. Internal resources that support creative thinking

Creative self-efficacy

Creative self-efficacy describes an individual's beliefs about their capacity to successfully produce creative work, especially when facing challenging circumstances (Beghetto and Karwowski, 2017[2]). Influenced by other factors such as prior experience, emotional affect and the surrounding environment, creative self-efficacy is fundamental in motivating individuals to overcome obstacles and engage in creative tasks (Beghetto, 2006[3]; Bandura, 1997[4]).

Openness

Research highlights the role of "openness," a core personality trait among creative individuals, in fostering creativity (McCrae, 1987[5]; Prabhu, Sutton and Sauser, 2008[6]; Werner et al., 2014[7]; Kaufman et al., 2010[8]; Kaufman et al., 2015[9]). Meta-analyses of studies on creativity and personality have found that openness appears to be a common trait in creative achievers across domains, whereas other personality traits tend to interact with creativity only insofar as they benefit individuals within specific domains (e.g. "conscientiousness" seems to enhance scientific creativity but detract from performance in the arts) (Batey and Furnham, 2006[10]; Feist, 1998[11]). The broader construct of openness has been further divided between "openness to art and experience" and "openness to intellect".

Openness to art and experience

Openness to art and experience describes an individual's receptivity to engage with novel ideas, imagination and fantasy (Berzonsky and Sullivan, 1992[12]). Its predictive value for creative achievement across domains is likely due to its inclusion of cognitive (e.g. imagination), affective (e.g. curiosity) and behavioural aspects (e.g. adventurousness) (Chávez-Eakle, 2009[13]; Feist, 1998[11]; Guastello, 2009[14]; Kashdan and Fincham, 2002[15]).

Openness to intellect

"Openness to intellect" describes an individual's receptivity to appreciate and engage with abstract or complex information, primarily through reasoning (DeYoung, 2014[16]). Distinct from the artistic inclination of "openness to art and experience," "openness to intellect" seems particularly correlated with scientific creativity (Kaufman et al., 2015[9]).

Imagination and adventurousness

The PISA index of imagination and adventurousness connects to the divergent thinking component of the creative thinking process (Guilford, 1956[17]). While convergent thinking aids in understanding problems and identifying and evaluating good ideas (Reiter-Palmon and Robinson, 2009[18]; Runco, 1997[19]), divergent thinking refers to the ability to think of original ideas, to make flexible connections between ideas or pieces of information, and to apply fluency of association and ideation (Cropley, 2006[20]). It also refers to the ability to break out of "fixed" performance scripts – in other words, to try new approaches, to look at problems from different angles, and to discover new methods of "doing" (Schank and Abelson, 1977[21]). In essence, divergent thinking brings forth novel, unusual or surprising ideas.

Source: (OECD, 2023[1]) PISA 2022 Assessment and Analytical Framework, https://doi.org/10.1787/471ae22e-en.

The four indices of attitudes towards creative thinking are positively correlated with one another. On average across OECD countries, the strongest correlations are observed between the index of openness to intellect, on one hand, and the other three indices on the other: with creative self-efficacy (r = 0.54), openness to art and experience (r = 0.49), and imagination and adventurousness (r = 0.47) (Table III.5.1). The correlations among the three other indices are also statistically significantly positive, ranging between 0.38 and 0.42. In a nutshell, the most open-minded students are the most imaginative (and vice versa, with all four attitudes). In terms of social-emotional constructs, stress resistance and emotional control appear very intertwined (r = 0.51) and often found in the same students; and so do persistence and curiosity, though to a lesser extent (r = 0.37).

Table III.5.1. Correlations between students' attitudes towards creative thinking and select social-emotional characteristics

OECD average

Correlation between index of									
Openness to intellect	Openness to art and experience	Imagination and adventurousness	Curiosity	Persistence	Assertiveness	Co-operation	Emotional control	Stress resistance	...and index of ...
0.54	0.40	0.38	0.33	0.23	0.29	0.20	0.08	0.11	Creative self-efficacy
	0.49	0.47	0.43	0.28	0.25	0.20	0.08	0.08	Openness to intellect
		0.42	0.21	0.07	0.08	0.06	-0.06	-0.11	Openness to art and experience
			0.30	0.11	0.19	0.12	-0.10	-0.08	Imagination and adventurousness
				0.37	0.27	0.25	0.10	0.08	Curiosity
					0.21	0.27	0.25	0.20	Persistence
						0.12	0.03	0.18	Assertiveness
							0.22	0.10	Co-operation
								0.51	Emotional control

All correlations are statistically significant (see Annex A3).
Source: OECD, PISA 2022 Database. The StatLink URL of this figure is available at the end of the chapter.

Creative self-efficacy

Creative self-efficacy describes students' confidence in successfully engaging in creative thinking activities and overcoming related challenging tasks (Beghetto and Karwowski, 2017[2]). Most students showed a high level of confidence in their ability to demonstrate creative thinking in everyday situations, for instance if prompted to come up with many good ideas for helping people in need (71% on average across OECD countries), or ideas for solving disagreements with people (70%) (Figure III.5.6 and Table III.B1.5.7). When broadly contextualised, a majority of students were also confident that they can be creative (72%). However, when prompted to think about a school situation or a specific assessment, less students felt that they can demonstrate creative thinking: for instance, just 62% were confident or very confident that they can come up with creative ideas for school projects.

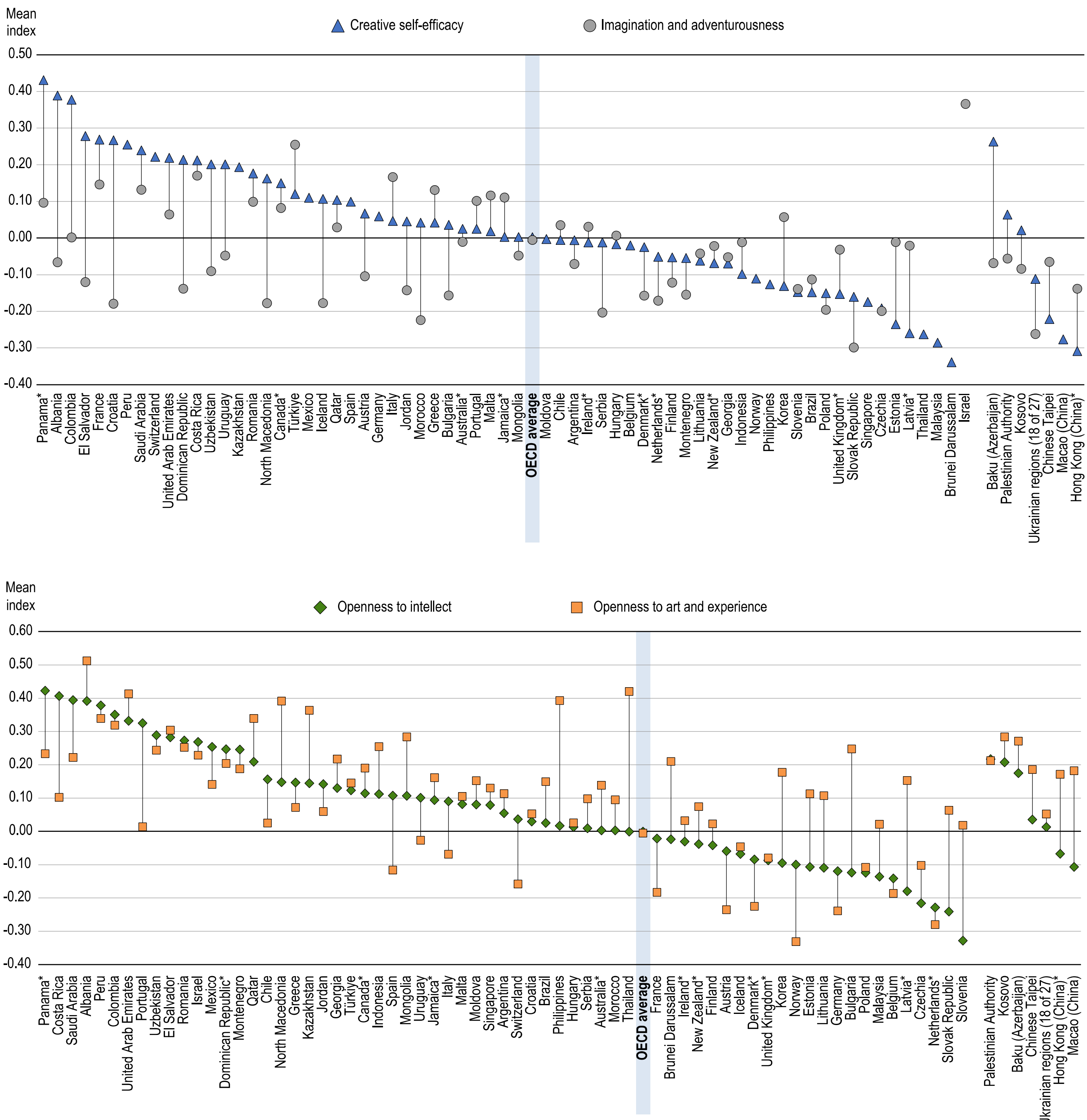
Students also less confidently believe that they can think creatively in specific domain contexts: only 61% were confident or very confident that they can tell creative stories; 58% that they can invent new things; 55% that they can produce creative drawings; and only 50% that they can come up with good ideas for science experiments. This suggests that actual or perceived domain readiness – prior domain knowledge and experience relevant to successfully produce creative work – is an important mediating factor (Baer, 2016[22]).

In all countries and economies where there is a statistically significant gender gap in creative self-efficacy, it was in favour of girls over boys – except in several Asian countries and economies including Korea, Hong Kong (China)*, Macao (China), Chinese Taipei and Indonesia (in descending order), as well as in Brazil, where it was in favour of boys over girls (Table III.B1.5.8). For comparison, boys reported higher levels of general self-efficacy than girls, across OECD countries, and much lower levels of fear of failure (OECD, 2023[23]).

A large socio-economic gap also exists across all participating countries and economies. There was a difference of 0.36 units on the index of creative self-efficacy in favour of advantaged students over their disadvantaged peers (Table III.B1.5.8).

Figure III.5.6. Student attitudes towards creative thinking, by country and economy

Mean index comparison across countries and economies



Notes: Only countries and economies with available data are shown.

Countries and economies are ranked in descending order the mean index of imagination and adventurousness and index of openness to intellect.

Source: OECD, PISA 2022 Database, Tables III.B1.5.7, III.B1.5.11, III.B1.5.15 and III.B1.5.19. The StatLink URL of this figure is available at the end of the chapter.

Openness to intellect, and openness to art and experience

Openness to intellect describes an individual's receptivity to appreciate and engage with abstract and complex information (Box III.5.1). Across OECD countries, most students reported that they enjoy learning new things, that they like doing something creative, or playing a game that challenges their creativity (all above 70%) (Table III.B1.5.11). Less students, though still a majority in most countries and economies, said they are open to intellect when the task they are prompted to think about is challenging. For instance, about one student out of two reported that he or she enjoys solving complex problems or doing challenging schoolwork, on average across OECD countries. Interestingly, the four countries and economies that underperformed the most in creative thinking given their performance in the other PISA tests (Czechia, Hong Kong [China]*, Macao [China], and Chinese Taipei) have the largest discrepancies between the shares of students who enjoy learning in general and those who enjoy learning at school.

This pattern is reflected in students' openness to art and experience, which captures individual's receptivity to engage with novel ideas, imagination, fantasy, aesthetics and emotions, and predicts creative achievement in the arts. When prompted to imagine an activity that involves the creation of an output (e.g. "I enjoy creating art", "I express myself through art") students were less prone to report high levels of openness to art and experience than when it relates to broader experiences or a less concrete outcome (e.g. "I see beauty in everyday things", I enjoy artistic activities") (Table III.B1.5.15). Perhaps surprisingly, only around one in two students across OECD countries reported enjoying artistic activities and creating art – especially considering that about the same percentage of students said they enjoy solving complex problems.

Openness to art and experience is a very gendered attitude across all countries and economies, with girls having scored 0.46 index-unit higher than boys on average across OECD countries (about half one standard deviation) (Table III.B1.5.16). It is also largely determined by their socio-economic status, with a 0.24 unit difference between advantaged and disadvantaged students on average across OECD countries. Indeed, not everyone has access to artistic activities inside or outside of school (see Chapter 6). Openness to intellect is less associated with gender (there is no statistically significant difference between boys and girls at the OECD average) but more associated with students' socio-economic status than openness to art and experience: there was a 0.36 index-unit difference between advantaged and disadvantaged students on average across OECD countries (Table III.B1.5.12). This also held for all countries and economies but Jamaica*.

Imagination and adventurousness

Engaging in creative thinking, and in particular in its *divergent thinking* component, entails expressing and communicating ideas and imagination, which is nurtured by dispositions to exploration and adventurousness. On average across OECD countries, most students said they would like to travel to places they have never been (88%) and that they would get bored doing the same thing every day (73%) (Table III.B1.5.19). Those dispositions relate to their adventurousness. Similarly, a majority of students reported that they have a good imagination (74%) and that coming up with new ideas is satisfying to them (74%). They often get lost in thought (73%) and like to be spontaneous (71%). The latter four dispositions relate to their imagination. If being creative was only a matter of imagining diverse ideas, 15-year-old students could be confident in their capacity to engage in creative thinking (see Chapter 4). Yet generating diverse ideas is just one facet of the creative thinking process; generating appropriate and original ideas, as well as evaluating and improving ideas, are two other key facets.

Students' self-reported sense of imagination and adventurousness differ by both their gender and socio-economic status (Table III.B1.5.20). Girls reported higher levels of imagination and adventurousness than boys (+0.29 index-unit on average across OECD countries), and so did advantaged students over their disadvantaged peers (+0.34 index-unit at the student level, +0.30 at the school level).

Relationship with creative thinking performance

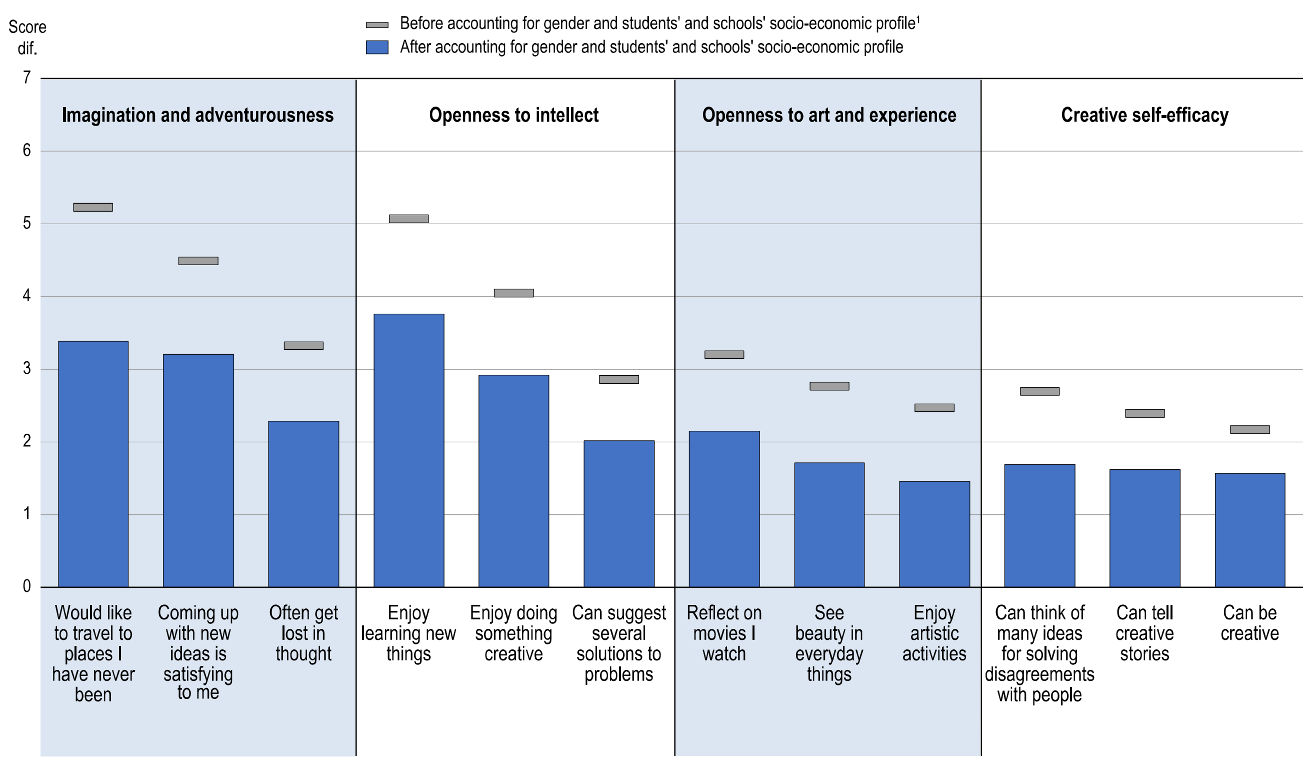
For almost all participating countries and economies, the four PISA indices were positively associated with students' creative thinking proficiency, even after accounting for student and school characteristics (Tables III.B1.5.10, III.B1.5.14, III.B1.5.18, and III.B1.5.22). On average across OECD countries, the largest performance change was observed with a one-unit increase in the index of imagination and adventurousness (+1.5 score points). Then comes the index of openness to intellect (+1.3 score points), of openness to art and experience (+0.9), and of creative self-efficacy (+0.8).

However, the variation along any of these four indices only explains a marginal part of the variance in creative thinking performance, ranging from 1 to 4.4% on average across OECD countries and after accounting students' and schools' socio-economic characteristics (Tables III.B1.5.10, III.B1.5.14, III.B1.5.18, and III.B1.5.22). For comparison, the variation in mathematics performance alone explains 28.4% of the variation in creative thinking performance, accounting for the same students' and schools' characteristics (Figure III.2.3).

Within those four attitudes, it is possible to identify sub-attitudes towards creative thinking that are more strongly associated with better creative thinking performance than others (Figure III.5.7). For instance, after accounting for students' and schools' characteristics, and on average across OECD countries, students who enjoy learning new things (openness to intellect) scored nearly 4 points higher than those who do not and those for whom coming up with new ideas is satisfying (imagination and adventurousness) scored around 3 points higher.

Figure III.5.7. Change in creative thinking performance associated with sub-attitudes towards creative thinking

Change in creative thinking score associated with agreeing/strongly agreeing or feeling confident/very confident with the following statements; OECD average



1. The socio-economic profile is measured by the PISA index of economic, social and cultural status.
Notes: All score-point differences are statistically significant (see Annex A3).
Single items are grouped by indices. For instance, the item "I enjoy learning new things" contributes to the index of "openness to intellect". The four indices are ranked by the magnitude of their association with the creative thinking score, after accounting for students' and schools' characteristics. A one-unit increase in the index of "imagination and adventurousness" was associated with a 1.5 score difference in creative thinking, while it was 1.3 for the index of "openness to intellect", 0.9 for "openness to art and experience", and 0.8 for "creative self-efficacy".
Source: OECD, PISA 2022 Database, Tables III.B1.5.10, III.B1.5.14, III.B1.5.18 and III.B1.5.22. The StatLink URL of this figure is available at the end of the chapter.

Box III.5.2 below provides some insights as to how parents' beliefs about creativity as well as about their and their child's openness to intellect, influence students' creative thinking performance.

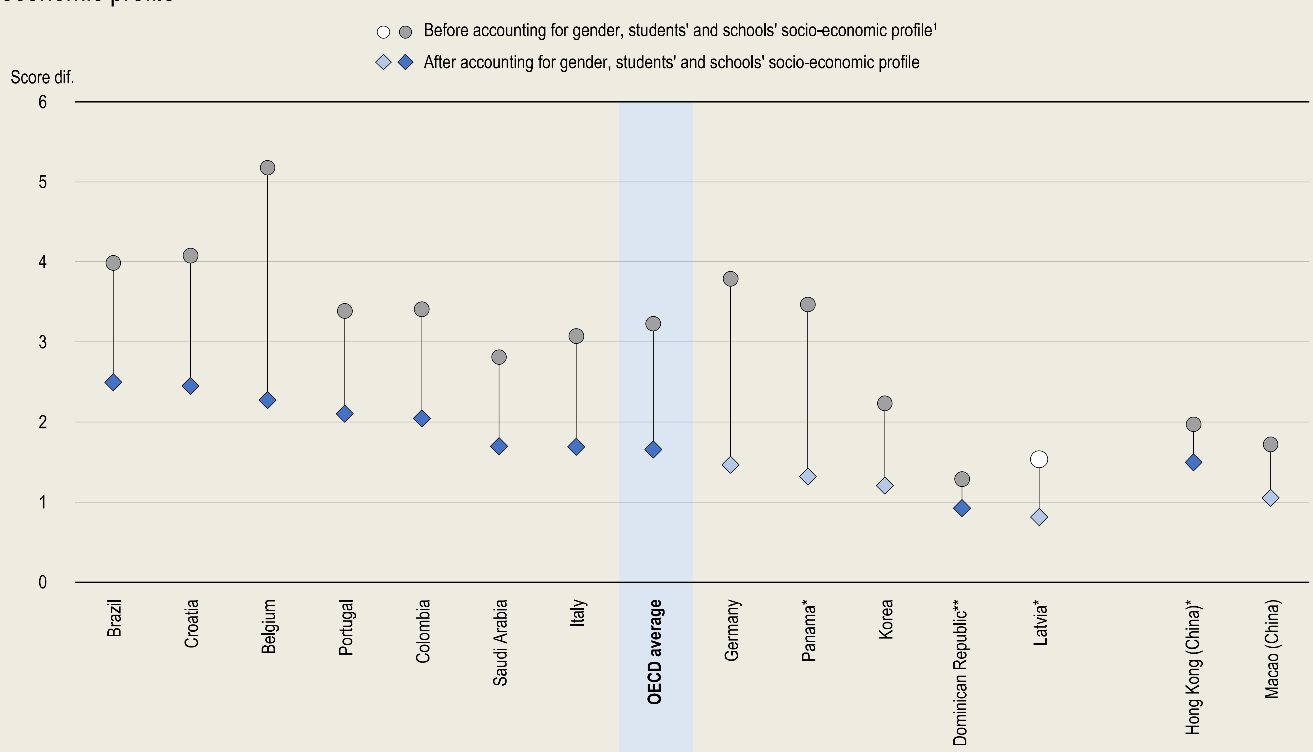
Box III.5.2. Parents' beliefs and attitudes towards creativity and their influence on their children's creative thinking proficiency

Parents' beliefs about creativity

Students' performance in creative thinking was positively associated with their parents' beliefs about creativity. Parents' beliefs about creativity are related to their child's creative thinking performance (Figure III.5.8 and Table III.B1.5.57). The more parents believe that it is possible to be creative in nearly any subject, or the more they believe creativity can be expressed outside of the arts, the better their child performed on the creative thinking assessment. This positive relationship held after accounting for gender and socio-economic status of the family and school. On average across OECD countries, 92% of parents agreed with the former statement and 77% with the latter (Table III.B1.5.55). Women and men shared similarly favourable beliefs about the nature of creativity; but parents from advantaged socio-economic backgrounds reported much more of these beliefs than their peers (Table III.B1.5.56).

Figure III.5.8. Change in student creative thinking performance associated with parents' beliefs about creativity

Score point difference between students whose parents agree/strongly agree that it is possible to be creative in nearly any subject and those who disagree/strongly disagree, before and after accounting for gender and students' and schools' socio-economic profile



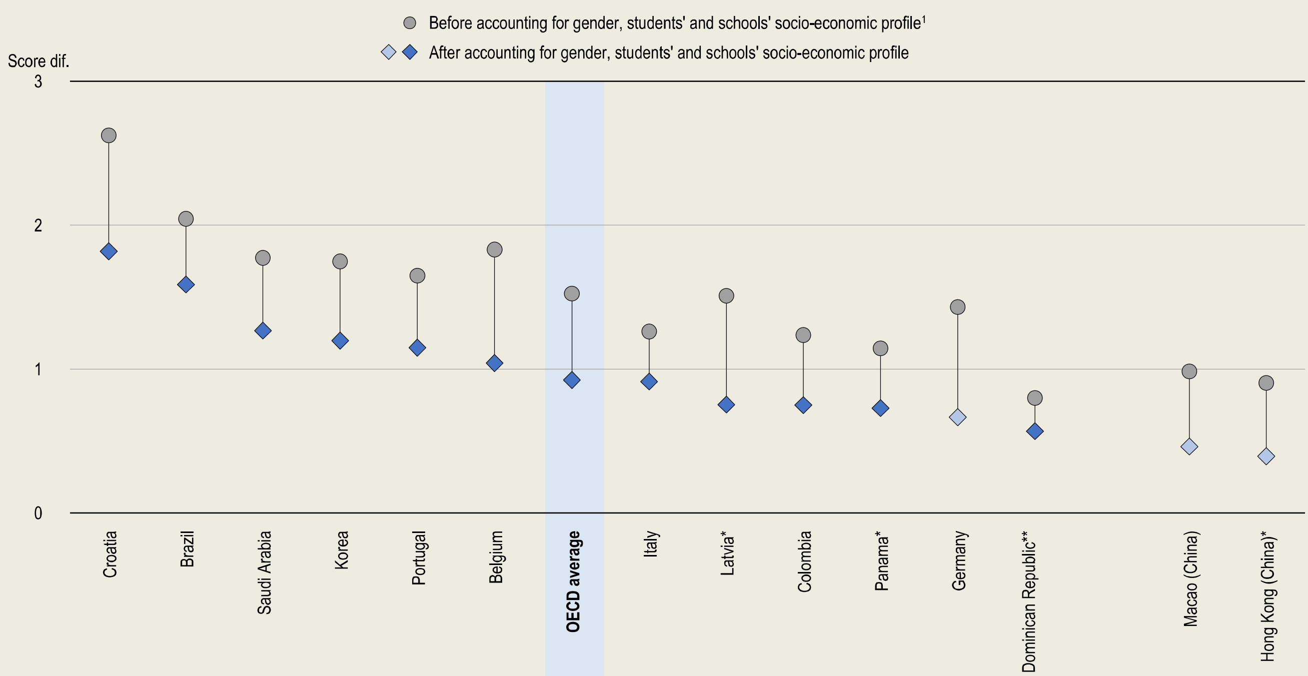
1. Socio-economic status is measured by the PISA index of economic, social and cultural status.
Notes: Only countries and economies with available data are shown. Statistically significant score-point differences are shown in a darker tone (see Annex A3).
Countries and economies are ranked in descending order of score-point difference in creative thinking, after accounting for gender, students' and schools' socio-economic profile.
Source: OECD, PISA 2022 Database, Table III.B1.5.57. The StatLink URL of this figure is available at the end of the chapter.

Parents' views on their own and their child's creativity

Parents' openness to intellect has no or little relationship with their child's creative thinking proficiency (Table III.B1.5.61). However, how much parents think their child is open to intellect does relate to their child's creative thinking performance (Figure III.5.9). In other words, the more parents think that their child is very creative (76% of parents on average across OECD countries), that they enjoy projects that require creative solutions (73%), and that they have a good imagination (83%), the better their child performed in creative thinking – again, accounting for student's and school's characteristics (Table III.B1.5.62 and Table III.B1.5.65). Parents who think their child enjoys learning new things, and those who think their child is very creative, have children who scored about 2 points higher than their peers, on average across OECD countries with available data.

Figure III.5.9. Change in creative thinking performance associated with parents' perception of their child's openness to intellect

Difference in creative thinking score associated with a one-unit change in the index of parents' perception of their child's openness to intellect, before and after accounting for gender and students' and schools' socio-economic status



1. Socio-economic status is measured by the PISA index of economic, social and cultural status.
Notes: Only countries and economies with available data are shown. Statistically significant score-point differences are shown in a darker tone (see Annex A3).
All score-point differences before accounting for gender, students' and schools' socio-economic status are statistically significant (see Annex A3).
Countries and economies are ranked in descending order of score-point difference in creative thinking, after accounting for gender, students' and schools' socio-economic status.
Source: OECD, PISA 2022 Database, Table III.B1.5.65. The StatLink URL of this figure is available at the end of the chapter.

Parents' perception of their child's openness to intellect tended to be quite accurate, although slightly over-estimated when compared to children's own reports. For instance, in the 18 countries where both information were available, parents were on average more likely to agree that their children are very creative, than children themselves (a 12 percentage-points difference on average across OECD countries). Fathers and mothers (or male and female tutors) shared relatively similar views on their child's openness to intellect, though fathers tended to think that their child enjoys projects that require creative solutions, or solving complex problems, more often than mothers did. However, both fathers and mothers tended to be much more likely to report higher levels of openness to intellect from their daughter, compared to their son. Across the board, this was also the case for families from more advantaged socio-economic backgrounds (Table III.B1.5.64).

The role of social-emotional characteristics as supporting attitudes

More general social-emotional characteristics may also support students to engage in creative thinking, and can be drivers of the overarching beliefs and mindsets previously discussed in this chapter. In particular, curiosity, persistence and perspective-taking are all attitudes that characterise good learners and that might support students' capacity to generate, evaluate and improve creative ideas (Box III.5.3).

Box III.5.3. How social-emotional characteristics might support attitudes towards creative thinking

Curiosity

Curiosity is a key driver of creativity (Chávez-Eakle, 2009[13]; Feist, 1998[11]; Guastello, 2009[14]; Kashdan and Fincham, 2002[15]). Curiosity manifests in several attitudes towards creative thinking, and in particular in attitudes that relate to open-mindedness (e.g. openness to intellect, openness to art and experience). Students with a high degree of curiosity show greater interest in novel ideas, love of learning, understanding, intellectual exploration and inquisitive mindset.

Persistence

Investing effort towards one's goal and overcoming difficulties are essential for engaging in creative thinking, as they enable individuals to maintain concentration for long periods and deal with frustrations that may arise from playing with novel and original ideas (Cropley, 1990[24]; Torrance, 1998[25]; Amabile, 1983[26]). Persistence draws on intrinsic and extrinsic motivations, whose role as a driver of creative work has also been well documented (Amabile, 1983[26]; Amabile, 1997[27]; Hennessey and Amabile, 2010[28]; Amabile and Pratt, 2016[29]). Intrinsic motivation pertains to finding work inherently meaningful or rewarding, for reasons such as enjoyment, self-interest or a desire to be challenged. The experience of "creative flow" – i.e. being fully immersed in a creative task and disregarding other needs – is a powerful driver of creativity because individuals in flow are intrinsically motivated to engage in a task (Csikszentmihalyi, 2013[30]; Nakamura and Csikszentmihalyi, 2002[31]). Extrinsic motivation refers to external incentives, goals or pressures that motivate people to engage in a particular task. Although research emphasises the importance of intrinsic task motivation in creative performance, extrinsic motivators such as deadlines or recognition can also motivate people to persist in their creative endeavours (Eisenberger and Shanock, 2003[32]; Amabile and Pratt, 2016[29]).

Perspective taking

Perspective taking supports both convergent and divergent thinking, as well as open-mindedness. When it comes to social problem solving, creative thinking involves understanding the perspectives of different people. In scientific problem-solving, creative thinking also requires engaging in a process of scientific inquiry by exploring and experimenting with different ideas and different perspectives. In a team, perspective taking also helps brings forth the creative benefits of diverse groups and the heterogeneity of viewpoints to elaborate new and original ideas (Hoever et al., 2012[33]). Finally, perspective taking is key to exerting critical thinking, a skill that intimately relates to creativity (Box III.5.4).

Source: OECD (2023[1]) PISA 2022 Assessment and Analytical Framework, PISA, OECD Publishing, Paris, https://doi.org/10.1787/dfe0bf9c-en.

Curiosity

Curiosity denotes an eagerness to learn and explore the unknown and is thus related to students' attitudes towards creative thinking (Box III.5.3). Students reported more curiosity when considering everyday life situations, as opposed to school experiences. A wide majority reported being curious about many different things (77% on average across

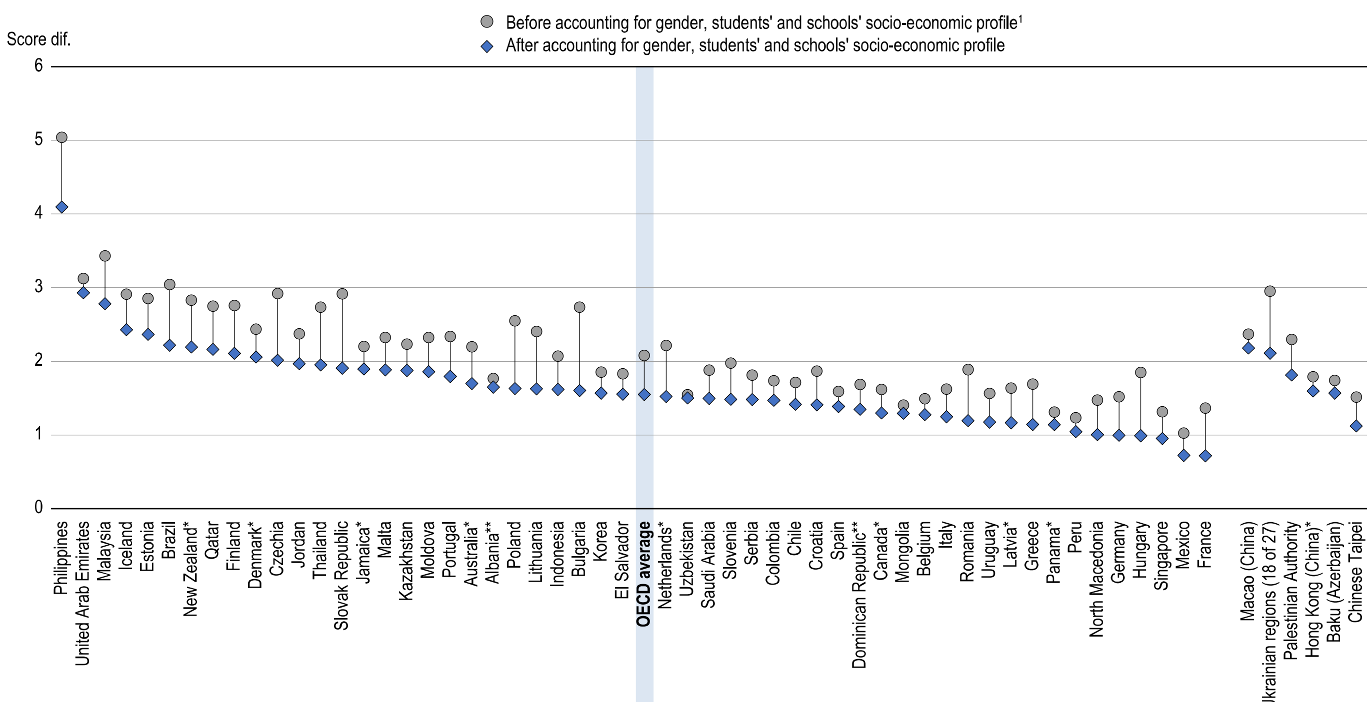
OECD countries) and liking to know how things work (77%) (Table III.B1.5.29). While 70% of students reported that they like learning new things, only 50% said they love learning new things *in school*.

A significant socio-economic gap exists in the index of curiosity. On average across OECD countries, there was a 0.36 index-unit difference between advantaged and disadvantaged students (more than one-third of its standard deviation, close to 1); and a 0.21 difference between advantaged and disadvantaged schools (Table III.B1.5.30). In many participating countries and economies, girls reported being significantly more curious than boys, with the highest gender gaps observed in Albania**, the Palestinian Authority, Jordan, the Dominican Republic** and Kosovo (as always, in descending order). However, in wealthier countries and economies, the curiosity gender gap was lower or even inverted and in favour of boys, as was the case on average across OECD countries and in Singapore and Chinese Taipei.

Students who reported a higher sense of curiosity performed better in creative thinking. On average across OECD countries, a one-unit increase in the index of curiosity was associated with a moderate increase of around 1.5 points in the creative thinking score – after accounting for gender and student and school socio-economic profile (Figure III.5.10). This relationship held for virtually all participating countries and economies, with the highest changes observed in the Philippines, the United Arab Emirates and Malaysia (above 3 score points).

Figure III.5.10. Change in creative thinking performance associated with curiosity

Difference in creative thinking score associated with one-unit change in the index of curiosity, before and after accounting for gender and students' and schools' socio-economic profile

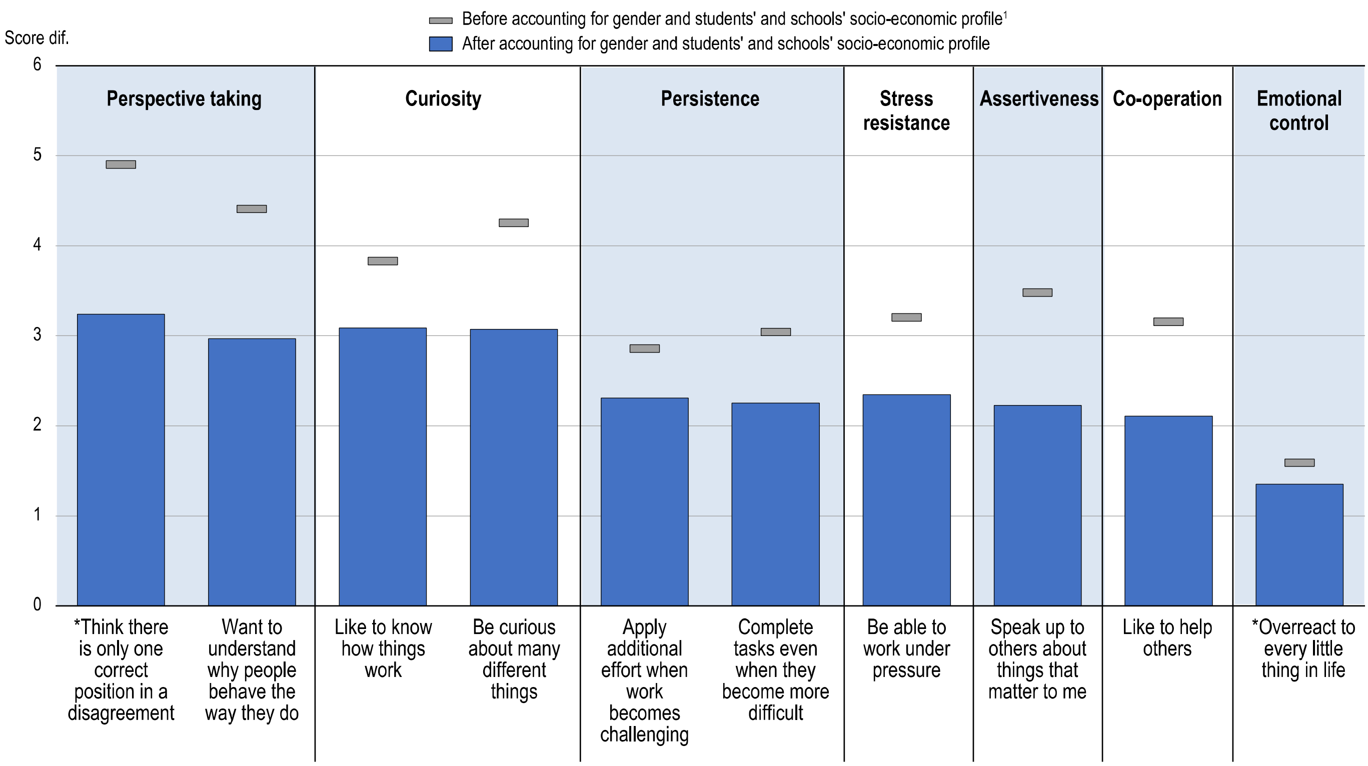


1. The socio-economic profile is measured by the PISA index of economic, social and cultural status.
Notes: Only countries and economies with available data are shown.
All score-point differences are statistically significant (see Annex A3).
Countries and economies are ranked in descending order of the score-point difference in creative thinking, after accounting for gender, students' and schools' socio-economic profile.
Source: OECD, PISA 2022 Database, Table III.B1.5.32. The StatLink URL of this figure is available at the end of the chapter.

In particular, students who reported being curious about many things, who like to know how things work, or who like learning new things, respectively scored about 3 points higher than those who did not, on average across OECD countries (Figure III.5.11).

Figure III.5.11. Change in creative thinking performance associated with social-emotional characteristics

Change in creative thinking score associated with agreeing/strongly agreeing (or disagreeing/strongly disagreeing)* with the following statements; OECD average



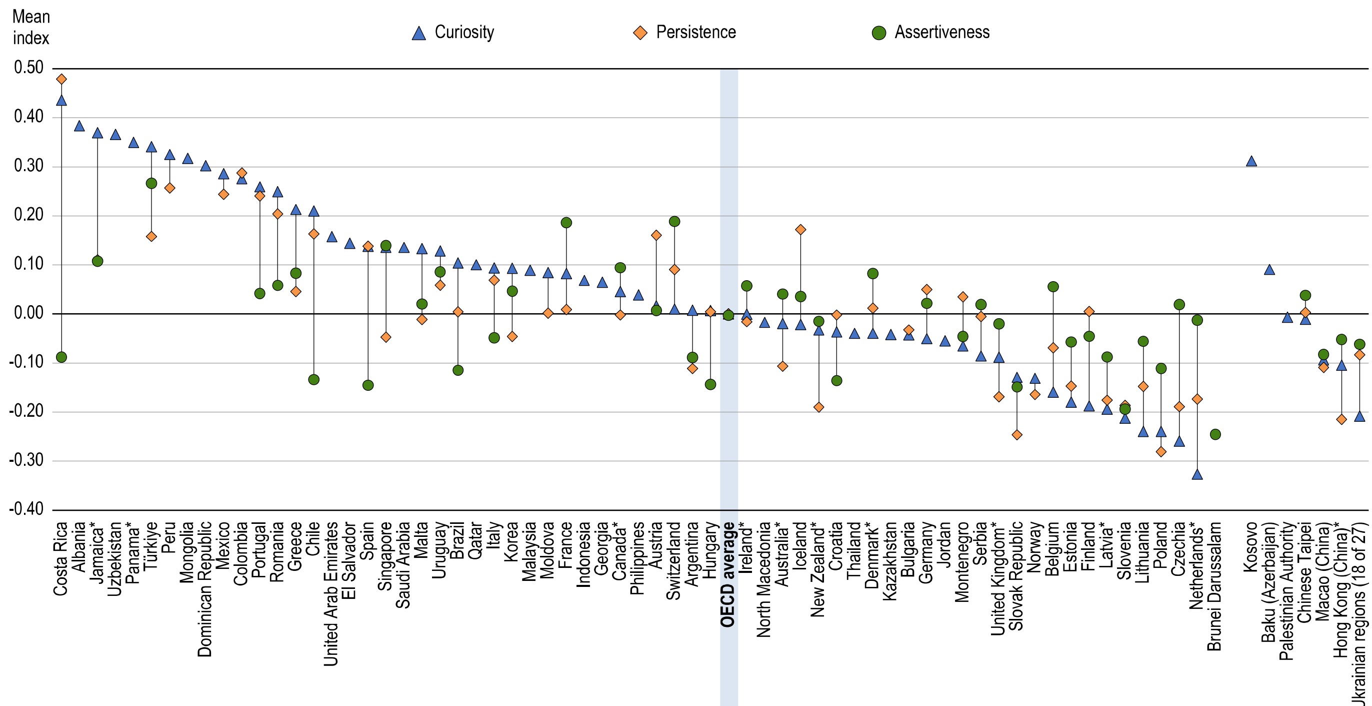
1. The socio-economic profile is measured by the PISA index of economic, social and cultural status.
* Indicates the change in creative thinking score when disagreeing/strongly disagreeing with the item.
Note: All score-point differences are statistically significant (see Annex A3).
Single items are grouped by broader constructs. Each construct is then ranked according to the magnitude of its item most associated with student creative thinking performance, after accounting for students' and schools' characteristics.
Source: OECD, PISA 2022 Database, Tables III.B1.5.26, III.B1.5.28, III.B1.5.32, III.B1.5.35, III.B1.5.37, III.B1.5.39 and III.B1.5.41. The StatLink URL of this figure is available at the end of the chapter.

Persistence

Persistence is also instrumental to the creative thinking process, as it allows students to maintain concentration for long periods and deal with frustrations that may arise when generating and iterating upon novel ideas (Box III.5.3). The index of persistence highly correlated with that of curiosity (more than other constructed indices, Table III.5.1): students who believe they are curious tend to believe they are persistent too; and countries with more curious students tend to be countries with more persistent students (Figure III.5.12).

Figure III.5.12. Students' social-emotional characteristics related to creative thinking

Mean index comparison across countries and economies



Notes: Only countries and economies with available data are shown.
Countries and economies are ranked in descending order of the mean index of curiosity.
Source: OECD, PISA 2022 Database, Tables III.B1.5.23, III.B1.5.29 and III.B1.5.36. The StatLink URL of this figure is available at the end of the chapter.

Across participating countries and economies, a majority of 15-year-old students reported being perseverant when facing challenges. On average across OECD countries, most students said that they keep working on a task until it is finished (62%), even when it becomes more difficult than they thought (55%) or boring (54%) (Table III.B1.5.23). Larger proportions of students disagreed with statements that are phrased negatively, as they reflect laziness or unwillingness more than a lack of persistence. For example, on average across OECD countries, only a minority of students agreed that they give up after making mistakes (15%), that they give up easily (18%), or that they stop doing homework if it is too long (27%) or when work becomes too difficult (27%). A similar pattern emerges between students' views on these supporting attitudes and the attitudes towards creative thinking examined earlier in this chapter. Namely, students appear more confident about their dispositions towards these activities when prompted to think about broad, everyday life situations rather than about their school life. Another similar pattern is the observation that students in Latin American countries reported the highest levels of persistence compared to others, with Costa Rica, Colombia, Peru and Mexico topping the list.

In most participating countries, boys showed significantly higher persistence than girls; and so did socio-economically advantaged students and students in advantaged schools (Table III.B1.5.25).

Reporting higher levels of persistence is also associated with stronger creative thinking performance. On average across OECD countries, a one-unit increase in the index of persistence was associated with a 1.2 points difference in the creative thinking scale – again, accounting for gender and students' and schools' profiles (Table III.B1.5.26). The more persistent students think they are, the better they performed in the assessment. This positive relationship held for all participating countries and economies except Chinese Taipei. By contrast with curiosity, the associated score-point increase remained quite homogenous across jurisdictions, with a minimum at 0.5 point in Romania and Singapore, and a maximum of just over 2 points in Denmark*.

Perspective taking

Perspective taking is linked to creativity (Box III.5.4) and supports creative thinking (Box III.5.3). Considering multiple perspectives on a topic, reflecting on (new) ideas and assessing alternative solutions from different points of view are typical critical thinking processes that are also central to creative thinking, as examined in Chapter 1 of this volume, and to related competencies such as design thinking.

Box III.5.4. Links between creativity and critical thinking

Commonalities in definitions

Creativity and critical thinking are two distinct but related higher-order cognitive skills. Both are cognitively challenging and involve some similar thought processes, but their goals differ. While creativity aims to create novel and appropriate ideas and products, critical thinking aims to carefully evaluate statements, ideas and theories relative to alternative explanations or solutions to reach a considered position. The research on creativity and on critical thinking do not overlap much, even though critical thinking plays an important role in creativity, and vice versa. School curricula and educational rubrics are, however, prone to group them together and to refer to "creative and critical thinking" collectively.

Many of the cognitive processes involved in creativity and critical thinking share commonalities. Both require prior knowledge in the domain of application. Working with a network of experts and teachers on internationally-agreed and practical definitions of creativity and critical thinking, the OECD Centre for Educational Research and Innovation (CERI) "Fostering students' creativity and critical thinking in education" project designed rubrics that outlined how the skills that need to be deployed for both competencies can be grouped under the same four categories: imagining, inquiring, doing and reflecting (Vincent-Lancrin et al., 2019[34]). Creativity puts more emphasis on imagining (brainstorming, generating ideas and alternatives), while critical thinking puts more emphasis on "inquiring", including its more analytical and systematic dimension (understanding and decomposing the problem, etc.). However, critical thinking also involves imagining alternative theories, counterfactuals, reasons, and results in an action (making a judgment); while creativity requires making judgments and decisions about the alternative ideas generated in the imaginative process, and more fundamentally to examine the assumptions of existing solutions and conventions before action.

Both creativity and critical thinking require a certain level of openness and curiosity. Engaging in both thinking processes may lead to challenging authority, values or accepted norms, and this is what makes them both valuable, and sometimes challenging, endeavours.

Commonalities in educational implications

In an educational context, both creative and critical thinking pursue a deeper understanding of knowledge and solutions, and thus, deeper learning. Developing creativity and critical thinking can improve student learning and enable students to acquire expertise in a domain – regardless of whether engaging in such thought processes ultimately leads to new knowledge and solutions.

Even though at the conceptual level, both creativity and critical thinking can be described in domain-general terms, they are mainly domain-specific in practice: they require knowledge about a field or specific context to be practiced, and usually being a strong creative or critical thinker in one domain does not imply significant transfer of those skills to another domain (Barbot, Besançon and Lubart, 2016[35]). These implications are straightforward for education. It does not mean that these skills cannot or should not be described in similar ways for all domains or subjects, nor that similar patterns cannot be recognised across domains. However, it does imply that creativity and critical thinking should be integrated and experienced with learning in specific subject areas, rather than as a special class on creativity or on critical thinking. In terms of assessment, this also implies that performance in a specific domain or type of task should not be generalised to people's creativity or critical thinking in general.

Note: The CERI creativity and critical thinking project's rubrics, as well as a wealth of interdisciplinary and discipline-specific lessons plans, are available here: https://www.oecd.org/education/ceri/fostering-assessing-students-creative-and-critical-thinking-skills-in-higher-education.htm.
Source: Vincent-Lancrin et al., (2019[34]), *Fostering Students' Creativity and Critical Thinking*, https://doi.org/10.1787/62212c37-en.

On average across OECD countries, less than half of students disagreed or strongly disagreed that there is only one correct position in a disagreement (46%), with two countries where the proportion went below 20% (Thailand and Indonesia in descending order) (Table III.B1.5.33). More students reported that they imagine how they would feel if they were in somebody else's place (68% on average across OECD countries) and that they want to understand why people behave the way they do (67%).

In nearly all participating countries and economies, girls tended to show higher dispositions towards perspective taking than boys; and so did socio-economically advantaged students over their disadvantaged peers (Table III.B1.5.34).

PISA 2022 data show that perspective taking is strongly associated with students' creative thinking proficiency (Figure III.5.11, Tables III.B1.5.37 and III.B1.5.39). Students who disagreed (or strongly disagreed) that there is only one correct position in a disagreement scored over 3 points higher than their peers on the creative thinking assessment, on average across OECD countries and after accounting for gender and students' and schools' profiles (Table III.B1.5.35). Those who want to understand why people behave the way they do scored around 3 points higher than those who do not; as did those who imagine how they would feel if they were in somebody's else place. Above a 3-point score difference constitutes a large performance gap, especially after controlling for other factors associated with higher performance in general.

Further analyses examined the relationships between students' creative thinking performance and other social-emotional constructs and attitudes that relate to their assertiveness, co-operation, stress resistance and emotional control. No strong relationships emerged overall, though a sample of sub-attitudes did positively relate to creative thinking performance, as reported in Figure III.5.11. Students who reported that they do not keep their opinions to themselves in group discussions, are comfortable with taking the lead role in a group, speak up to others about thing that matter to them, and take initiatives when working with their classmates, scored about 2 points higher than their peers on average across OECD countries. Those who reported that they can work under pressure or like to help others also scored about 2 points higher than their peers.

Box III.5.5. Examples of system-level initiatives that target beliefs and attitudes towards creative thinking

A consensus has now emerged in academic research regarding the malleability and teachability of creative thinking as a skill. However, the same cannot be said about many of the beliefs and attitudes that are identified in this chapter as associated with creative thinking proficiency, whether they are learning attitudes or broader social-emotional characteristics. In many contexts, curiosity, persistence, or open-mindedness are still perceived as personality traits, innate talents that no intervention can influence.

Nonetheless, several jurisdictions and education systems have aimed to change students' beliefs about creativity and nurture attitudes and dispositions that support their creative thinking process. Students are not necessarily the primary target of such policies though; most often, efforts are targeted towards teachers and the broader school environment, with expectations that they will trickle down to students.

Changing beliefs, attitudes and mindset: An OECD experimental study on creativity and critical thinking

Between 2015 and 2019, an OECD study aimed at fostering and measuring creativity (and critical thinking) in education, working with networks of schools and teachers in 11 countries to develop shared definitions and trial a set of pedagogical resources that exemplify what it means to teach, learn and make progress in creativity (and critical thinking) in primary and secondary education.

An important lesson learnt from the project is that a key condition for the successful implementation of activities with opportunities for creative (and critical thinking) is to create a caring and non-threatening environment where students are willing to take the risk of sharing their personal ideas – see Chapter 6 of this Volume for more on classroom and school openness to creativity. This environment presupposes a series of teacher attitudes and beliefs, such as a positive attitude towards mistakes and a belief in the malleability of students' skills and knowledge. It also requires discernment and the ability to lead good dialogues and conversations with students.

This approach helps students develop a growth mindset on creativity, which in turn helps students persist longer in the creative process. For instance, the teacher induction programme developed by the trial team in **the Netherlands** discussed a practice that consisted of displaying the “most beautiful mistake” that occurs while attempting to solve a mathematics problem, and from which the entire class would learn something. Another example from this programme was to choose a question that the teacher themself cannot resolve, as a way to make it clear to students that the thinking process behind a mathematical problem can be as important as its answer. Other lesson plans attempted to nurture a risk-free environment through mindfulness techniques that make students more aware of their self-image, emotions and goals. This approach can help learners to dare to propose and share new and unexpected ideas.

Making space for attitudes towards creative thinking

Some countries have implemented similar pilot projects that aim to scale at the whole education level. For instance, “School for an Innovator” (*Szkoła dla innowatora*) in **Poland** is a three-year pilot project that supports teachers and primary school principals in introducing changes allowing for the effective development of innovative competencies in students, including courage and risk taking, creativity, curiosity, having a hobby, persistence or improvising. Educational programmes supporting students’ innovative skills and attitudes have been designed and implemented in 20 schools across the country, and positive outcomes from the initiative are expected to be gradually extended to other schools.

Note: 1. The sample sizes, the relative short duration of the intervention with students, and the fact that the intervention was still under development invite interpreting them with caution.
Source: (OECD, 2023[36]), Supporting Students to Think Creatively: What Education Policy Can Do, retrieved from: https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1_; (Vincent-Lancrin et al., 2019[34]), *Fostering Students' Creativity and Critical Thinking*, https://doi.org/10.1787/62212c37-en.

Goal setting and expectations for the future

Setting goals and expectations, and persevering until they are achieved, denotes a set of student attitudes that are conducive to creative thinking – at least within the context of an exercise, a task or a piece of schoolwork. On a longer timeframe, PISA 2022 also asked students about their goals and expectations for the future, namely about the level(s) of education they expect to complete and about the kind of job they expect to work at 30 years old. Answers to those questions can be seen as expressions of students’ motivation, may it be intrinsic or extrinsic, and may thus relate to their creative thinking performance. Reciprocally, these data cast light on the extent to which positive attitudes related to creative thinking shape future study and career aspirations. Furthermore, analysing the sectors in which students expect to work, in light of their current creative thinking proficiency, may allow the identification of potential skills mismatch.

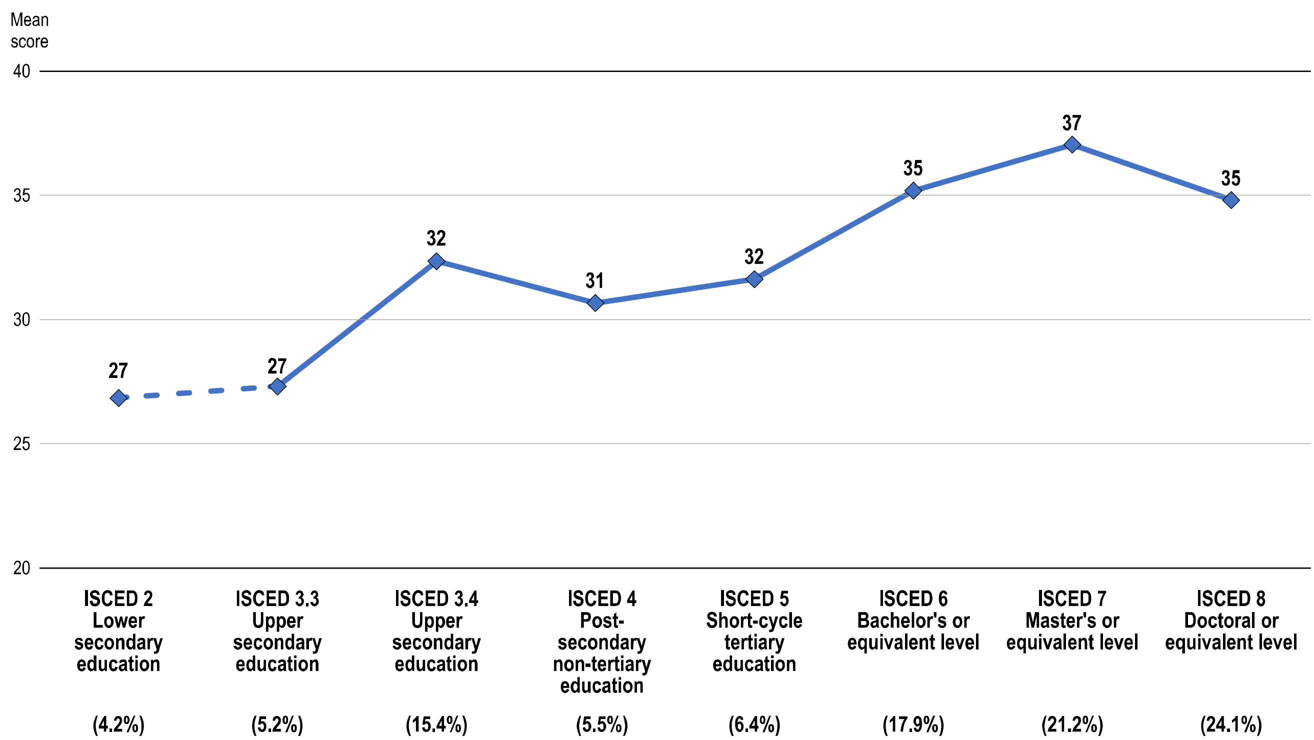
Expected end of education

Fifteen-year-old students who expect to complete at least a certain degree of higher education demonstrated more creative thinking proficiency than those who have lower education expectations. Accounting for students’ and schools’ characteristics, this finding held across all participating countries and economies except Kazakhstan. On average across OECD countries, the 70% of 15-year-old students who expect to complete at least a certain degree of higher education (ISCED 5 and above) scored 2.4 points higher than their peers. Further accounting for their mathematic and reading performance, their advantage in creative thinking appears lower but remains significant, at close to 1 score-point (Tables III.B1.5.43 and III.B1.5.45).

Looking more closely at students’ answers to the question, it appears that the score-point increase in creative thinking performance is relatively linear along students’ expected end of education: the higher their expectations, the higher their scores (Figure III.5.13). Two exceptions exist though; first, students who expect to stop after they complete a general upper-secondary level of education (ISCED 3.4, which directly leads to tertiary education) largely outperformed those who expect to stop after a post-secondary, non-tertiary education degree (ISCED 4) and are on par with those who expect to complete a short-cycle tertiary education degree (ISCED 5) (Table III.B1.5.46). This is partly explained by the fact that in many countries, 15-year-old students are already enrolled in either a general or vocational track, so the selection bias is important and reflects the differences in creative thinking performance observed in those two populations (see Chapter 3). Second, those who expect to complete every level education up to a doctoral level (ISCED 8) scored lower than those who expect to leave formal education after a bachelor's or a master's degree. The reason for that partly lies in student over-statement: 23% of students said they expect to complete a doctoral degree or equivalent (more than any other level), which probably hides a number of streamliners (students ticking all the boxes), or a self-desirability bias, or simply a misunderstanding of what a doctoral degree is. Accounting for gender, students' and schools' profile flattens the curve, but level-to-level differences remain statistically significant. Further accounting for mathematics and reading performance, only the strongest differences remain statistically significant (Table III.B1.5.46).

Figure III.5.13. Creative thinking performance and expected end of education

OECD average



Notes: The share of students at each highest expected level of education is shown in parentheses.
This percentage corresponds to the average of OECD countries that administered the test on creative thinking.
Differences between categories that are not statistically significant are marked with dotted lines (see Annex A3).
Source: OECD, PISA 2022 Database, Table III.B1.5.44. The StatLink URL of this figure is available at the end of the chapter.

Expected job at 30 years old

The PISA 2022 assessment also asked 15-year-old students about the kind of job they expect to have at 30 years old. Student responses can be coded and classified according to the 2008 International Standard Classification of Occupations (ISCO-08). Interestingly, no significant difference in creative thinking performance was observed between students who have a clear idea about their future job, and those who do not. However, among those who already have a clear idea, a sharp difference appeared between students who expect to work a job in the cultural and creative sectors, and those who expect to work in a different sector.[1] On average across OECD countries, students who expect to work in the cultural and creative sector scored over 2 points higher than their peers in creative thinking (Table III.B1.5.49). This difference is not a result of a comparison between the career expectations of high-performing students and students who struggle: accounting for their mathematic and reading performance, as well as for their gender and for students' and schools' socio-economic profile, the difference remained significant at around 1 score point. Furthermore, this score-point advantage in creative thinking was higher than the one observed between students who expect to work as managers or professionals (jobs that belong in the top two major groups in the ISCO-08 classification, some of which include cultural and creative sectors), after accounting for the same characteristics (Table III.B1.5.54).

These score-point differences suggest that there is a good skills match between students who demonstrate the highest creative thinking proficiency at 15 years old and those who expect to work a job in the cultural and creative sectors at 30 years old – though working in such sectors is not always indicative of working a job that involves engaging in creative thinking. It also aligns with the first results from the OECD survey of social and emotional skills that evidenced high corelations between students' self-reported creativity and expectations to work a creative occupation at 30-year-old (OECD, 2021[37]). In any case, thinking creatively – as measured in PISA – is an asset in any profession and any sector.

Students who reported having at least one parent working in the cultural and creative sectors did not demonstrate stronger creative thinking than students who do not, accounting for mathematics and reading performance and student and school backgrounds (Table III.B1.5.51). They are, however, more likely to pursue a career in these sectors (Table III.B1.5.48).

Interestingly, the percentage of students who expect to work in the cultural and creative sectors (about 6.1% on average across OECD countries, Table III.B1.5.47) was three times superior to the percentage of students who reported having at least one parent working in these sectors (1.8% on average, Table III.B1.5.50). A share of the difference may be explained by the relative scarcity of those jobs compared to their demand. But there may be other reasons – are these jobs more attractive at 15 than they are at 30? Or does something in the school environment temper students' inclination towards creativity and creative thinking to the benefit of other skills that they see more suitable for the job market? The following Chapter 6 will address these questions and others.

Table III.5.2. Student attitudes and beliefs towards creative thinking: Chapter 5 figures and tables

Figure III.5.1	PISA 2022 coverage of student beliefs, attitudes and expectations related to creative thinking
Figure III.5.2	Student beliefs about the nature of creativity
Figure III.5.3	Change in creative thinking performance associated with more open beliefs about the nature of creativity
Figure III.5.4	Students with growth mindset on creativity, by socio-economic status
Figure III.5.5	Change in creative thinking performance associated with holding a growth mindset on creativity
Table III.5.1	Correlations between students' attitudes towards creative thinking and select social-emotional characteristics
Figure III.5.6	Student attitudes towards creative thinking, by country and economy
Figure III.5.7	Change in creative thinking performance associated with sub-attitudes towards creative thinking
Figure III.5.8	Change in student creative thinking performance associated with parents' beliefs about creativity
Figure III.5.9	Change in student creative thinking performance associated with parents' perception of their child's openness to intellect
Figure III.5.10	Change in creative thinking performance associated with curiosity
Figure III.5.11	Change in creative thinking performance associated with social-emotional characteristics
Figure III.5.12	Students' social-emotional characteristics related to creative thinking
Figure III.5.13	Creative thinking performance and expected end of education

StatLink https://stat.link/o7qbg0

Note

[1] The classification of jobs that belong to the Cultural and Creative Sectors (CSS) based on the ISCO-08 classification is retrieved from Galian et al. (2021).

References

Amabile, T. (1997), “Motivating Creativity in Organizations: On Doing What You Love and Loving What You Do”, *California Management Review*, Vol. 40/1, pp. 39-58, https://doi.org/10.2307/41165921. [27]

Amabile, T. (1983), “The social psychology of creativity: A componential conceptualization.”, *Journal of Personality and Social Psychology*, Vol. 45/2, pp. 357-376, https://doi.org/10.1037/0022-3514.45.2.357. [26]

Amabile, T. and M. Pratt (2016), “The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning”, *Research in Organizational Behavior*, Vol. 36, pp. 157-183, https://doi.org/10.1016/j.riob.2016.10.001. [29]

Baer, J. (2016), *Creativity doesn’t develop in a vacuum*, Wiley Periodicals, Inc. [22]

Bandura, A. (1997), *Self-Efficacy: The Exercise of Control*, Worth Publishers, https://books.google.fr/books/about/Self_Efficacy.html?id=eJ-PN9g_o-EC&redir_esc=y. [4]

Barbot, B., M. Besançon and T. Lubart (2016), “The generality-specificity of creativity: Exploring the structure of creative potential with EPoC”, *Learning and Individual Differences*, Vol. 52, pp. 178-187, https://doi.org/10.1016/j.lindif.2016.06.005. [35]

Batey, M. and A. Furnham (2006), “Creativity, intelligence, and personality: a critical review of the scattered literature”, *Genetic, Social and General Psychology Monographs*, pp. pp. 355-429. [10]

Beghetto, R. (2006), “Creative Self-Efficacy: Correlates in Middle and Secondary Students”, *Creativity Research Journal*, Vol. 18/4, pp. 447-457, https://doi.org/10.1207/s15326934crj1804_4. [3]

Beghetto, R. and M. Karwowski (2017), “Toward Untangling Creative Self-Beliefs”, in *The Creative Self*, Elsevier, https://doi.org/10.1016/b978-0-12-809790-8.00001-7. [2]

Berzonsky, M. and C. Sullivan (1992), “Social-Cognitive Aspects of Identity Style”, *Journal of Adolescent Research*, Vol. 7/2, pp. 140-155, https://doi.org/10.1177/074355489272002. [12]

Chávez-Eakle, R. (2009), *Creativity and 16 Personality. Measuring creativity*. [13]

Cooper, M. (ed.) (2014), *Openness/intellect: a dimension of personality reflecting cognitive exploration*, American Psychological Association, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.725.2495&rep=rep1&type=pdf. [16]

Cropley, A. (2006), “In Praise of Convergent Thinking”, *Creativity Research Journa*, Vol. Vol. 18/3, pp. pp.391-404. [20]

Cropley, A. (1990), “Creativity and mental health in everyday life”, *Creativity Research Journal*, Vol. Vol. 13/3, pp. pp. 167-178. [24]

Csikszentmihalyi, M. (2013), *Creativity: The Psychology of Discovery and Invention*, Harper Collins, New York. [30]

Eisenberger, R. and L. Shanock (2003), “Rewards, intrinsic motivation, and creativity: a case study of conceptual and methodological isolation”, *Creativity Research Journal*, Vol. Vol. 15/2-3, pp. pp. 121-130, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.615.6890&rep=rep1&type=pdf. [32]

Feist, G. (1998), “A meta-analysis of personality in scientific and artistic creativity”, *Personality and Social Psychology Review*, Vol. Vol. 2/4, pp. pp. 290-309. [11]

Guilford, J. (1956), “The structure of intellect.”, *Psychological Bulletin*, Vol. 53/4, pp. 267-293, https://doi.org/10.1037/h0040755. [17]

Hennessey, B. and T. Amabile (2010), “Creativity”, *Annual Review of Psychology*, Vol. Vol. 61, pp. pp. 569-598. [28]

Hoever, I. et al. (2012), “Fostering team creativity: Perspective taking as key to unlocking diversity’s potential.”, *Journal of Applied Psychology*, Vol. 97/5, pp. 982-996, https://doi.org/10.1037/a0029159. [33]

Kashdan, T. and F. Fincham (2002), “Facilitating creativity by regulating curiosity”, *The American Psychologist*, Vol. Vol. 57/5, pp. pp. 373-4, http://www.ncbi.nlm.nih.gov/pubmed/12025769. [15]

Kaufman, J. et al. (2010), “Personality and Self-Perceptions of Creativity across Domains”, *Imagination, Cognition and Personality*, Vol. 29/3, pp. 193-209, https://doi.org/10.2190/ic.29.3.c. [8]

Kaufman, S. et al. (2015), “Openness to Experience and Intellect Differentially Predict Creative Achievement in the Arts and Sciences”, *Journal of Personality*, Vol. 84/2, pp. 248-258, https://doi.org/10.1111/jopy.12156. [9]

McCrae, R. (1987), “Creativity, divergent thinking, and openness to experience.”, *Journal of Personality and Social Psychology*, Vol. 52/6, pp. 1258-1265, https://doi.org/10.1037/0022-3514.52.6.1258. [5]

OECD (2023), *PISA 2022 Assessment and Analytical Framework*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/dfe0bf9c-en. [1]

OECD (2023), *PISA 2022 Results (Volume II): Learning During – and From – Disruption*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/a97db61c-en. [23]

OECD (2023), *Supporting Students to Think Creatively: What Education Policy Can Do*, https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1_. [36]

OECD (2021), *Beyond Academic Learning: First Results from the Survey of Social and Emotional Skills*, OECD Publishing, Paris, https://doi.org/10.1787/92a11084-en. [37]

Prabhu, V., C. Sutton and W. Sauser (2008), “Creativity and Certain Personality Traits: Understanding the Mediating Effect of Intrinsic Motivation”, *Creativity Research Journal*, Vol. 20/1, pp. 53-66, https://doi.org/10.1080/10400410701841955. [6]

Reiter-Palmon, R. and E. Robinson (2009), “Problem identification and construction: What do we know, what is the future?”, *Psychology of Aesthetics, Creativity, and the Arts,*, Vol. Vol. 3/1, pp. pp. 43-47. [18]

Runco, M. (1997), *The creativity research handbook*. [19]

Schank, R. and R. Abelson (1977), *Scripts, Plans, Goals, and Understanding : An Inquiry into Human Knowledge Structures*, L. Erlbaum Associates. [21]

Snyder, C. (ed.) (2002), *The concept of flow*, Oxford University Press, New York, NY. [31]

Sternberg, R. (ed.) (1998), *The nature of creativity as manifest in its testing*, Cambridge University Press, http://psycnet.apa.org/record/1988-98009-002. [25]

T. Rickards, M. (ed.) (2009), *Creativity and personality*, Routledge/Taylor & Francis Group. [14]

Vincent-Lancrin, S. et al. (2019), *Fostering Students’ Creativity and Critical Thinking: What it Means in School*, Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/62212c37-en. [34]

Werner, C. et al. (2014), “The Chinese Version of the Revised Creativity Domain Questionnaire: First Evidence for its Factorial Validity and Systematic Association with the Big Five”, *The Journal of Creative Behavior*, Vol. 48/4, pp. 254-275, https://doi.org/10.1002/jocb.51. [7]

6 School environment and creative thinking

This chapter explores how 15-year-old students' school environment, and the opportunities they have to engage in creative activities with their teachers or at home, may influence their creative thinking proficiency. The chapter first compares school principals' and teachers' beliefs about creativity with those of their students. Then, it analyses the use of certain pedagogies in the classroom and student participation in different activities at school, examining how they relate to creative thinking proficiency in different types of tasks. Finally, the chapter looks at students' broader environment, and in particular through the lens of digitalisation, assessing the relationship between digital tools and creative thinking performance.

For Australia*, Canada*, Denmark*, Hong Kong (China)*, Ireland*, Jamaica*, Latvia*, the Netherlands*, New Zealand*, Panama*, and the United Kingdom* caution is advised when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).

For Albania** and the Dominican Republic**, caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

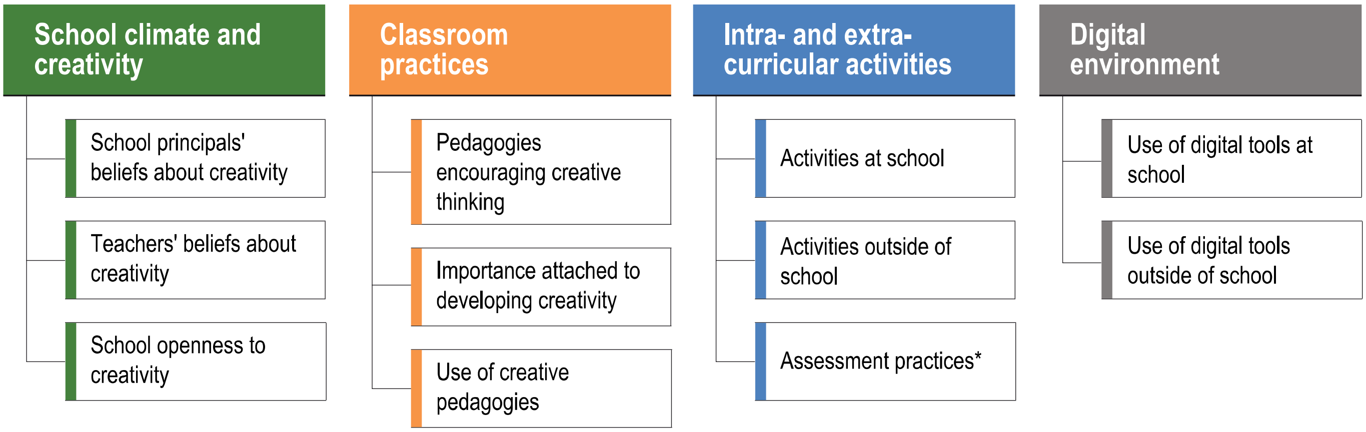
> "A creative life is an amplified life. It's a bigger life, a happier life, an expanded life."
>
> Elizabeth Gilbert

Classroom and school environments, and broader educational approaches, are important factors that can shape creative thinking in education (OECD, 2023[1]). But can school really kill creativity? Are we all born creative and then educated out of it? This has been the concern of many researchers (Sarson, 1990[2]; Sharan and Tan, 2008[3]; Sternberg, 2007[4]; Robinson and Aronica, 2009[5]). It is also a concern for students themselves, as reported by a recent OECD study on social-emotional skills finding that 15-year-old students *felt* less creative than 10-year-olds did (OECD, 2024[6]). Yet, nurturing a classroom climate conducive to creativity, cultivating positive beliefs and attitudes towards creative thinking amongst educators, and increasing opportunities and rewards for students to express their ideas and produce creative work can all contribute to supporting the development of creative thinkers. This chapter analyses how student performance in creative thinking relates to different aspects of students' school and social environments. It examines school principals', teachers' and parents' beliefs and attitudes towards creativity and compares these with students' own beliefs and attitudes. It also casts light on the extent to which students are exposed to certain pedagogies and activities, both inside and outside of school, and how these practices may support creative thinking.

What the data tell us

- On average across OECD countries, about 90% of 15-year-old students are in schools whose principal believes that creativity can be trained, or that it is possible to be creative in nearly any subject. This is about twice as much as the share of students who think they can do something about their own creativity. Though educators' openness helps nurture a positive school climate around creativity, PISA 2022 data suggest that it takes more than positive beliefs from school staff to really support students' creative thinking.
- Certain classroom pedagogies are related to students' proficiency in creative thinking. On average across OECD countries, between 60 and 70% of students reported that their teachers value their creativity, that they encourage them to come up with original answers, and that they are given a chance to express their ideas in school – with relatively higher shares in Latin American countries, and lower shares in European countries. Students who experience more of these pedagogies tended to demonstrate slightly stronger creative thinking proficiency than their peers, especially when asked to evaluate and improve ideas in the context of scientific problem solving.
- Students who take part in art, music, or creative writing activities/classes on a weekly basis at school, scored only modestly better than their peers. They do, however, demonstrate relatively stronger creative thinking in the domain of visual expression and in the most difficult questions of the assessment overall; and they reported higher levels of openness to intellect and creative-self efficacy, two attitudes conducive to creative thinking. Both more frequent (every day) and more irregular (once or twice every semester) attendance in these activities is negatively related to performance, though (self-)selection plays a role here.
- Digitalisation has transformed the social environment of 15-year-old students, inside and outside of school. Using digital tools for learning purposes for more than one hour a day only modestly relates with students creative thinking performance, as it did with mathematics (+0.8 points outside of school, +0.2 points at school). Spending the same amount of time on digital tools for leisure purposes, however, plays out very differently on students' creative thinking performance: positively when this time is spent outside of school (about 3 points), but – unsurprisingly – negatively if spent at school (-0.8 points).

Figure III.6.1. PISA 2022 coverage of aspects of the educational environment related to creative thinking



Notes: This chapter covers items from the following PISA 2022 background questionnaires: students, school principals, teachers and ICT. See Annex A6 for more information on the data origin of the indices and constructs presented above.
The * indicates that the results on schools' assessment practices, and their association with creative thinking performance, can be found in the annex chapter (Table III.B1.5).

School climate and creativity

Do educators believe creativity and creative thinking are important? Do school principals feel that their school and school staff provide spaces for creativity, and do these beliefs match how students feel about their school environment? This section examines openness towards creativity in school and how a favourable school climate relates to student performance in creative thinking.

School leaders' beliefs about the nature of creativity

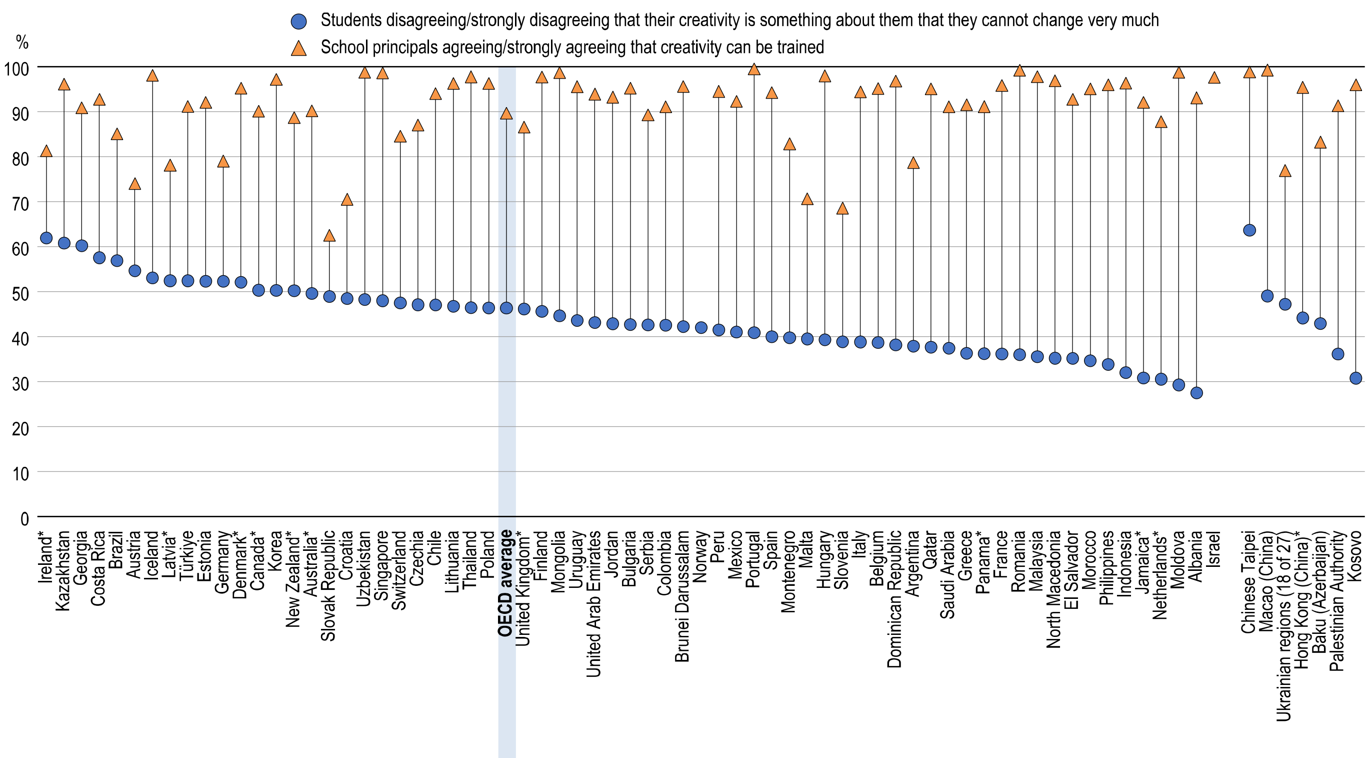
Across participating countries and economies, school principals generally hold favourable beliefs about the nature of creativity and its potential to be developed through practice. On average across OECD countries, almost all students are in a school whose principal agreed or strongly agreed that there are many different ways to be creative (98%) or that it is possible to be creative in nearly any subject (89%) (Table III.B1.6.55).

The vast majority of students also attend a school whose principal reported that creativity is a skill that can be trained (90% on average across OECD countries) (Figure III.6.2). Only in the Slovak Republic, Slovenia, Croatia, Austria and Malta do less than three out of four students have school principals who disagreed with the notion that creativity can be trained. On average across OECD countries, school principals' beliefs about the nature of creativity were similarly favourable across advantaged and disadvantaged, public and private, and general and vocational schools (Table III.B1.6.56). Though this general lack of variation is driven by the very favourable beliefs of nearly all school principals, there are a few countries where large discrepancies between schools exist. In Montenegro, Malta, Georgia, North Macedonia, Albania**, Serbia and Latvia*, principals of socio-economically advantaged schools were much more likely to report that creativity can be trained and/or that it can be expressed in nearly any subject than their peers (more than 15-percentage points difference with their colleagues in disadvantaged schools); while it was the opposite in Croatia.

Given the largely favourable views of school principals across most countries and economies, what school leaders believe about creativity was rarely associated with differences in student performance. Additionally, their beliefs were not necessarily matched by students. For instance, the share of students who attend a school whose principal believes creativity can be trained was about twice the proportion of students who think their creativity is something about them that they can change very much (47% on average across OECD countries, Figure III.6.2) – in other words, who hold a growth mindset towards creativity. The largest gaps between principals' and students' beliefs were observed in European countries – particularly Moldova, Albania** and Kosovo (in descending order) – but that is also the region where principals' and students' beliefs were most aligned, as observed in the Slovak Republic, Ireland*, Austria and Croatia. While it may be easier (and more socially desirable) for school principals to believe that creativity can be trained, in general, than it is for students to believe their own creativity can be improved, the gap between what learners and those in charge of their learning think is important – especially as PISA 2022 results show that students with a growth mindset towards creativity outscored their peers with fixed mindsets, after accounting for students' and schools' characteristics (see Chapter 5). Therefore, a first step towards nurturing school environments that are conducive to creative thinking may be for educators to more actively transmit their favourable beliefs about the nature and malleability of creativity to their students.

Figure III.6.2. Students' and school principals' growth mindset on creativity

Percentage of students who disagree/strongly disagree that "Your creativity is something about you that you cannot change very much"; percentage of students in schools whose principal agree/strongly agree that "Creativity can be trained"



Notes: Only countries and economies with available data are shown.

Countries and economies are ranked in descending order of the percentage of students holding a growth mindset on creativity.

Source: OECD, PISA 2022 Database, Tables III.B1.5.4 and III.B1.6.55. The StatLink URL of this figure is available at the end of the chapter.

School openness to creativity

School principals mostly believe that students in their school are open to creativity, an index that captures their perceptions of students' openness to learn and to engage in creative work. On average across OECD countries, around 75% of students' principals agreed or strongly agreed that most of their students are creative, imaginative and enjoy doing creative projects (Table III.B1.6.59). However, less than half reported that most of their students are artistic, suggesting that many perceive artistic skills to be somewhat separate to broader creative or imaginative skills. Most school leaders also reported that students enjoy learning new things (89% on average across OECD countries) – which is generally aligned with students when asked the same question. While nearly three-quarters (72%) of students had school principals who reported that most students at their school enjoy work that is challenging. This appears to be a large over-estimation as less than half (47%) of all students across OECD countries reported that they like schoolwork that is challenging (Tables III.B1.6.59 and III.B1.5.11).

The index of school openness to creativity is subject to greater disparities between different types of schools than the index of school principals' beliefs about creativity. On average across OECD countries, principals in charge of socio-economically advantaged schools, private schools, and general education schools tended to report higher levels of openness to creativity from their students (Table III.B1.6.60). The socio-economic gap is important, particularly in Asian countries and economies such as Brunei Darussalam, Malaysia, Hong Kong (China)*, Macao (China), Singapore, but also in Israel, Bulgaria, Romania, Jamaica* and Hungary.

What school principals think of their students' openness to learn and to engage in creative work is moderately associated with students' creative thinking proficiency. A one-unit increase in the index, as reported by school principals, was associated with a 0.3 score-point increase in students' creative thinking proficiency on average across OECD countries (after accounting for students' and schools' characteristics) (Table III.B1.6.62).

Box III.6.1. Teachers' beliefs about creativity and their openness to creative thinking

Results from the PISA 2022 Teacher Questionnaire

Across 17 countries and economies with available data, teachers of 15-year-old students largely held similarly positive beliefs about creativity as school leaders. On average across OECD countries, around 9 in 10 teachers agreed or strongly agreed that creativity can be trained, that people can be creative if they keep trying, and that it is possible to be creative in nearly any subject. Nearly all (98%) believed that there are many different ways to be creative (Table III.B1.6.74). Male and female teachers shared similarly positive beliefs, as did teachers in schools with large or small shares of students from socio-economically disadvantaged homes (Table III.B1.6.75).

Teachers are also confident about their own openness to intellect, with large majorities having reported that they enjoy learning new things (82% on average across OECD countries), that they have a good imagination (80%), or that they are very creative (77%) (Table III.B1.6.76). Women were much more likely to say they enjoy artistic activities (a difference of 11 percentage points) or that they express themselves through art (6 percentage points), while men were more likely to report that they enjoy solving complex problems (6 percentage points) and that they have a good imagination (5 percentage points). The socio-economic composition of their school, however, is not a strong marker of difference (Tables III.B1.6.77 and III.B1.6.78).

Nearly all teachers reported that they attach great importance to developing their students' creativity. On average across OECD countries, more than 9 teachers out of 10 reported valuing students who have many new ideas, and that it is important for students to solve science problems creatively or to produce creative drawings and paintings (Table III.B1.6.79). Teachers in Latin American countries, including the Dominican Republic**, Panama*, Colombia and Costa Rica, reported a particularly strong importance attached to developing their students' creativity.

System-level initiatives to develop teachers' understanding of creativity and their creative self-efficacy

To support the development of creative thinking at school, jurisdictions need to support teachers in their understanding of creativity and in the confidence that they place in their ability to be creative and teach creatively. Research has shown that teachers' creative self-efficacy, encompassing both perceptions about their ability to teach creatively and to facilitate creativity in learners, can give teachers a sense of agency and control for enacting creativity-fostering practices in the classroom (Rubenstein et al., 2018[7]). Teachers' creative self-efficacy is also correlated with their perceptions of the value that society places on creativity, of the potential of students to become creative, and of their own creativity (Rubenstein, McCoach and Siegle, 2013[8]). Amongst countries where teachers attached great importance to developing their students' creativity, it is a practice encouraged through in-service training (i.e. professional development activities) in **Panama** and **Colombia,** while in the **Dominican Republic** it features in initial teacher training (OECD, 2023[1]).

Source: OECD, PISA 2022 Database, Annex B1, Chapter 6.

Pedagogies, activities and school policies conducive to creative thinking

While a school climate that is perceived as broadly open to creativity by both students and educators is a good start, it is not enough for students to develop stronger creative thinking skills. Different educational approaches and practices may encourage or discourage students' creative expression and achievement, for example the use of classroom pedagogies encouraging creative thinking and the availability of and participation in activities related to creativity. For example, students might have more opportunities to develop their creative thinking in schools where teachers encourage them to come up with and express their own ideas, or when they are offered activities that encourage them to produce creative outputs.

Pedagogies encouraging creative thinking

Teaching practices that perpetuate the idea that there is only one way to learn or solve problems, that cultivate attitudes of fear of authority, or that discourage students' curiosity and inquisitiveness can stifle creative thinking (Nickerson, 2010[9]). Research suggests that teaching practices involving group work, finding ideas through brainstorming, playing educational games, debating ideas or current issues, giving students time to explore topics on their own, journaling, and incorporating creative activities like drawing or poetry into projects, offer opportunities to demonstrate and improve creative thinking (see Box III.6.4 on teachers' use of creative pedagogies, which are one element of a broader set of both traditional and innovative pedagogies that can encourage creative thinking). However, teachers need to be supported with relevant training, resources and guidance to use such pedagogies and to encourage students' creative thinking (see Box III.6.2 for field-trialled design criteria, and Box III.6.5 for international system-level initiatives).

Box III.6.2. Fostering and assessing creativity and critical thinking: An international field trial of pedagogical rubrics, lesson plans and design criteria by the OECD

Building a shared understanding of what creativity means, nationally or internationally, is a first step towards nurturing a classroom and school climate conducive to creative thinking. However, while PISA 2022 results show that teachers, school principals and education policymakers largely consider creativity to be an important learning goal, it remains unclear to many what it means to develop it in a school setting. To make this goal more tangible, the OECD Centre for Educational Research and Innovation (CERI) worked with networks of schools and teachers in 11 countries to develop and trial a set of pedagogical resources that exemplify what it means to teach, learn and make progress in creativity (and critical thinking) in primary and secondary education. Through a portfolio of rubrics and examples of lesson plans, teachers in the field gave feedback, implemented the proposed teaching strategies, and documented their work.

These field-trialled lesson plans exemplify the kind of approaches and tasks that allow students to develop their creativity and critical thinking while acquiring content and procedural knowledge across different domains of the curriculum. Eight "design criteria", also co-developed with teachers and experts, and refined throughout the project's implementation, summarise what pedagogies should involve to align with the internationally agreed rubrics on creativity (and critical thinking):

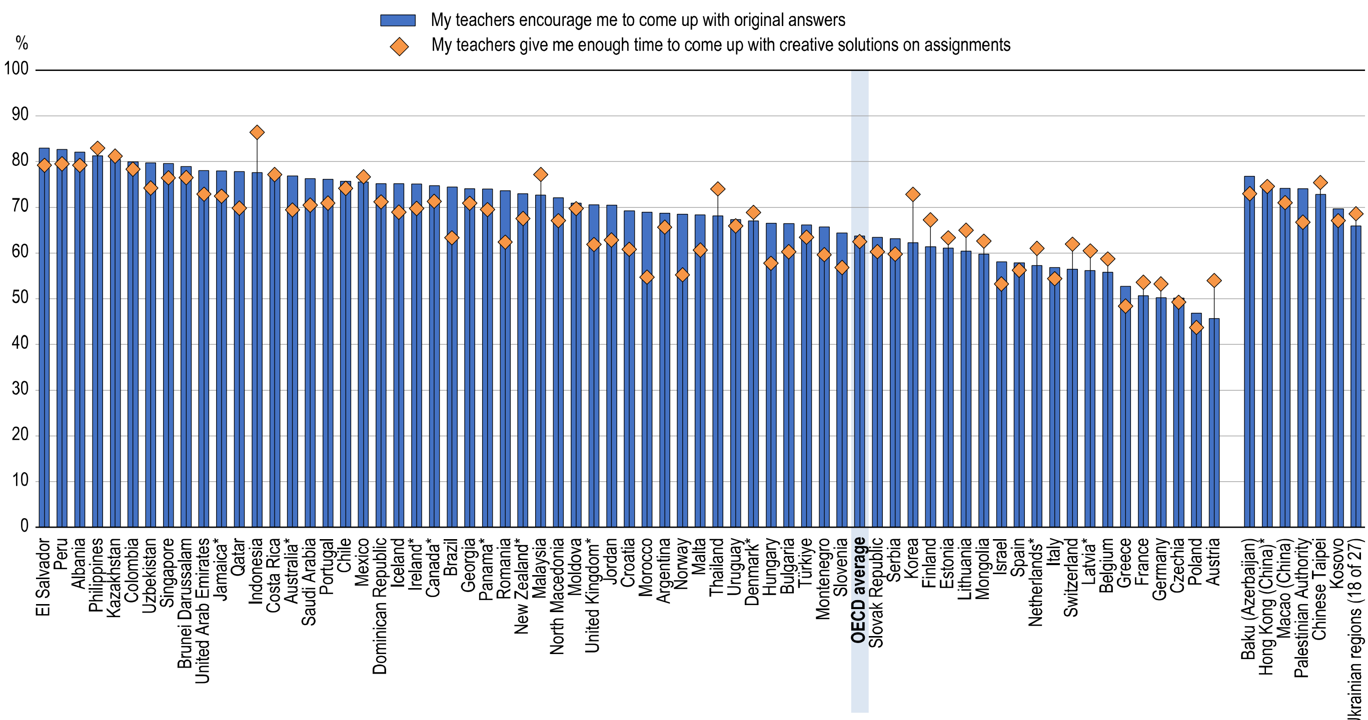
- create students' need and interest to learn;
- be challenging;
- develop clear technical knowledge in one domain or more;
- include the development of a product;
- have students co-design part of the product/solution;
- deal with problems that can be looked at from different perspectives;
- leave room for the unexpected;
- include space and time for students to reflect and to give and receive feedback.

Notes: All of the OECD-CERI "Fostering and assessing creativity and critical thinking" project's outputs are publicly available as open education resources. Rubrics, lesson plans and design criteria can be downloaded here https://oe.cd/5z7. They can also be retrieved from the CERI CCT Mobile App: http://www.oecdcericct.com
Source: Vincent-Lancrin, S., et al. (2019), *Fostering Students' Creativity and Critical Thinking: What it Means in School*, https://doi.org/10.1787/62212c37-en.

Many students across OECD countries believe that their teachers broadly value their creativity (70% of students on average across OECD countries) and that school gives them a chance to express their ideas (69%) (Table III.B1.6.1) – both factors that contribute to creating a positive school climate for creativity, as described in the first section of this chapter. Most students also reported that their teachers employ more concrete practices that are conducive to encouraging creative thinking in the classroom. Notably, about two-thirds of students reported that their teachers encourage them to come up with original answers (63%) or creative solutions on assignments (64%) (Figure III.6.3). Only in Austria, Czechia, Greece and Poland did less than half of students report that their teachers encourage them to come up with original and/or creative solutions on assignments.

Figure III.6.3. Student-reported use of pedagogies encouraging creative thinking

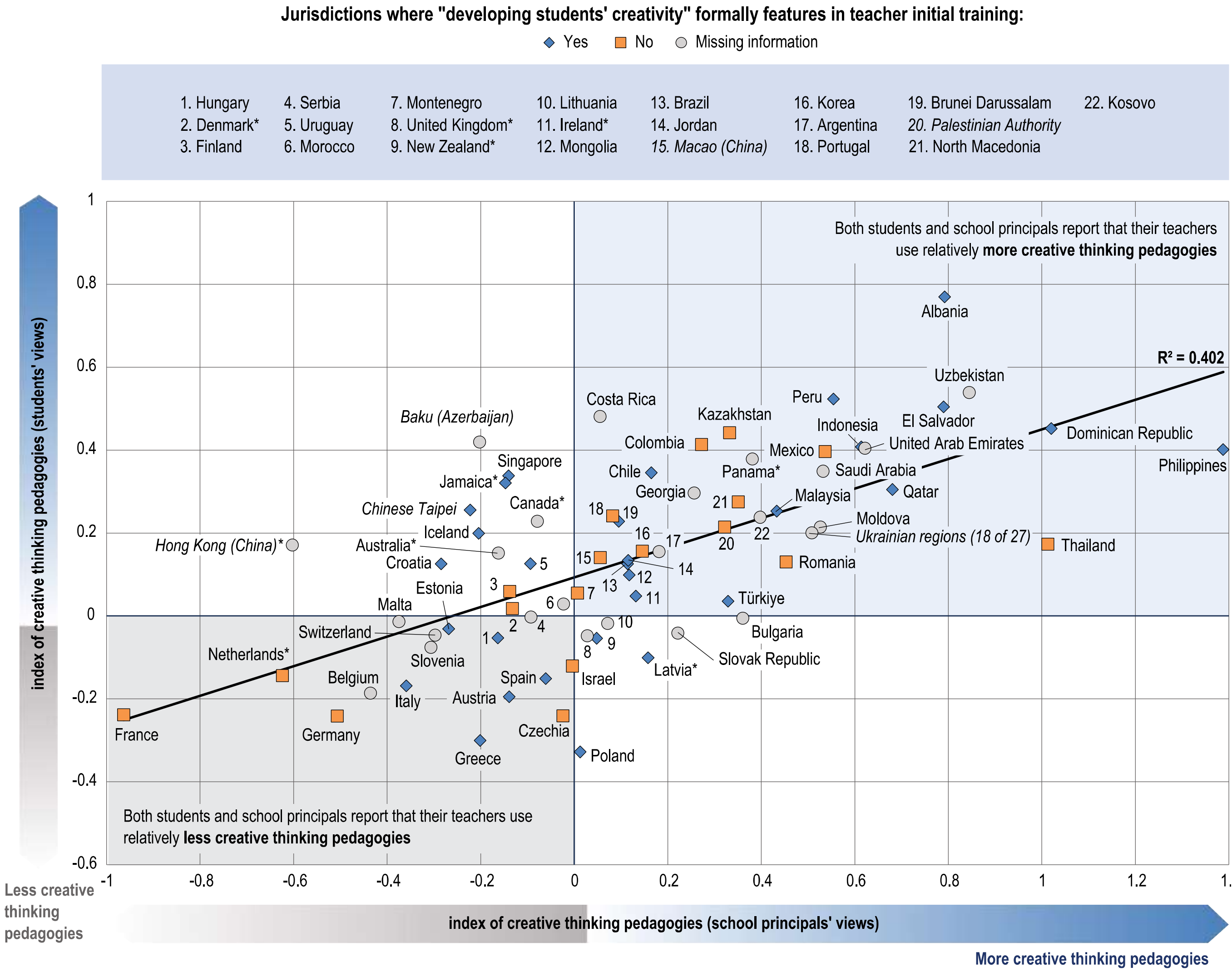
Percentage of students who agree/strongly agree with the following statements



Note: Only countries and economies with available data are shown.
Countries and economies are ranked in descending order of the percentage of students reporting that their teachers encourage them to come up with original answers.
Source: OECD, PISA 2022 Database, Table III.B1.6.1. The StatLink URL of this figure is available at the end of the chapter.

An index of pedagogies encouraging creative thinking combines students' perceptions of their teachers' practices with their broader school openness towards encouraging creative thinking. Many Latin American countries, such as Peru, El Salvador, Costa Rica, the Dominican Republic** and Colombia, are among the countries and economies with the highest index of student-reported creative thinking pedagogies – together with Albania**, Uzbekistan, Kazakhstan, Baku (Azerbaijan) and Indonesia, in descending order (Figure III.6.4, Y-axis). By contrast, the countries at the bottom end of this index exclusively consist of European countries, including Spain, Italy, Belgium, Austria, France, Czechia, Germany, Greece and Poland (also in descending order). Across many countries and economies at the upper end as much as at the lower end of the distribution, "developing students' creativity" is formally integrated into initial teacher training (Figure III.6.4, green markers) (OECD, 2023[1]). PISA results suggest that this is not sufficient for students to perceive more attempts from their teachers to encourage creative thinking.

Figure III.6.4. Students' and school principals' views on their teachers' use of pedagogies encouraging creative thinking



Note: Only countries and economies with available data are shown.
Sources: OECD, PISA 2022 Database, Tables III.B1.6.1 and III.B1.6.67; and OECD, PISA 2022 System-Level Questionnaire on Creative Thinking.
The StatLink URL of this figure is available at the end of the chapter.

On average across OECD countries, socio-economically advantaged students reported that their teachers employ pedagogies encouraging creative thinking more than their disadvantaged peers; but students in socio-economically advantaged schools reported the use of these pedagogies less frequently than their peers in disadvantaged schools (Table III.B1.6.3). This may suggest that students in advantaged schools expect their teachers and broader school environment to encourage and value creative thinking more than they do, thus leading students in advantaged schools to underreport their frequency; or that advantaged schools and their teachers indeed leave less room for student creativity in school assignments, perhaps to the benefit of more traditional pedagogical practices and tasks.

Students in general educational track schools reported fewer pedagogies encouraging creative thinking than students in vocational and prevocational schools (Table III.B1.6.3). This finding may point to differences in the ways that students are taught and assessed in vocational schools, which may also be linked to inherent differences in the kinds of subjects studied by students in vocational schools (Box III.6.3).

Box III.6.3. Pedagogies encouraging creative thinking in vocational and pre-vocational schools

In several countries and economies participating in PISA 2022, a share of 15-year-old students might have already been enrolled in vocational or pre-vocational schools at the time of the assessment. These schools have long emphasised the teaching and practicing of technical skills that meet the specific needs of the sectors and industries that they aim to prepare students for. In addition to technical skills, other “soft skills”, such as self-discipline, reliability, critical thinking and, of course, creativity, are in demand everywhere in the labour market and in wider society, and thus feature highly in the skillset expected from future-ready vocational and training systems (OECD, 2023[10]).

Hands-on training, a hallmark of vocational education and training (VET), is an active and inductive professional learning method where individuals gain knowledge and skills through direct experience and practice, which often requires them to tackle concrete challenges using their own skill set. Hands-on, active-learning environments typical of VET can be leveraged to enhance creative thinking skills. The concept of cognitive apprenticeship, which combines traditional apprenticeship’s hands-on approach with formal schooling’s problem-solving strategies, also thrives in VET settings. Studies suggest that it offers a promising model for developing creative thinking by making the thought processes behind tasks visible and encouraging reflection across different tasks (Collins, Brown and Newman, 1989[11]).

Another feature of some VET programmes is the importance given to the master-apprentice dynamic. A research experiment investigated the development process of “high-level creativity” in the practice of haute cuisine (Stierand, 2014[12]). High-level creativity is defined as “expert-level creativity that produces popular and respected output that, in some cases, will even be known and enjoyed by generations to come” (Kaufman and Beghetto, 2009[13]). Authors found that a master–apprentice relationship allows apprentices to practice their creative sensemaking in open-ended contexts (Agryris, 1982[14]; Cunliffe, 2002[15]; Tsoukas and Chia, 2002[16]) and to experience first-hand the bridging between practice and creativity (Chia, 2003[17]).

Finally, VET courses often involve project-based learning, as well as work-based and problem-based learning. Several studies have highlighted the assets of these learning models to enhance students’ creativity and problem-solving skills (Usmeldi and Amini, 2022[18]; Musset, 2019[19]), pointing to the potential for innovative VET pedagogical approaches to inspire pedagogies in other educational settings (Ulger, 2018[20]).

Across participating countries and economies, school principals and students tend to share the same views on their teachers’ use of pedagogies encouraging creative thinking in their school (Figure III.6.4, X-axis), Although school principals generally all held very favourable views on their teachers’ use of such pedagogies, European school principals appeared relatively more critical than their peers in Latin American countries, Albania**, Indonesia and Uzbekistan.

Unlike students’ reports, principals of socio-economically advantaged schools, as well as principals of general schools, reported a higher incidence of pedagogies encouraging creative thinking in their schools than their colleagues in disadvantaged and vocational schools, respectively (Table III.B1.6.68). One reason for this may be that principals of advantaged and general schools also reported that their schools offer various activities and classes to students more frequently than their peers in other types of schools (see the following section for further information), which may influence their perceptions on the use of pedagogies encouraging creative thinking in their schools.

Box III.6.4. Teacher-reported use of creative pedagogies

In all 17 countries and economies with available data, teachers of 15-year-old students reported that they attached importance to using creative pedagogies. Debating ideas or current issues, finding ideas though brainstorming, group work, and giving students time to explore topics on their own, are practices valued by more than 9 out of 10 teachers, on average across OECD countries (Table III.B1.6.82). Playing educational games, journaling, or incorporating creative activities like drawing or poetry into projects, are also important for a majority of teachers. The importance given to teaching practices has to be put into perspective of the autonomy given to teachers across systems: while 9 out of 10 teachers on average across OECD countries said they have a lot or full control over their teaching methods, only 7 out of 10 reported the same autonomy in determining course content (Table III.B1.6.85).

The use of creative pedagogies is more gendered than the beliefs teachers hold about creativity (Box III.1.1). On average across OECD countries, 76% of female teachers, compared to 64% of male teachers, reported that they attach importance to incorporating creative activities into projects (a difference of 12 percentage points). Playing educational games, journaling, finding ideas through brainstorming and group work are also pedagogies more likely to be valued by women educators than by men.

Similar to teacher-reported beliefs about the importance of developing students' creativity, it is in Latin American countries that teachers reported that they attach relatively more importance to creative pedagogies: Dominican Republic**, Peru, Panama*, Colombia, Costa Rica (in descending order).

Pedagogies that encourage creative thinking and creative thinking performance

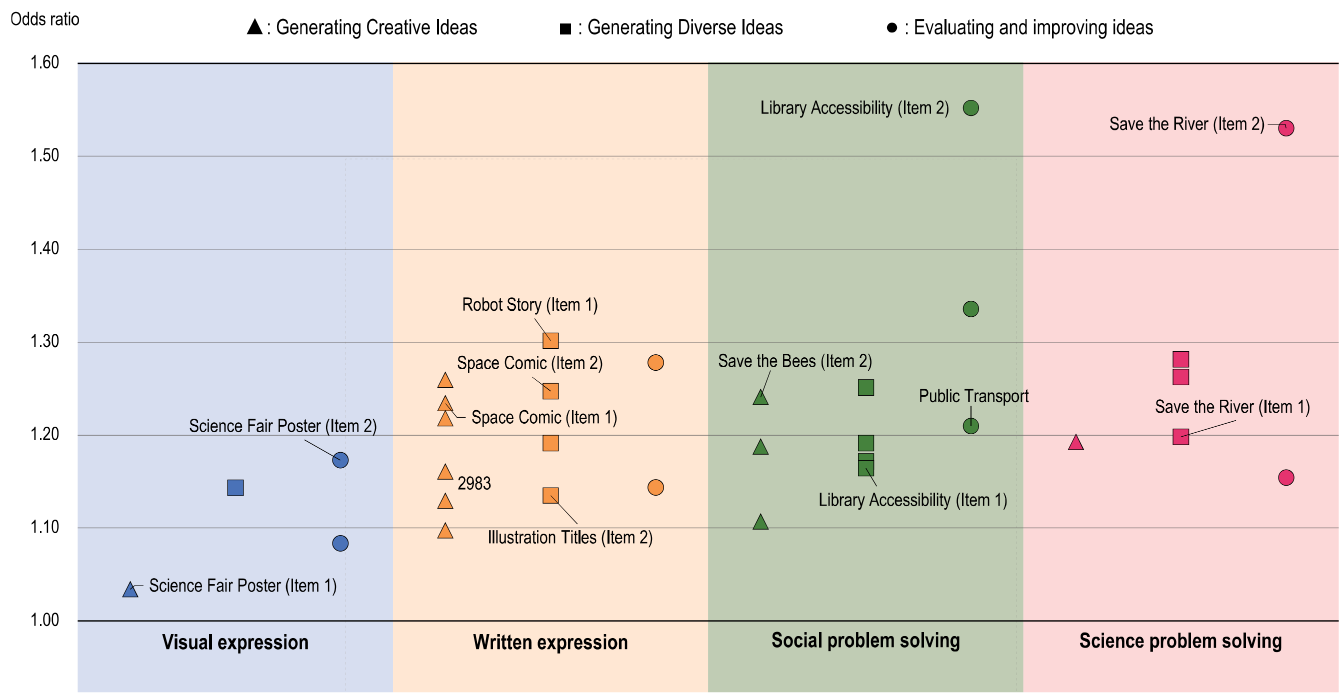
Does the use of pedagogies that encourage creative thinking make a difference to students' creative thinking performance? After accounting for students' and schools' socio-economic characteristics and for their mathematics and reading performance, students who reported that their teachers encourage creative thinking in their classroom in general performed slightly better than those who did not (+0.2 points on average across OECD countries with a one-unit increase in this index). The two countries where this advantage is the greatest (Jamaica* and Malaysia) are countries where initial teacher training explicitly includes content focused on developing students' creativity, teaching creatively and assessing creativity (OECD, 2023[1]). On average across OECD countries, this positive association was the strongest (though nonetheless modest) for students who believe their teachers value students' creativity more broadly – these students scored 0.4 points higher than their peers who said their teachers do not value their creativity (Table III.B1.6.4). Other, more specific classroom practices are also positively, though marginally, associated with student performance in creative thinking (after accounting for students' and schools' characteristics and for their mathematics and reading performance): for example, students who reported that their teachers encourage them to come up with original answers or creative solutions on assignments scored 0.2 points higher, on average across OECD countries, then their peers; as did those students who think the activities they do in their classes help them think about new ways to solve problems (+0.3 points).

While these pedagogies were only modestly associated with a better creative thinking score overall, interesting patterns emerged when examining students' performance across different types of tasks. For instance, students who reported that their teachers value students' creativity were more likely to achieve full credit on items asking them to evaluate and improve others' ideas (average odds ratio = 1.27) than generate diverse ideas (1.21) or creative ideas (1.17) (Figure III.6.5). In other words, students whose teachers value their creativity are 27% more likely to suggest original ways to improve others' ideas than their peers and "only" 17% more likely to generate creative ideas. This aligns with research suggestions that evaluating the appropriateness of ideas is more easily amenable in an educational context than generating original ideas (Howard-Jones, 2002[21]). These students are also more likely to perform relatively better on items in scientific problem-solving contexts (1.27) than on those in the visual expression domain (1.11); and they are slightly more likely to achieve full credit than other students as the item difficulty increases.

The odds ratios are similar for students who reported that their teachers give them enough time to come up with creative solutions on assignments. In contrast, students who said they are given a chance to express their ideas at school did relatively better than others on items in the social problem-solving domain and that require generating diverse ideas.

Figure III.6.5. Pedagogies that encourage creative thinking, and creative thinking proficiency across assessment domains and facets

Likelihood (odds ratio) of getting full credit on the test items when students agree/strongly agree that "their teachers value students' creativity", by ideation processes and domain contexts; OECD average



Notes: Each marker corresponds to one of the 32 items in the PISA 2022 Creative Thinking Assessment. Shapes denote the three different facets and colours denote the four different domains. Labelled markers correspond to items that are publicly released (see Chapter 1).
Source: OECD, PISA 2022 Database, Table III.B1.6.5. The StatLink URL of this figure is available at the end of the chapter.

Box III.6.5. System-level policies or initiatives aiming to teaching for creative thinking

Provide dedicated resources for teachers to teach with and towards creativity…

Policymakers can support schools and teachers to reflect on and experiment with new practices in different ways. One type of system-level support includes providing training and teaching resources for educators to teach for creativity. In **Scotland (United Kingdom)**, for instance, Education Scotland, a government agency, has provided teachers with a National Improvement Hub that includes learning resources, articles, impact reports, self-evaluation tools and exemplars of practice for improving teaching and learning, some of which relate to creativity and creative thinking.[1] For instance, practitioners are given access to a "Creativity Toolbox" (2018), which contains 13 short films on creative approaches to support planning and improvement, and to a "Planning for and Evaluating Creativity" approach (2017), which contains several open access resources, such as the "Creative Learning Survey for Pupils", the "Creative Teaching & Learning Graphic Equaliser", and a "Creativity Evaluation Checklist" and "Creativity Planning Checklist".[2] The Creativity Portal, developed in partnership between Education Scotland and Creative Scotland, offers additional support in the form of "a one-stop shop to help teachers, community learning leaders, and educators find high quality creative partnerships, case studies of good practice, the latest creativity research, online teaching resources, and local creative learning contacts".[3] In **England**

(United Kingdom), eight Creativity Collaboratives, clusters of 8–12 schools, were funded in 2021 to embed creative thinking in their curricula and beyond (Lucas, 2022[22]). The programme builds networks of schools to test innovative practices in teaching for creativity, sharing lessons learnt to facilitate system-wide change. Working alongside existing school structures, teachers and educators will co-develop creative strategy and pedagogy, test out approaches to teaching and learning, and evaluate their impact on pupils, schools and communities. Also in 2021, a new online platform, Creativity Exchange, was created as a space for school leaders, teachers, those working in cultural organisations, scientists, researchers and parents to share ideas about how to teach for creativity and develop young people's creativity at school and beyond.

Other examples of support in the form of teaching guidelines and materials across PISA 2022 participating jurisdictions include the Moodle platform developed in **North Macedonia** in 2018, which comprises four courses on developing critical thinking, creative problem solving and programming skills.

… and materials for schools to offer creative learning environments

With a focus on resourcing learning environments, several jurisdictions also have funding schemes in place to facilitate appropriate materials, equipment and facilities for teachers and students to be able to work creatively. For instance, in **Iceland**, the government makes funding available for the establishment and maintenance of fabrication laboratories ("FabLabs").[4] These laboratories include different tools and devices to facilitate work on digital design and creation. Commonly located in upper-secondary schools, the Labs are typically open to the public. In **China**, schools in two districts of Shanghai – Jiading and Pudong – have developed a Creative Lab that draws inspiration from the five-dimensional model developed by the Centre for Real-World Learning in England.[5] The project has involved schools identifying a specific theme with regional characteristics, for example, the automotive or maritime industries, constructing a curriculum, designing problem-based learning modules, mapping the five-dimensional model against the curriculum, encouraging students to generate creative solutions or products as the result of their learning, and developing rubrics to assess their progress.

Source: OECD (2023[1]) *Supporting Students to Think Creatively: What Education Policy Can Do*, retrieved from: https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1; Lucas (2022[22]) *Creative thinking in schools across the world: A snapshot of progress in 2022. London: Global Institute of Creative Thinking.*

Availability of and participation in creative activities at school

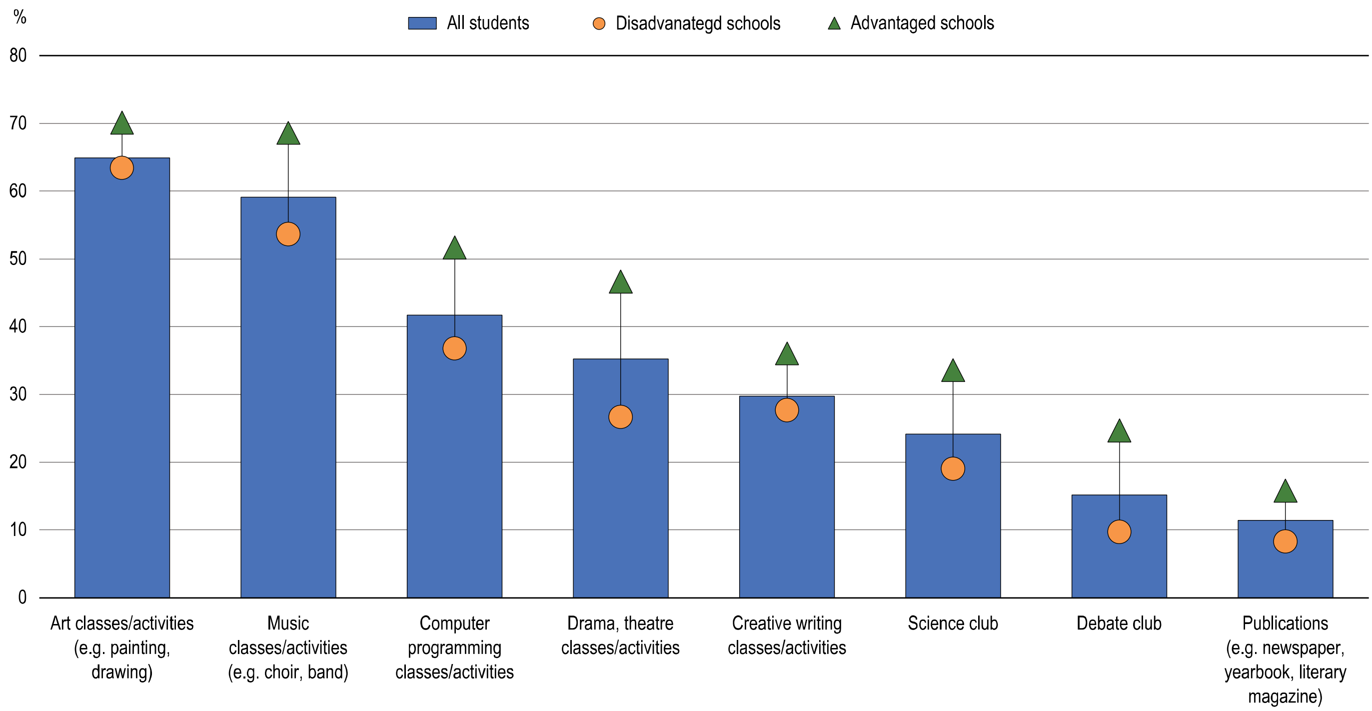
In addition to teaching students core content and skills, like reading, mathematics and science, schools often provide opportunities for students to engage in activities or classes that aim to broaden their experiences and further their holistic development. These might include activities focusing on artistic or expressive endeavours (such as art and design, creative writing, music or theatre activities) that are typically associated with "creative" practices, or they might focus on games and competitions, physical education, community engagement or developing other specialised skills or interests.

PISA 2022 asked school principals to report on the availability of and frequency with which different classes and activities are offered in their schools.[6] On average across OECD countries, 65% of students reported having once a week or more access to art classes/activities, 59% to music classes/activities, 42% to computer programming classes, 35% to dramatics and theatre classes/activities, 31% to a science club, and 30% to creative writing classes (Figure III.6.6). Activities and classes that were much less frequently available, on average across OECD countries, include debate (15% of students were in schools that offer it at least once a week) and publications-related activities (11% of students on average). In Jamaica*, the United Kingdom*, Australia*, the United Arab Emirates and Macao (China), students have the greatest access to a range of different school activities (Table III.B1.6.65), according to school principals. By contrast, school principals in Greece, Norway, Belgium, Poland and Czechia reported that their schools offer relatively less activities to students compared to other countries.

Principals in socio-economically advantaged schools reported that their schools offer various classes and activities at least once a week to students more frequently than in disadvantaged schools. The largest disparity in weekly offer between advantaged and disadvantaged schools, on average across OECD countries and economies, was drama and theatre classes/activities (20 percentage points difference), as well as debate club, science club, computer programming classes/activities and music classes/activities (all 15 percentage points difference) (Table III.B1.6.66).

Figure III.6.6. Availability of activities at school, by school socio-economic profile

Percentage of students in schools whose principal reported that their school offers the following activities at least once a week; OECD average



Notes: Differences between advantaged and disadvantaged schools are all statistically significant (Annex A3). A socio-economically disadvantaged (advantaged) school is a school in the bottom (top) quarter of the PISA index of economic, social and cultural status (ESCS) amongst all schools in the relevant country/economy.
Items are ranked in descending order of the percentage of students in schools whose principal reported that their school offers the activities at least once a week.
Source: OECD, PISA 2022 Database, Tables Table III.B1.6.65 and Table III.B1.6.66. The StatLink URL of this figure is available at the end of the chapter.

Students were also asked about their participation in the same set of activities. Taking part in school-based activities might be mandated by teachers, schools or the curriculum in some countries and economies, while in other education systems and schools, this might be elective or even restricted to just a small number of students. Countries and economies with the greatest availability of different activities in schools are therefore not necessarily the same as those with the largest levels of student participation. In Albania**, Uzbekistan, Baku (Azerbaijan), the Dominican Republic** and the Palestinian Authority, students reported the highest frequency of participation in various activities at school (Table III.B1.6.6). Comparatively, in Czechia, Lithuania, Poland, Portugal and France, students reported taking part in these activities the least often in school. The highest discrepancies between participation in activities (students' reports) and their availability at school (school principals' reports) were seen in the United Kingdom*, with the school offering much higher than student participation.

On average across OECD countries, students participate at least once a week in art classes/activities (27% of students), music classes/activities (22%), computer programming classes/activities (17%), creative writing classes/activities (16%) and drama and theatre classes/activities (11%) (Table III.6.1). These activities correspond to those that are offered most frequently by schools, according to school principals. This finding is logical: the more that activities are made available to students in school, especially when integrated into the curriculum, the more likely students are to participate in such activities. Broadening students' skills and experiences at school fundamentally depends on the opportunities available to them.

Table III.6.1. Students' participation in activities at school

Less than 25%
Between 25% and 50%
More than 50%

	Percentage of students who report that they participate in the following activities in their school at least once a week							
	Art classes/ activities (e.g. painting, drawing)	Music classes/ activities (e.g. choir, band)	Computer programming classes/ activities	Creative writing classes/ activities	Science club	Drama, theatre class/ activities	Debate club	Publications (e.g. newspaper, yearbooks, literary magazine)
	%	%	%	%	%	%	%	%
Korea	60	55	29	27	16	8	12	8
Estonia	53	53	14	21	10	10	9	9
Germany	49	39	24	15	11	10	5	5
Peru	47	24	20	34	16	19	15	17
Colombia	45	27	30	35	26	22	25	21
Switzerland	42	33	21	17	10	10	8	7
Uruguay	42	20	20	29	13	17	18	17
North Macedonia	40	37	36	35	26	27	28	27
Austria	40	35	34	17	27	10	10	9
Brazil	39	19	20	39	18	22	20	19
Albania	38	37	38	41	29	35	34	34
Dominican Republic	36	28	28	33	20	27	28	28
Chile	35	30	16	22	18	14	14	13
Philippines	34	33	30	38	26	26	21	24
Thailand	34	30	26	31	24	21	20	21
Slovenia	34	23	22	12	12	12	11	10
Ireland*	33	26	20	23	6	17	10	7
Uzbekistan	33	33	39	35	45	32	34	33
Netherlands*	33	12	11	13	6	10	7	6
Kazakhstan	33	27	34	34	23	23	27	23
Norway	33	24	12	19	7	10	9	8
Costa Rica	33	31	26	20	12	9	11	9
Panama*	32	27	24	28	18	18	16	17
Finland	32	22	14	19	7	9	7	7
Indonesia	31	27	31	29	23	22	24	23
United Arab Emirates	31	23	35	32	23	23	20	20
Romania	30	25	29	21	13	13	14	11
Jordan	30	23	28	29	28	27	28	27
Latvia*	30	25	12	17	9	10	8	9
Qatar	29	21	30	30	22	19	19	19
Türkiye	29	25	21	12	10	11	9	9
Malaysia	29	15	20	23	23	13	12	15
Hungary	28	24	21	13	7	9	8	7
Canada*	28	19	15	23	9	16	8	8
Jamaica*	28	21	23	34	17	19	14	14
OECD average	27	22	17	16	11	11	9	8
Mongolia	26	22	25	30	21	15	22	18
Bulgaria	26	23	27	20	22	22	22	19
Australia*	25	19	13	23	7	13	7	6
New Zealand*	25	18	14	21	6	12	6	5

(white)	Less than 25%
(light blue)	Between 25% and 50%
(dark blue)	More than 50%

	Percentage of students who report that they participate in the following activities in their school at least once a week							
	Art classes/ activities (e.g. painting, drawing)	Music classes/ activities (e.g. choir, band)	Computer programming classes/ activities	Creative writing classes/ activities	Science club	Drama, theatre class/ activities	Debate club	Publications (e.g. newspaper, yearbooks, literary magazine)
	%	%	%	%	%	%	%	%
El Salvador	25	22	26	27	19	21	19	22
Mexico	24	15	20	22	14	12	12	13
United Kingdom*	24	15	14	21	11	12	5	5
Iceland	24	19	9	19	8	16	10	12
Slovak Republic	24	17	16	19	17	16	17	15
Argentina	23	17	28	20	17	16	14	13
Georgia	23	22	20	23	21	20	25	21
Brunei Darussalam	22	6	16	25	10	6	5	5
Serbia	22	18	21	14	16	14	13	13
Montenegro	22	19	21	19	21	17	18	16
Spain	21	16	23	10	11	9	10	7
Saudi Arabia	19	17	27	22	21	20	21	21
Moldova	18	18	22	22	15	15	16	14
Malta	17	10	20	25	11	10	9	8
Morocco	17	20	29	21	23	22	21	21
Croatia	17	15	38	14	10	10	11	10
Belgium	16	14	12	9	6	7	5	5
France	15	9	12	9	6	8	6	6
Singapore	15	18	12	15	6	8	4	6
Czechia	14	14	9	7	7	8	7	7
Greece	14	13	27	19	17	13	13	12
Israel	13	11	22	12	15	12	11	9
Lithuania	13	18	10	9	10	10	8	7
Poland	13	9	13	6	8	8	7	7
Italy	11	7	13	8	8	8	10	8
Portugal	10	7	7	7	6	6	7	5
Denmark*	9	9	9	10	15	6	9	5
Macao (China)	55	58	38	25	14	12	8	7
Chinese Taipei	44	53	37	22	13	29	10	12
Palestinian Authority	37	23	35	31	31	28	27	28
Baku (Azerbaijan)	34	35	28	36	20	29	29	31
Kosovo	31	29	28	30	29	26	28	25
Hong Kong (China)*	29	33	16	16	9	12	8	9
Ukrainian regions (18 of 27)	21	18	25	19	15	17	15	15

Notes: Only countries and economies with available data are shown.
Countries and economies are ranked in descending order of the percentage of students reporting that they are participating in art classes/activities (e.g. painting, drawing) in their school at least once a week.
Source: OECD, PISA 2022 Database, Table III.B1.6.6. The StatLink URL of this table is available at the end of the chapter.

Boys participate in activities at school more frequently than girls, on average across OECD countries– although gender differences vary depending on the type of activity (Table III.B1.6.16). For example, girls participate significantly more often than boys in art classes/activities at least once a week (30% of girls compared to 24% of boys, on average across OECD countries), and there are no significant differences in the participation of boys and girls in music classes/activities at least once a week. The greatest gender differences in favour of boys are observed in science club (5 percentage points more boys) and computer programming activities (8 percentage points more boys), which reflect entrenched gender preferences and align with the current under-representation of girls in science, technology, engineering and mathematics (STEM) disciplines.

One interesting finding is that, while advantaged schools appear to provide students with greater access to different activities at school, according to school principals, it is students in socio-economically disadvantaged schools who participate in activities more often than their advantaged peers, on average across OECD countries (Table III.B1.6.16). These patterns are also observed outside of school: in general, boys, socio-economically disadvantaged students, and students in disadvantaged schools, report more frequent participation in the same activities outside of school than their peers (Tables III.B1.6.20 and III.B1.6.21). The only exception to this trend across OECD countries is participation in music classes/activities, where advantaged students participate more often than disadvantaged students.

One reason for this counter-intuitive association between participation in different school-based activities and student background may be that students from more advantaged backgrounds, or who attend more advantaged schools, are more likely to focus their time and orient their educational choices towards traditionally “academic” subjects that have a greater influence on their ability to transition into tertiary education – and eventually, access high-paying jobs. These students may thus be less likely to choose to participate in such classes or activities regularly, especially as part of their formal studies. Students from more advantaged backgrounds may also have greater access to extra-curricular activities not asked about in PISA, such as private tutors or language classes, or more “elite” sports and clubs that are not typically offered at school.

Activities at school and relationship to creative thinking performance

In general, students who participate in many activities at school scored lower in creative thinking than those who do not, on average across OECD countries. However, this negative association may be explained by the characteristics of students who frequently participate in school-based activities. After accounting for students’ and schools’ characteristics, as well as students’ mathematics and reading performance, there is no strong association between participation in activities and creative thinking performance – except for in a handful of countries and economies, where it is either moderately negative (Denmark*, Kazakhstan, Malta, Chinese Taipei and Indonesia) or moderately positive (Chile and Iceland) (Table III.B1.6.17). Again, these findings imply that students from advantaged backgrounds, and/or those who are top performers in the core curricular domains, participate less frequently in school-based clubs and activities, perhaps to the benefit of concentrating on “core” school subjects.

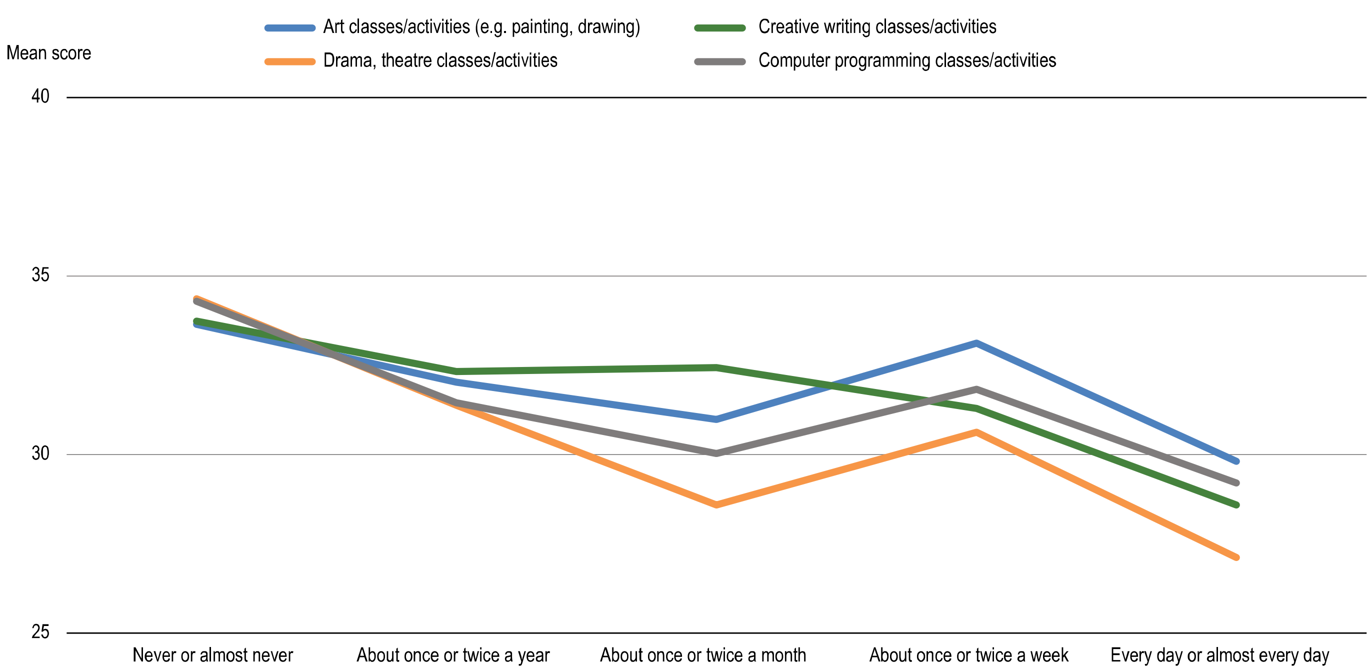
Nonetheless, some interesting patterns emerge when examining the average creative thinking performance of students who participate in school-based activities at different levels of engagement (Figure III.6.7). Amongst students who participate in various activities, those who take part in music, art, computer programming or drama classes/activities about once or twice a week scored better on average than both students who take part in those activities infrequently or on an ad-hoc basis (e.g. once a month or once or twice a year) as well as students who do so very often (e.g. every day or almost every day). This finding suggests, on the one hand, that excessive participation in such activities and classes in school – perhaps at the expense of other “core” curriculum areas – may not be conducive to developing stronger creative thinking skills. On the other hand, participating irregularly, for instance just once or twice every semester, is not ideal either for developing creative thinking skills. It may be that activities that are consistently embedded within the curriculum and that engage students in tasks that require creative thinking on a regular but considered basis (e.g. as part of lessons taken once or twice a week in secondary education) may be best for developing students’ skills.

It is also important to note that the PISA 2022 Creative Thinking assessment measured students’ capacity to think flexibly and to make original and appropriate idea associations, rather than their artistic talents. For example, in the visual expression domain, students’ outputs were not evaluated with respect to their aesthetic quality but rather with respect to the originality of their idea associations. Similarly, students were not judged on the quality of their writing but rather on their capacity to suggest an unconventional story idea. In order to perform well on the test, students had to draw on cognitive skills like flexible thinking and, in some domain contexts (e.g. scientific problem solving), combine these skills with their knowledge; these cognitive assets are developed through challenging, active learning activities across subject areas. The weak associations observed between activities that belong to the wider domain of "the arts" and students' scores in the PISA test are thus not so surprising. Put differently, while theatre or music classes surely help students to express themselves in a performative manner, they do so by enacting ideas that are not their own and they are rarely asked to come up with new ideas or to produce their own original outputs.

Similarly, art classes may teach students how to draw, paint or sculpt with the right techniques, but this not what tasks in the visual expression domain in the PISA assessment aimed to capture – and what the digital drawing tool allowed (i.e. only combining shapes and stamps). Nonetheless, across participating countries and economies, students who participate in art classes at least once a week were more likely than their peers to get full credit on visual expression tasks (average odds ratio = 1.05), and especially so for the more difficult items that required students to evaluate and improve ideas (average odds ratio = 1.10) (Table III.B1.6.18). As described in Box III.4.2 in Chapter 4, full credit responses for these items required students to combine lines, shapes, stickers and colours to create relevant objects of significance – thus likely aided by some level of visual art or graphic design skill.

Figure III.6.7. Student participation in activities at school and creative thinking proficiency

Mean score in creative thinking; OECD average

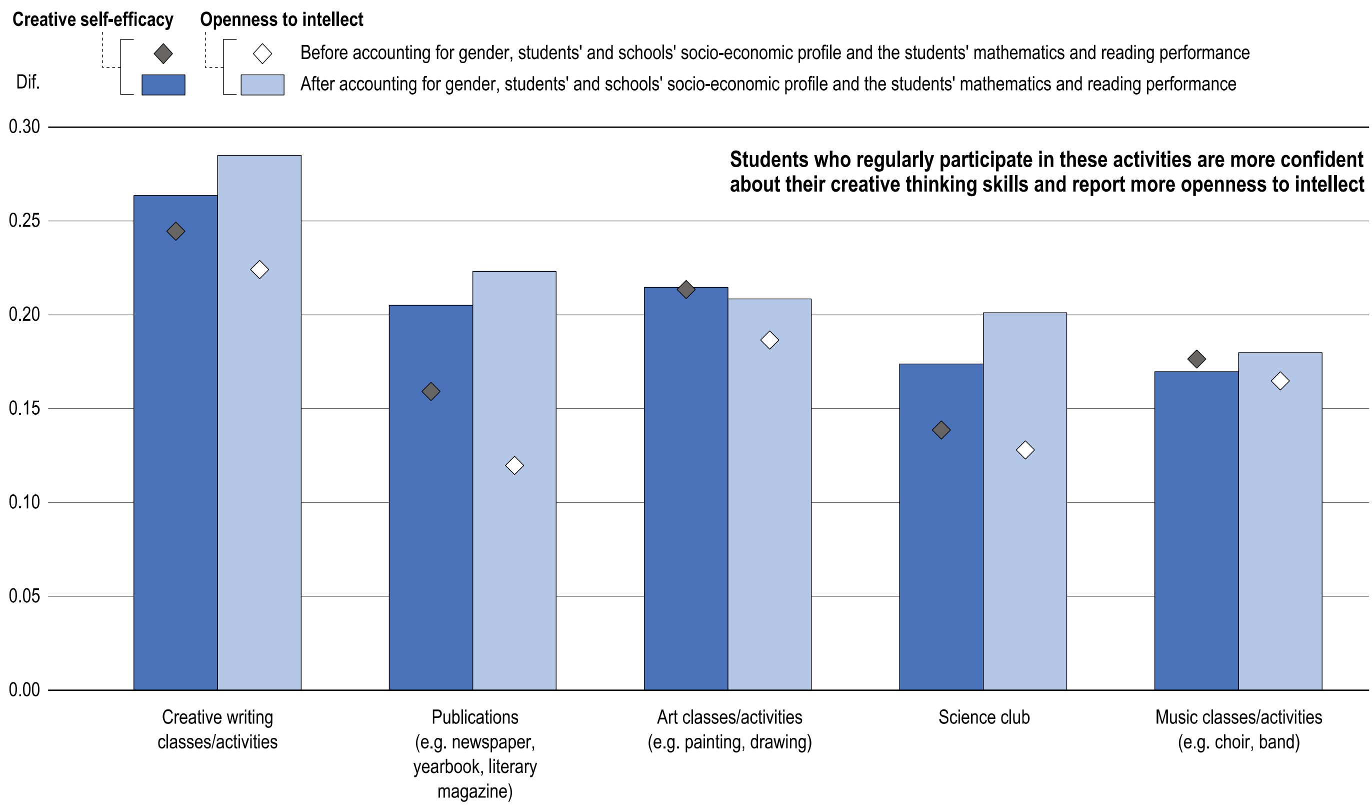


Source: OECD, PISA 2022 Database, Tables III.B1.6.7, III.B1.6.8, III.B1.6.11 and III.B1.6.14. The StatLink URL of this figure is available at the end of the chapter.

The relationship between participation in activities and performance is complex, in part because of self-selection issues. Regular but moderate participation seems to be most productive for developing the fundamental cognitive processes required for creative thinking. Yet, developing more specialised domain readiness via such activities seems productive for helping students to apply creative thinking in difficult tasks that also require them to combine creative thinking skills with other skills, for instance visual expression (see Chapter 4 for more details). Finally, beyond student performance in the PISA test, weekly participation in school activities is positively associated with a range of student attitudes that in turn support creative thinking, such as creative self-efficacy and openness to intellect (Figure III.6.8, see also Chapter 5). These positive associations held for all types of activities, across all participating countries and economies, and after accounting for students' and schools' characteristics and students' mathematics and reading performance. The strongest associations were observed amongst students who take part in creative writing classes/activities, publications activities, and art classes/activities at least once a week (above 0.2 points in both the index of creative self-efficacy and in the index of openness to intellect, on average across OECD countries).

Figure III.6.8. Student participation in activities at school and their attitudes towards creative thinking

Mean index difference between students who participate at least once a week in the following activities compared to the rest of students; OECD average



Notes: All differences are statistically significant (see Annex A3).
Items are ranked in descending order of the difference in the index of openness to intellect, after accounting for gender, students' and schools' socio-economic profile and the students' maths and reading performance.
Source: OECD, PISA 2022 Database, Tables III.B1.6.23 and III.B1.6.24. The StatLink URL of this figure is available at the end of the chapter.

Digitalisation and creative thinking

Digitalisation permeates all sectors and layers of society, and the social environment of 15-year-old students makes no exception. As students use digital devices both in class and at home – and often the same devices for both – the frontiers of the school environment have become blurred. Moreover, students' uses of digital resources for different purposes are also increasingly intertwined as they mix learning and leisure in overlapping times and spaces.

Though challenging in many aspects, the digitalisation of schools and school environments presents many (proven and potential) benefits for teaching and learning, when properly guided and supported (OECD, 2023[23]; OECD, 2021[24]). PISA 2022 data showed that it is not necessarily the time spent using digital resources that makes a difference to students' performance in mathematics, but rather the purpose and context in which they use them (OECD, 2023[25]). This section analyses how the time students spend on digital devices interacts with their creative thinking performance, and whether it plays out differently at school or at home, on weekdays or on weekends, and for learning or for leisure.

The use of digital resources and creative thinking performance

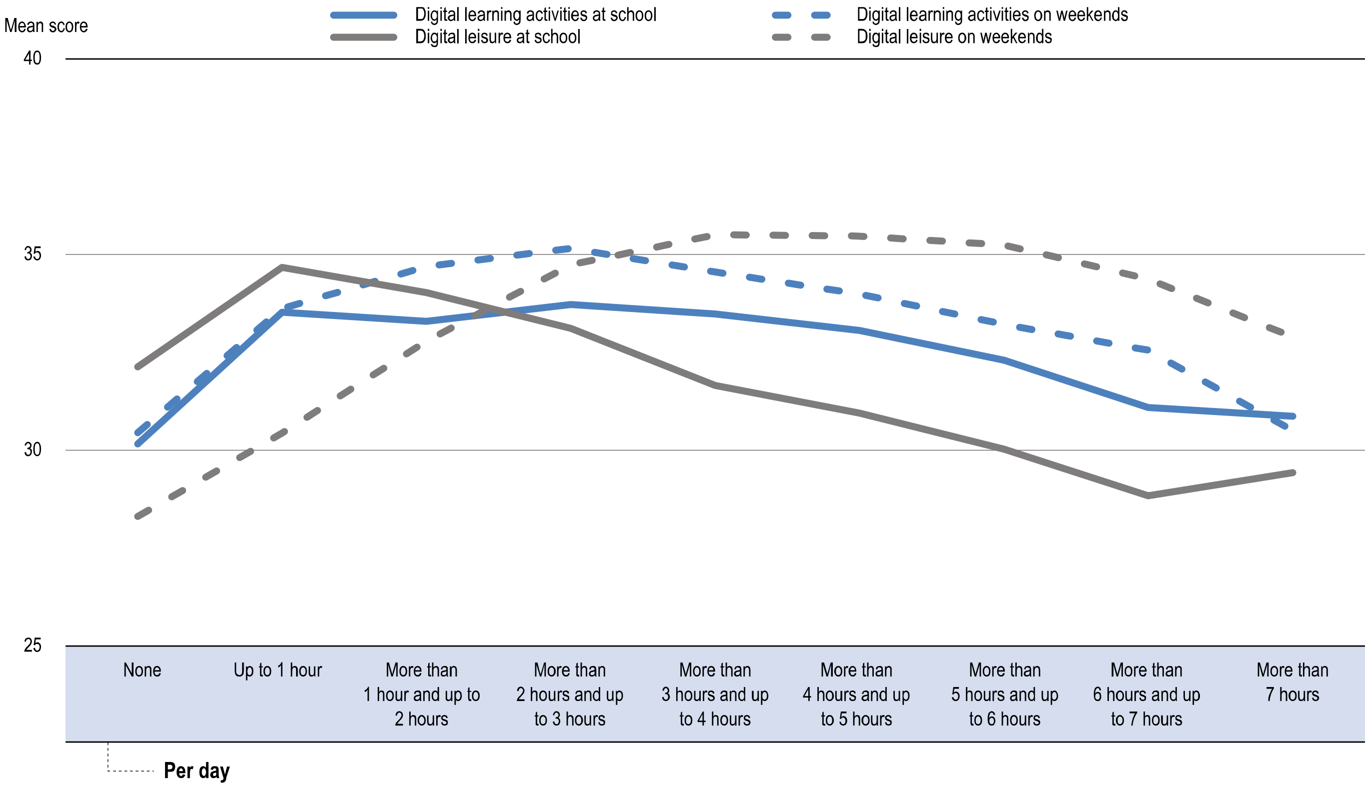
More and more, students use digital resources for *learning* activities, under the instruction of their teachers in class or on their own at home. Outside of school (either before or after school, or over the weekend), students who use digital resources for the purpose of *learning* performed better in creative thinking than those who do not, after accounting for students and schools' characteristics. On average across OECD countries, about 50% of students reported spending at least one hour a day learning outside of school using digital resources, and they scored 0.8 points better than their peers from similar socio-economic backgrounds (Tables III.B1.6.25 and III.B1.6.32). Using digital resources for learning for at least one hour a day inside of school is also associated with better performance in creative thinking, but to a lesser extent (0.2 points). In short, the use of digital resources for learning has the same association with creative thinking performance as with mathematics' (OECD, 2023[25]).

The use of digital resources for *leisure*, however, has a much stronger relationship with creative thinking performance than the use of digital resources for learning. On average across OECD countries, 69% of students reported using digital resources for leisure for one hour a day or more outside of school on a weekday; and 80% on a weekend day. These students significantly outscored their peers in creative thinking, by 2.5 and 3.3 points respectively. These score differences account for students' and schools' socio-economic backgrounds, so this performance gap cannot solely be reduced to a digital divide. At school, this relationship is inverted: students who spend an hour a day or more using digital resources for leisure scored, on average, 0.8 points below their peers. This finding aligns with the PISA 2022 Results (Volume II) observation that, above one hour a day of use at school, students' mathematics performance decreases with their use of digital devices for leisure (OECD, 2023[25]).

Unsurprisingly, even when used at the weekend, spending too many hours on digital devices – regardless of purpose – is associated with a decrease in creative thinking performance. Interestingly though, this inflection point is later for leisure time than it is for learning time (Figure III.6.9). One explanation might be that students who make the biggest use of digital tools for learning during the weekend are those who may already struggle with school, and therefore turn to digital learning activities in order to catch up. Another explanation is that leisure time, digital or otherwise, is important for well-being and therefore beneficial to students' learning and their proficiency in creative thinking – especially if this digital leisure time involves some creative processes.

Figure III.6.9. Student use of digital devices and creative thinking proficiency

Mean score in creative thinking; OECD average



Note: Accounting for gender and students' and schools' socio-economic profiles, all paired differences are statistically significant at school, except for the difference between "more than 7 hours a day" and "more than 6 hours and up to 7 hours" at school for leisure.
Source: OECD, PISA 2022 Database, Tables III.B1.6.26, III.B1.6.28, III.B1.6.29 and III.B1.6.31. The StatLink URL of this figure is available at the end of the chapter.

On a typical weekend day, students who spend an hour or more playing videogames (60% of students on average across OECD countries) or browsing social networks (76%) scored slightly better than those who do not, scoring 0.5 and 0.2 points higher on average across OECD countries, respectively, after accounting for gender and students' and schools' socio-economic profile. In contrast, students who spend at least one hour communicating and sharing digital content on social networks or communication platforms (56%), listening to or reading information materials to learn how to do something (39%), creating or editing personal digital content (37%), or looking for practical information online (37%) scored below those who spend less time on these digital activities in creative thinking (Tables III.B1.6.46 and III.B1.6.54). Here again, after a certain threshold, spending too much time on any type of digital leisure activities, even on weekends, is associated with a decrease in creative thinking performance.

Table III.6.2. School environment and creative thinking: Chapter 6 figures and tables

Figure III.6.1	PISA 2022 coverage of aspects of the students' educational environment related to creative thinking
Figure III.6.2	Students' and school principals' growth mindset on creativity
Figure III.6.3	Student-reported use of pedagogies encouraging creative thinking
Figure III.6.4	Students' and school principals' views on their teachers' use of pedagogies encouraging creative thinking
Figure III.6.5	Pedagogies encouraging creative thinking and creative thinking proficiency across assessment domains and facets
Figure III.6.6	Availability of activities offered at school, by school socio-economic profile
Table III.6.1	Students' participation in activities at school
Figure III.6.7	Student participation in activities in school and creative thinking proficiency
Figure III.6.8	Student participation in activities at school and their attitudes towards creative thinking
Figure III.6.9	Student use of digital devices and creative thinking proficiency

StatLink https://stat.link/da2q5i

Notes

[1] National Improvement Hub: https://education.gov.scot/improvement/.

[2] Creativity Toolbox: https://education.gov.scot/improvement/learning-resources/creativity-toybox/; Planning for and Evaluating Creativity ZIP file: https://education.gov.scot/improvement/self-evaluation/planning-for-and-evaluating-creativity/.

[3] Creativity Portal: https://creativityportal.org.uk/.

[4] FabLabs: https://fablab.is/.

[5] Centre for Real-World Learning: https://www.winchester.ac.uk/research/Our-impactful-research/Research-in-Education/Centres-and-Institutes-in-Education/Centre-for-Real-World-Learning.

[6] Unless otherwise specified, the "activities offered at school" refer to classes and activities students participate in during school, which might include activities during their core, mandatory formal education classes, or elective classes that form part of their formal education, or extra-curricular activities that take place at school.

References

Agryris, C. (1982), "The executive mind and double-loop learning", *Organizational Dynamics*, Vol. 11/2, pp. 5-22, https://doi.org/10.1016/0090-2616(82)90002-x. [14]

Chia, R. (2003), "From Knowledge-Creation to the Perfecting of Action: Tao, Basho and Pure Experience as the Ultimate Ground of Knowing", *Human Relations*, Vol. 56/8, pp. 953-981, https://doi.org/10.1177/00187267030568003. [17]

Collins, A., J. Brown and S. Newman (1989), *Cognitive apprenticeship: teaching the creaft of reading, writing and mathematics*, L. B. Resnick (ed.). [11]

Cunliffe, A. (2002), "Reflexive Dialogical Practice in Management Learning", *Management Learning*, Vol. 33/1, pp. 35-61, https://doi.org/10.1177/1350507602331002. [15]

Howard-Jones, P. (2002), "A Dual-state Model of Creative Cognition for Supporting Strategies that Foster Creativity in the Classroom", *International Journal of Technology and Design Education*, Vol. 12/3, pp. 215-226, https://doi.org/10.1023/a:1020243429353. [21]

Kaufman, J. and R. Beghetto (2009), "Beyond Big and Little: The Four C Model of Creativity", *Review of General Psychology*, Vol. 13/1, pp. 1-12, https://doi.org/10.1037/a0013688. [13]

Lucas, B. (2022), *Creative thinking in schools across the world: A snapshot of progress in 2022*. [22]

Musset, P. (2019), "Improving work-based learning in schools", *OECD Social, Employment and Migration Working Papers*, No. 233, OECD Publishing, Paris, https://doi.org/10.1787/918caba5-en. [19]

Nickerson, R. (2010), "How to Discourage Creative Thinking in the Classroom", in *Nurturing Creativity in the Classroom*, Cambridge University Press, https://doi.org/10.1017/cbo9780511781629.002. [9]

OECD (2024), *Social and Emotional Skills for Better Lives: Findings from the OECD Survey on Social and Emotional Skills 2023*, OECD Publishing, Paris, https://doi.org/10.1787/35ca7b7c-en. [6]

OECD (2023), *Building Future-Ready Vocational Education and Training Systems*, OECD Reviews of Vocational Education and Training, OECD Publishing, Paris, https://doi.org/10.1787/28551a79-en. [10]

OECD (2023), *Learning during - and from - disruption*, OECD Publishing, Paris, https://doi.org/10.1787/a97db61c-en. [25]

OECD (2023), *OECD Digital Education Outlook 2023: Towards an Effective Digital Education Ecosystem*, OECD Publishing, Paris, https://doi.org/10.1787/c74f03de-en. [23]

OECD (2023), *Supporting Students to Think Creatively: What Education Policy Can Do*, https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1_. [1]

OECD (2021), *OECD Digital Education Outlook 2021: Pushing the Frontiers with Artificial Intelligence, Blockchain and Robots*, OECD Publishing, Paris, https://doi.org/10.1787/589b283f-en. [24]

Robinson, K. and L. Aronica (2009), *The element: How finding your passion changes everything*, Penguin. [5]

Rubenstein, L., D. McCoach and D. Siegle (2013), "Teaching for Creativity Scales: An Instrument to Examine Teachers' Perceptions of Factors That Allow for the Teaching of Creativity", *Creativity Research Journal*, Vol. 25/3, pp. 324-334, https://doi.org/10.1080/10400419.2013.813807. [8]

Rubenstein, L. et al. (2018), "How teachers perceive factors that influence creativity development: Applying a Social Cognitive Theory perspective", *Teaching and Teacher Education*, Vol. 70, pp. 100-110, https://doi.org/10.1016/j.tate.2017.11.012. [7]

Sarson, S. (1990), *The predictable failure of educational reform*. [2]

Sharan, S. and I. Tan (2008), *Organizing schools for productive learning*, New York: Springer. [3]

Sternberg, R. (2007), *Creativity as a habit*. [4]

Stierand, M. (2014), "Developing creativity in practice: Explorations with world-renowned chefs", *Management Learning*, Vol. 46/5, pp. 598-617, https://doi.org/10.1177/1350507614560302. [12]

Tsoukas, H. and R. Chia (2002), "On Organizational Becoming: Rethinking Organizational Change", *Organization Science*, Vol. 13/5, pp. 567-582, https://doi.org/10.1287/orsc.13.5.567.7810. [16]

Ulger, K. (2018), "The Effect of Problem-Based Learning on the Creative Thinking and Critical Thinking Disposition of Students in Visual Arts Education", *Interdisciplinary Journal of Problem-Based Learning*, Vol. 12/1, https://doi.org/10.7771/1541-5015.1649. [20]

Usmeldi, U. and R. Amini (2022), "Creative project-based learning model to increase creativity of vocational high school students", *International Journal of Evaluation and Research in Education (IJERE)*, Vol. 11/4, p. 2155, https://doi.org/10.11591/ijere.v11i4.21214. [18]

7 From data to insights

Results from the PISA Creative Thinking assessment offer a wealth of data points that can highlight aspects of education policy and pedagogy that merit further investigation and reflection. This chapter provides a summary and interpretation of the key messages highlighted throughout this volume to suggest how policies and practices might be improved to support the needs of students in creative thinking.

For Australia*, Canada*, Denmark*, Hong Kong (China)*, Ireland*, Jamaica*, Latvia*, the Netherlands*, New Zealand*, Panama*, and the United Kingdom* caution is advised when interpreting estimates because one or more PISA sampling standards were not met (see Reader's Guide, Annexes A2 and A4).

For Albania** and the Dominican Republic**, caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide and Annex A4).

For the first time, it its 2022 cycle, PISA measured creative thinking with the aim of providing internationally comparable data on students' competencies that have clear implications for education policies and pedagogies. Today's students need to be able to think creatively and adapt to new ways of thinking and doing, as our societies increasingly depend on innovation and knowledge creation to address emerging challenges.

The PISA 2022 results showed that students in Singapore scored significantly higher than all other participating countries/economies in creative thinking (with a mean score of 41 points out of a total 60 points). Students in 11 other countries – in descending order, Korea, Canada*, Australia*, New Zealand*, Estonia, Finland, Denmark*, Latvia*, Belgium, Poland and Portugal – also performed above the OECD average in creative thinking (33 points).

In general, high-performing systems in creative thinking were amongst those that also performed above the OECD average in the PISA core domain assessments of mathematics, reading and science (with the exception of Portugal, which performed around the OECD average in all three core domains, and Belgium and Estonia which performed around the OECD average in reading). However, not all high-performing systems in the PISA core domains were amongst those high-performing systems in creative thinking: students in Czechia, Hong Kong (China)*, Macao (China) and Chinese Taipei performed well above the OECD average in mathematics, reading and science, but performed around or below the OECD average in creative thinking.

Beyond mean scores and rankings, results from PISA 2022 offer policymakers a wealth of data points that can highlight aspects of education that merit further investigation – and that might point to productive changes in policies and practices, or the design and implementation of new ones, for improving student outcomes in creative thinking.

Strong performance in creative thinking and academic subjects is both possible and complementary

Academic excellence is not a pre-requisite for excellence in creative thinking…

PISA results show that it is possible to be proficient in both creative thinking and in the core subject areas of mathematics, reading and science. Student performance in creative thinking correlates positively to performance in the PISA core domain assessments (correlation of between 0.66 and 0.67). However, only a relatively small proportion of the total variation in student performance in creative thinking can be associated uniquely with performance in mathematics (28% on average across the OECD).

PISA data also show that, amongst students who performed at the upper and lower ends of the mathematics scale, there was less variability in their creative thinking performance: around half of all students in the top quintile of performance in mathematics (and over half of all students in the bottom quintile) were also in the top quintile of performance in creative thinking (or bottom quintile, respectively). In other words, students who performed at the highest and lowest levels in creative thinking tended to also perform at the highest and lowest levels in mathematics. However, only around 28% students within the middle (i.e. third) quintile of creative thinking performed within the same quintile in mathematics, with similar proportions of students also performing within the second (23%) or fourth quintiles (24%), respectively. Moreover, around 14% of students within the middle quintile of mathematics performed within the upper quintile of creative thinking.

These data imply that performance in creative thinking and academic performance are complementary to some extent – particularly at the upper and lower ends of the proficiency scales – but that academic excellence is not a pre-requisite for excellence in creative thinking. Indeed, PISA data show that it is possible for many students to be strong creative thinkers, not just those who perform at the highest levels in mathematics, reading and science.

…but students need a baseline level of skills in core subject areas to excel in creative thinking

While students of all levels of proficiency in the PISA core domains have the potential to excel in creative thinking, PISA data showed that this was especially so for students who reached at least a baseline level of proficiency in mathematics, reading and science. This makes sense: without a minimum level of knowledge and experience in a given context, it would be very hard to generate appropriate, different or original ideas. Amongst the 14 lowest-performing countries and economies in creative thinking, 12 had over 50% of students who performed below a baseline level of proficiency in mathematics, reading and science.[1]

Some countries and economies performed better in creative thinking than expected

After accounting for students' mathematics and reading performance, some education systems showed an overall relative strength in creative thinking

As summarised in Chapter 2 of this report, performance in creative thinking was positively correlated with performance in the PISA core domains. Yet some countries and economies performed relatively better than expected in creative thinking, given their students' mathematics and reading performance. These included both high-performing and lower-performing countries, but students in Australia*, Canada*, Finland, and New Zealand* demonstrated a large overall relative strength in creative thinking together with high mean performance. On average, students in these countries scored around 3 or more points higher in creative thinking (a large performance difference) after accounting for both their mathematics performance and reading performance, respectively.

Other regional clusters of countries also demonstrated a moderate overall strength in creative thinking after accounting for student performance in mathematics and reading (e.g. Chile, Costa Rica, El Salvador, Mexico and Uruguay in Latin America; Belgium, Denmark*, Estonia, Germany, Latvia*, Malta, Poland, Slovenia and Spain in Europe; Israel, Qatar and the United Arab Emirates in the Middle East; and Singapore and Korea in East Asia).

Within countries/economies, students demonstrated different strengths and weaknesses in creative thinking

The PISA 2022 Creative Thinking test assessed students' capacity to generate, evaluate and improve original and diverse ideas in four distinct domains contexts: written expression, visual expression, scientific problem solving and social problem solving. While students in high-performing systems tended to excel in all types of tasks, several countries tended to perform better in some domains than others. For example, students in Czechia, Italy, Lithuania and Iceland demonstrated the greatest relative performance in written expression items, achieving full credit in around 10 percentage point more items than they did across other task contexts. The country with the weakest relative performance in the written domain was Malaysia (with a negative difference of over 8 percentage points).

Creating original or diverse ideas in scientific problem-solving contexts was relatively hard in most countries and economies. However, after accounting for the relative difficulty of the tasks, students in Korea, Albania**, Italy, Spain and the Netherlands* demonstrated a moderate relative strength in this domain context, scoring full credit in over 5 percentage point more items in scientific problem solving than other domains. Conversely, students in Latvia* and Slovenia showed the weakest relative performance in scientific problem-solving tasks across countries and economies, achieving full credit in around 8 percentage point fewer items in this domain compared to their performance on all other items, after accounting for the difficulty of items.

Some high-performing systems adopt whole-system approaches to embedding, supporting and measuring creative thinking

In several high-performing systems in creative thinking, or those with a notable relative strength overall in creative thinking, system-level reforms of curricula and assessment practices over the past decades have focused on furthering the importance of creative thinking in education. Promoting the development of creative thinking consistently and effectively in education requires educators, curriculum developers and assessment designers to have a shared understanding of what creative thinking is, how students can develop creative thinking skills, and how their progress can be measured. Redefining curricula and learning progressions explicitly with these goals in mind can facilitate the development of creativity-supportive teaching and learning.

More concretely, high-performing systems in creative thinking have often implemented at least two of the following four approaches to supporting the development of creativity and creative thinking in education:

1. **Embedding creativity and/or creative thinking throughout the curriculum.** While creative thinking is increasingly included in global curricula, as either a transversal competency or within specific subject areas (OECD, 2023[1]), few jurisdictions provide strategic leadership and clear guidance in practice to accompany curriculum reforms. Indeed, in many cases, references to creative thinking are superficial at best with little guidance provided as to how or why these skills should be taught. Countries like Denmark, Korea, Singapore, Canada and Australia have all integrated creative thinking as cornerstones of their educational reforms in recent years, articulating its importance in education and accompanied by high-level strategic documents and practical resources for educators (see below).
2. **Supporting educators to recognise, develop and evaluate creative thinking by defining learning progressions or rubrics.** Some jurisdictions have developed detailed guidance and learning progressions to help educators understand the types of outcomes that ought to be expected of students and the learning trajectories they typically follow to reach them. Providing clarity to educators on expected learning outcomes and progressions is especially important in the context of complex competencies, like creative thinking, that can manifest in different ways across contexts and that include both thought processes and behaviours. In Australia, for example, the Assessment and Reporting Authority (ACARA) have developed a "critical and creative thinking learning continuum" to map progression in creative thinking according to different levels of proficiency; the continuum supports the 2010 curriculum reform which included "critical and creative thinking" as one of seven general capabilities that intersect with the eight subjects or learning areas. Similarly in some provinces in Canada, creative thinking performance standards have been mapped across the content of subject areas in the curriculum, across grades and age groups (see Box III.2.2 for more information and examples of resources).
3. **Creating opportunities in the curriculum for students to engage in creative and/or interdisciplinary work.** Another challenge identified by policymakers is how to balance integrating creative thinking into education given already overcrowded curricula (OECD, 2023[1]). Some countries have attempted to reduce the number of compulsory subjects within the curriculum areas (e.g. Korea), and/or offer more practical or experiential courses encouraging creative work in primary or secondary education as elective subjects or as part of the core curriculum (e.g. Korea, Denmark). Another strategy to optimise instruction time and content coverage is to introduce dedicated interdisciplinary modules. When implemented successfully, interdisciplinary learning allows pedagogies to be articulated around more contextualised and authentic problems and enables students to engage in more active and meaningful learning experiences. Examples of this approach include in Finland, where the national curriculum requires schools to teach at least one inter-disciplinary module a year that makes connections across disciplines, and in Singapore, where students in secondary education can choose to undertake interdisciplinary modules that allow students to develop projects in authentic settings across society and industry. In New Zealand, the "Creatives in Schools" initiative provided funding to schools to partner with creative practitioners and to engage students in an extended project aiming to develop their creative thinking and collaboration skills. Other strategies adopted by some countries include carving out dedicated "exam-free" periods within the curriculum to allow more flexible moments in which students and teachers can engage in creative and interdisciplinary projects without the pressure of meeting standardised assessment targets.
4. **Encouraging accountability through monitoring and evaluation.** Very few systems assess creative thinking in a standardised way as part of efforts to monitor and evaluate student learning outcomes in this area. Indeed, one of the main challenges of developing creative thinking in education identified by PISA participating countries was the lack of assessment focus on creativity (OECD, 2023[1]). One exception is in the state of Victoria in Australia: since 2016, the Victorian Curriculum and Assessment Authority has administered Critical and Creative Thinking (CCT) assessments annually to a sample of schools. The CCT

assessments support its commitment to measure its Education State Targets, one of which aims for 25% or more Year-10 students to have developed excellent critical and creative thinking skills. Increased evaluation and assessment efforts that explicitly focus on creative thinking reinforce to educators and students that these are important skills to develop and that creative ideas in education are valued.

Significant gender gaps in creative thinking exist in most countries and economies

Girls outperform boys in creative thinking in all tasks…

PISA 2022 results show that in no participating country/economy did boys outperform girls in creative thinking, and in all but three countries and economies – Chile, Mexico and Peru – the difference in average performance between boys and girls was statistically significant (see Figure III.3.4 in Chapter 3). On average across OECD countries, girls scored nearly 3 points higher than boys – a large performance difference – and in Jordan, Finland, the Palestinian Authority, Saudi Arabia, Jamaica*, the United Arab Emirates and Qatar (in descending order), girls scored 5 or more points higher than boys. The data also show that boys were less likely to be high achieves in creative thinking (i.e. score within the 75^{th} percentile within their country/economy) than girls.

These performance differences cannot be explained solely by girls' performance in the PISA core domains. After accounting for mathematics and reading performance, girls still largely outperformed boys in creative thinking: in all countries and economies, girls performed relatively better than boys with similar mathematics performance, and their performance advantage remained significant in around half of all countries and economies after accounting for reading performance (Table III.B1.3.6).[2] Despite similar gender differences observed overall in creative thinking and reading performance across countries and economies, girls scored 1 point higher in creative thinking than boys with similar reading scores on average across the OECD (a small but significant difference in performance); and in Macao (China), Saudi Arabia, Finland, Jamaica*, Hong Kong (China)* and Jordan (in descending order), girls scored over 2 points higher than boys in creative thinking after accounting for reading performance (a moderate performance difference).

…especially creative expression tasks and tasks building on others' ideas.

Performance differences between boys and girls also persisted across all types of tasks, including by different domain contexts and ideation processes (see Chapter 4). In nearly all countries and economies, girls performed equally to or outperformed boys in all task groupings. The only exception was observed in Mexico, where boys were more successful in scientific problem-solving tasks than girls. In contrast, in Finland – the country with the largest observed gender gap in performance overall – girls achieved full credit in at least 10 percentage point more items than boys in nearly every subset of items.

Girls demonstrated the biggest advantage in success in written expression tasks, particularly in Finland, Iceland, Korea and Qatar (over 10 percentage points, rising to 17 percentage points in Finland) (Figure III.4.12). Even when comparing students with similar mathematics and reading scores, gender differences remained the largest in written expression tasks on average across OECD countries (over 5 percentage points) (Table III.B1.4.8). Girls also outperformed boys in most countries and economies in visual expression tasks, with the largest gender gap observed in Israel (14 percentage points), Latvia*, Estonia, Hong Kong (China)*, Iceland and Romania (over 10 percentage points). In terms of ideation processes, girls had the greatest overall success compared to boys across countries and economies in tasks requiring them to build on others' ideas, and differences generally remained significant for performance in these tasks after accounting for the performance of boys and girls in mathematics and reading. In Finland, girls achieved full credit in over 10 percentage point more items corresponding to this ideation process after accounting for their performance in mathematics and reading, and in Jamaica*, Latvia* and Estonia, performance differences were around 9 percentage points after accounting.

These results on gender differences in performance show that boys need support to fully demonstrate their creative potential. While research on gender differences in creative thinking have tended to show that girls perform better than boys on certain types of creative thinking tasks (see Box III.4.5), the consistency with which gender differences are observed across countries and economies in PISA 2022, and across different types of tasks, points towards a need to address boys' disadvantage in this area – perhaps, in part, by supporting their attitudes and beliefs towards creativity and their engagement with more open-ended learning and problem-solving tasks.

Girls also have more positive beliefs about creativity, in general…

As well as outperforming boys on the PISA creative thinking test, PISA data show that girls often reported more positive beliefs about the nature of creativity or higher levels of attitudes and socio-emotional skills associated with creative thinking. On average across the OECD, more girls than boys reported believing that creativity extends beyond the arts and that it is possible to be creative in nearly any subject. Students who reported having such beliefs scored higher on the PISA creative thinking test than their peers by over 3 points on average across the OECD (a large difference in performance), even after accounting for gender and students' and schools' socio-economic profiles (Figure III.5.3).

…and in their own capacity to engage in creative work…

When it comes to gender differences in students' beliefs about their own capacity to engage in creative work, PISA results are more nuanced. Boys and girls equally reported believing that their creativity is something about themselves that they cannot change much, but when it comes to engaging in specific creative tasks, girls reported slightly higher levels of creative self-efficacy than boys. This finding is more notable given that, across OECD countries and economies, boys reported higher levels of general self-efficacy than girls and much lower levels of fear of failure (OECD, 2023[2]). However, in several Asian countries, including Korea, Hong Kong (China)*, Macao (China), Chinese Taipei and Indonesia (in descending order), as well as in Brazil, boys reported higher levels of creative self-efficacy (Table III.B1.5.8). Overall, after accounting for gender and student and school socio-economic profiles, students who reported higher levels of creative self-efficacy performed better in creative thinking on average than those who did not.

…as well as some other attitudes and socio-emotional skills associated with creative thinking.

Girls also reported significantly higher levels of some attitudes that support creative thinking, including openness to art and experience (+0.46 index-unit higher than boys, on average across the OECD – a large difference) and imagination and adventurousness (+0.29 index-unit higher than boys, on average across the OECD). After accounting for student and school characteristics, a one-unit increase in the indices of imagination and adventurousness and openness to art and experience were associated with higher scores in creative thinking (between 1.5 and 1 point, on average).

In nearly all participating countries and economies, girls also reported a higher propensity for perspective-taking than boys, with several items strongly associated with creative thinking performance (Figure III.5.11, Tables III.B1.5.37 and III.B1.5.39). However, gender differences across other indices with similarly strong associations with creative thinking performance were either mixed (openness to intellect, curiosity) or in favour of boys (persistence), suggesting that gender differences in attitudes and beliefs associated with creative thinking may only explain a small proportion of the observed differences in performance between boys and girls.

Socio-economic divides in performance persist in creative thinking

All students should be provided with opportunities to fulfil their potential, express their ideas, and think outside of the box. Yet PISA 2022 results show that socio-economically advantaged students outperformed their disadvantaged peers in creative thinking, as they did in the core PISA assessment domains. Across OECD countries, the difference in creative thinking performance between students in the top quarter of the PISA index of socio-economic and cultural status (ESCS) – or advantaged students – and students in the bottom quarter of the index – disadvantaged students

– is very large at 9.5 score points, which represents a difference of over one proficiency level in creative thinking. In Brunei Darussalam, Bulgaria, Hungary, Israel, Romania, the Slovak Republic and Peru, the difference in performance between advantaged and disadvantaged students is well over 12 score points.

The strength of the association between socio-economic status and performance, however, is weaker in creative thinking than it is in the PISA assessments of mathematics, reading and science, respectively, on average across the OECD (Figure III.3.10 and Table III.B1.3.8).[3]

In some countries, disadvantaged students perform well in creative thinking…

PISA 2022 results show that low socio-economic status need not be a determinant of poor academic outcomes, including students' capacity to think creatively. Several countries and economies combined high-performance in creative thinking with relatively small differences in performance between advantaged and disadvantaged students (with respect to the OECD average): for example, the gap between advantaged and disadvantaged students in Latvia* was around 6 points, and around 7 points in Australia*, Canada*, Denmark*, Estonia and Korea.

PISA data also show that in some countries and economies, students from disadvantaged backgrounds even excelled in creative thinking. Indeed, in some high-performing countries like Australia*, Estonia and Latvia*, the mean performance of disadvantaged students is around the OECD average (33 points), and well exceeds that in Singapore (36 points), Korea (35 points) and Canada* (34 points).

Another way to examine the success of disadvantaged students in creative thinking across countries and economies is to consider academic resilience. Academically resilient students are defined in PISA as students who are in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in their own country/economy (i.e. disadvantaged students) and who scored in the top quarter in that country/economy (i.e. high achievers), thus attaining educational excellence in comparison with students in their own country. The share of academically resilient students in creative thinking varies across countries and economies, from as much as 20% of disadvantaged students in Uzbekistan to below 8% of disadvantaged students in Romania, Bulgaria and Peru (Figure III.3.11). In these latter countries, few disadvantaged students are high achievers in creative thinking. Amongst the highest-performing systems overall, Korea (16.7%), Canada* (16.1%), Estonia (15.0%) and Latvia* (14.6%) have the largest share of resilient students in creative thinking, and Singapore (9.9%) and New Zealand* (9.0%) have the smallest shares. In New Zealand*, this low share of resilient students is combined with a relatively large gap in the performance of advantaged and disadvantaged students (11.7 score points compared to 9.5 score points in Singapore, for example, or 6 points in Latvia*).

…but poor literacy skills may largely prevent disadvantaged students from being able to fully reach their potential in creative thinking.

In general, the association between socio-economic status and performance in creative thinking likely reflects the range of economic and cultural factors, experiences and mechanisms known to affect student achievement overall. After accounting for students' mathematics and reading performance, differences in the performance of advantaged and disadvantaged students are much smaller across all countries/economies – and they even become statistically non-significant in 14 countries/economies (Table III.B1.3.7).

Examining performance differences across types of tasks provides further insights into potential sources of difficulty for disadvantaged students and the relationship between basic literacies and creative thinking performance. In general, large performance differences are observed between advantaged and disadvantaged students across all task groupings (Table III.B1.4.9 and Table III.B1.4.10). On average across the OECD, advantaged students have the largest advantage in "generate diverse ideas" tasks (a difference of around 18 percentage points) and the smallest in "evaluate and improve ideas" tasks (13.5 percentage points) (Figure III.4.14). Disadvantaged students thus appeared less successful in more open tasks, compared to those where an idea is already provided; it may be that such constraints weaken some of the performance differences otherwise observed between advantaged and disadvantaged students in tasks that are more open and, perhaps, influenced by advantaged students' relatively larger resources of prior knowledge and experience (see Box III.4.6).

Across domain contexts, the association between socio-economic advantage and creative thinking performance is strongest in written expression tasks and weakest in visual expression tasks (where writing and comprehension skills were less likely to influence task performance) (Table III.B1.4.10). In around one-third of all countries/economies, advantaged students were successful in over 20 percentage point more items in the written expression domain than disadvantaged students. This significant advantage may be influenced by the likely greater cultural wealth of advantaged students (e.g. more books at home) as well as their overall stronger proficiency in basic literacies. After accounting for mathematics and reading performance, differences in success between advantaged and disadvantaged students remained significant but much smaller (around 3 percentage points), and largely of a similar magnitude across the different domain contexts (Table III.B1.4.12).

Indeed, item-level analyses of performance on specific tasks showed that disadvantaged students performed notably worse than their advantaged peers in tasks requiring extended written responses, even on items within the same unit (and therefore domain context) (see Box III.4.6 in Chapter 4). In contrast, performance gaps between advantaged and disadvantaged students in the visual expression domain were relatively small and akin to those observed in items requiring short, written responses in other domains. In fact, in six countries and economies (Croatia, Jordan, Macao (China), Malta, the Palestinian Authority and Uzbekistan), there were no significant differences observed in the performance of advantaged and disadvantaged students in visual expression tasks, on average. These domain- and item-level patterns in success suggest that disadvantaged students may struggle to fully express their creative potential when tasks demand more than simple written responses (e.g. a few words). Addressing students' basic writing skills could therefore help close some of the observed gap in creative thinking performance across countries and economies between advantaged and disadvantaged students.

However, socio-economic differences in performance persist across many countries and economies even after accounting for mathematics and reading performance

It should be noted that differences in mathematics and reading performance do not account for all of the observed differences in performance by socio-economic profile – even after accounting for these variables, disadvantaged students still scored lower in creative thinking than advantaged students on average. Moreover, in some countries and economies, the performance gap between disadvantaged students and advantaged students remains large even after accounting for academic performance: for example, in Bulgaria, disadvantaged students' scored nearly 4 points lower than advantaged students with similar mathematics and reading performance (i.e. after accounting), and in New Zealand* and Peru, this performance gap is over 4.5 score points.

Creative thinking requires engaged students

Students around the world are curious and motivated learners…

In general, creative work requires a set of internal resources including domain readiness, cognitive skills and some level of task engagement and goal orientation (OECD, 2022[3]). In other words, individuals are unlikely to engage in creative work unless motivated to invest some effort towards achieving their creative goals. Creative self-efficacy, openness to intellect and curiosity are thus important for supporting students to engage in creative work and are all associated with small but positive changes in creative thinking performance (a difference of around 1 point).

PISA data show that students across countries and economies reported largely positive attitudes towards learning and engaging in creative work in general. For example, across OECD countries, nearly 83% of students reported that they enjoy learning new things; in Brunei Darussalam, Costa Rica, Colombia, France, Mexico, Italy, Peru, Panama* and Portugal, over 90% of students agreed or strongly agreed with this statement (Table III.B1.5.11). Only in Slovenia did considerably fewer students report that they enjoyed learning new things (61%). Students' reported enjoyment of learning new things was strongly associated with creative thinking performance on average across the OECD – after accounting for students' and schools' characteristics, these students scored nearly 4 points higher in creative thinking than those who did not.

Similarly, many students reported high levels of curiosity across OECD countries: around 77% of students on average reported that they are curious about many things and that they like to know how things work, while only 11% of students reported that they find learning new things to be boring. However, over 1 in 4 students in Morocco, the Philippines and Saudi Arabia said they found learning new things to be boring. General attitudes of curiosity were also strongly associated with better creative thinking performance, with students who reported being curious about many things and liking to know how things work scoring about 3 points higher in creative thinking than those who did not, on average across OECD countries.

…who are confident about being creative, in general,…

Most students also reported high levels of confidence in their ability to be creative in general (72.5% of students on average across the OECD), as well as to demonstrate creative thinking in everyday social problem-solving situations, such as coming up with many good ideas for helping people in need (71%, OECD average) or ideas for solving disagreements with people (70%, OECD average) (Figure III.5.6 and Table III.B1.5.7).

…but students in many countries/economies report that they do not find learning or engaging in creative work at school particularly enjoyable.

Despite high levels of curiosity and openness to intellect, in general, far fewer students reported such positive attitudes towards learning in the context of school. For example, while over 8 in 10 students across the OECD reported enjoying learning new things, only 1 in 2 students reported that they love learning new things in school. Students in some European countries in particular reported a lack of enjoyment of learning new things in school: in decreasing share of students, less than 40% of students in Lithuania, Estonia, Germany, Finland, the Netherlands* and Czechia agreed with this statement, with as few as 26% of students in Poland reporting agreement.

Similarly, students were less confident in their abilities to demonstrate creative thinking in specific school contexts compared to more general situations: on average across the OECD, 62% of students reported that they were confident that they could come up with creative ideas for school projects. In some countries and economies, including Brunei Darussalam, Czechia, Estonia, Hong Kong (China)*, Latvia*, Macao (China), Malaysia, Morocco, Poland, Chinese Taipei and Thailand, around 50% or fewer students reported that they could come up with creative ideas for school projects – perhaps reflecting limited opportunities and experience in engaging in creative work at school. Countries in which students reported the largest discrepancies between their confidence in being creative, in general, and in coming up with creative ideas for school projects, are Latvia* (around 25 percentage points), Thailand (23 percentage points), Czechia and Chinese Taipei (21 percentage points), and Poland (20 percentage points).

Boys and disadvantaged students, in particular, demonstrated higher levels of disengagement with the PISA 2022 creative thinking tasks

Part of the difference in creative thinking performance between girls and boys might be explained by different levels of engagement with the PISA test. In general, boys showed higher levels of task disengagement than girls, and this pattern was consistent across all three engagement indicators examined in Annex A8 (Tables III.A8.8 to III.A8.13). Significant gender gaps across engagement indicators were observed in many of the countries and economies that recorded large differences in the performance of girls and boys in creative thinking. For example, girls left significantly fewer items without a response than boys in the Palestinian Authority and Albania** (over 8 percentage points difference). Gender differences in engagement across different types of tasks also mirrored gender differences in engagement with the test overall, with boys showing the greatest disengagement with tasks in the written domain compared to girls.

Similarly, disadvantaged students exhibited more disengaged behaviours across all task groupings and across all three engagement indicators (Annex A8, Tables III.A8.14 to III.A8.19). While disengaged behaviours were generally similar across the task groupings for each measure, disadvantaged students showed slightly more disengaged behaviours in scientific problem-solving tasks – especially relative rapid responding behaviours and non-response behaviours. In some countries and economies, disadvantaged students recorded particularly high levels of disengaged behaviours with respect to their advantaged peers and compared to other countries. For example, large differences in non-response behaviours between disadvantaged and advantaged students were observed in North Macedonia (difference of 17 percentage points), Romania (15 percentage points), Bulgaria (14 percentage points), and the Slovak Republic and Israel (around 13 percentage points).

What students believe about their creative potential matters

Students who believe they can develop their creative skills performed better in creative thinking…

PISA data show that on average across OECD countries, around 1 in 2 students believe that their creativity is something about themselves that they cannot change much. Put differently, only 46% students on average hold a growth mindset on creativity– far fewer than those who hold a growth mindset on their own intelligence (57%, OECD average) (Table III.B1.5.4). These results imply that many students consider creativity to be akin to an innate talent that no education, training or experience can improve (i.e. fixed mindset). In Chinese Taipei, only 36% of all students hold a growth mindset on creativity, and in Kazakhstan, Georgia and Ireland*, less than 40% of all students.

This is a worrying finding in the context of developing creative thinking through education and practice. If creative thinking and creative work requires engaged learners, then students need to believe that they can develop these skills through practice – in the same way that they can improve their mathematics, reading or science literacy. PISA 2022 data show that holding a growth mindset on creativity has a positive association with creative thinking performance on average across the OECD, after accounting for student and school characteristics. In some countries this association is particularly strong, for example in Brazil (4 points), Peru and Saudi Arabia (3 points).

…but socio-economic divides also persist in student beliefs about creativity.

PISA data also show that socio-economically disadvantaged students were less likely to hold a growth mindset on creativity, on average across countries and economies. Differences in the proportion of advantaged and disadvantaged students who reported a growth mindset on creativity were particularly large in Brazil and Panama* (14 percentage points) and Peru (16 percentage points). In only two countries (Korea and Italy) were disadvantaged students more likely to report holding a growth mindset on creativity than their peers. Even larger differences between advantaged and disadvantaged students were observed when asked about their creative self-efficacy (i.e. their confidence in carrying out creative tasks) (Table III.B1.5.8 and III.B1.5.9). At the index level, advantaged students reported considerably higher levels of creative self-efficacy than disadvantaged students (+0.36 index-unit, on average across the OECD).

Schools and teachers can make a difference

Pedagogies encouraging creative thinking are associated with better student performance…

On average across OECD countries, between 60 and 70% of students reported that their teachers value their creativity, that they encourage them to come up with original answers, and that they are given a chance to express their ideas in school – with relatively higher proportions of students reporting such pedagogies in Latin American countries and lower proportions of students in European countries (Table III.B1.6.1). For example, in Austria, Czechia, Greece and Poland, less than half of all students reported that their teachers encourage them to come up with original and/or creative solutions on assignments.

Students who reported experiencing more pedagogies that encourage creative thinking demonstrated slightly stronger creative thinking proficiency than their peers, after accounting for students' school and socio-economic profiles and students' performance in mathematics and reading. This positive association was the strongest for students who believed that their teachers value students' creativity more broadly and who reported that the activities they do in their classes help them think about new ways to solve problems (Table III.B1.6.4).

…especially in certain types of tasks…

Interesting patterns emerged when examining the relationship between the use of pedagogies encouraging creative thinking and students' performance across different types of tasks. Students who reported that their teachers value their creativity were more likely to achieve full credit on items asking them to evaluate and improve others' ideas (average odds ratio = 1.27) than to generate diverse ideas (1.21) or creative ideas (1.17) (Figure III.6.5). In other words, students whose teachers' value their creativity were 27% more likely to suggest original ways to improve others' ideas than students who felt their teachers did not value their creativity. This aligns with research suggesting that evaluating the appropriateness of ideas is a skill that is more easily amenable in an educational context than, for example, generating original ideas (Howard-Jones, 2002). Students who reported that their teachers valued their creativity were also more likely to perform relatively better on items in scientific problem-solving contexts (1.27) than on those in the visual expression domain (1.11), and they were more likely to achieve full credit than other students as the difficulty of items in the test increased.

Similar odds ratios were observed for students who reported that their teachers give them enough time to come up with creative solutions on assignments. In contrast, students who reported that they are given a chance to express their ideas at school did relatively better than others on items in the social problem-solving domain and in tasks that required generating diverse ideas.

…but more needs to be done to support teachers to develop students' creative thinking in schools.

Across many PISA participating jurisdictions, policymakers reported that "developing students' creativity" was formally integrated into initial teacher training in their country/economy (OECD, 2023[1]). However, findings from the OECD's Teacher and Learning International Survey (TALIS) in 2018 showed significant variation between countries and economies on the extent to which teaching "cross-curricular skills" – of which creative thinking is just one of many – were included in initial teacher training, ranging from over 90% of teachers surveyed in Chile and the United Arab Emirates to less than 50% of teachers in Austria, Czechia, France and Slovenia (OECD, 2023[1]).

Even if included in initial teacher training, the extent to which developing students' creativity is given importance likely varies substantially. More could be done across countries and economies to support teachers to implement practices encouraging students to engage in creative thinking, both as part of their professional training and education and as part of their everyday classroom tools and practices. For example, teachers might benefit from pedagogical resources that exemplify what it means to teach, learn and make progress in creativity in primary and secondary education, and how to connect pedagogies encouraging creative thinking to different elements of the curriculum (see Boxes III.2.4, III.6.2 and III.6.5 for examples).

Many schools offer students opportunities to engage in creative work…

Schools often provide opportunities for students to engage in activities or classes that aim to broaden their educational experiences beyond developing core literacies and/or further their holistic development. Such activities might focus on artistic or expressive endeavours (such as art and design, creative writing, music or theatre activities) that are typically associated with "creative" practices, or they might focus on games and competitions, physical education, community engagement or developing other specialised skills or interests. PISA data show that, on average across OECD countries, 65% of students reported having access to art classes/activities once a week or more, 59% to music classes/activities, 42% to computer programming classes, 35% to dramatics and theatre classes/activities, 31% to a science club, and 30% to creative writing classes (Figure III.6.6). Students in Jamaica*, the United Kingdom*, Australia*, the United Arab Emirates and Macao (China) have the greatest access to a range of different school activities, according to school principals, with school principals in Greece, Norway, Belgium, Poland and Czechia having reported that their schools offer relatively less activities to students compared to other countries (Table III.B1.6.65).

Taking part in school-based activities might be mandated by teachers, schools or the curriculum in some countries and economies, while in other education systems and schools, student participation in such activities might be elective or even restricted to just a small number. On average across OECD countries, students reported participating at least once a week in art classes/activities (27% of students), music classes/activities (22%), computer programming classes/activities (17%), creative writing classes/activities (16%) and drama and theatre classes/activities (11%) (Table III.6.1). In Albania**, Uzbekistan, Baku (Azerbaijan), the Dominican Republic** and the Palestinian Authority, students reported the highest frequency of participation in various activities at school, compared to students in Czechia, France, Lithuania, Poland and Portugal who reported taking part in these activities in school the least often. In the United Kingdom*, the availability of school activities according to school principals was much higher than the reported participation of students in such activities. Nonetheless, it follows that the more that such activities are made available to students in school, especially when integrated into the curriculum, the more likely students are to participate in them.

…but the availability of and participation in such activities are strongly associated with socio-economic factors, leading to mixed associations with performance outcomes…

In general, advantaged schools provide students with greater access to different school activities, according to school principals – with the largest disparity in weekly offer between advantaged and disadvantaged schools, on average across OECD countries and economies, being drama and theatre classes/activities (20 percentage points difference), as well as debate club, science club, computer programming classes/activities and music classes/activities (all 15 percentage points difference) (Table III.B1.6.66). Yet it is students in socio-economically disadvantaged schools who participate in activities more often than their advantaged peers, on average across OECD countries (Table III.B1.6.16).[4]

One reason for this counter-intuitive association between participation in different school-based activities and student background may be that students from more advantaged backgrounds, or who attend more advantaged schools, are more likely to focus their time and orient their educational choices towards traditionally "academic" subjects that have a greater influence on their ability to transition into tertiary education – and eventually, access high-paying jobs. These students may thus be less likely to choose to participate in such classes or activities regularly, especially as part of their formal studies. Students from more advantaged backgrounds may also have greater access to extra-curricular activities not asked about in PISA, such as private tutors or language classes, or more "elite" sports and clubs that are not typically offered at school.

Students who report participating in many activities at school scored lower in creative thinking than those who did not, on average across OECD countries – although this negative association can largely be explained by the characteristics of students who frequently participate in school-based activities. After accounting for students' and schools' socio-economic profiles, as well as students' mathematics and reading performance, there was no strong association between participation in activities and creative thinking performance. This weak relationship can also be explained by the fact that the PISA test does not reward students for the intrinsic quality of their work (i.e. whether a story is well written with an elaborate vocabulary, or whether a visual output is aesthetically appealing); instead, the test focuses on whether students can make original and diverse idea associations, and this capacity to think outside of the box can be developed through active learning experiences across all school subjects (not just through participation in activities associated with the arts, for example).

…although moderate and regular participation in certain activities in school is associated with more positive student outcomes

Despite mixed associations between participation in creative activities and creative thinking performance, in general, an interesting pattern emerges when examining the average creative thinking performance of students who reported participating in school-based activities at different levels of engagement. Students who take part in art, music, creative writing or computer programming activities/classes on a weekly basis at school scored modestly better in creative thinking than their peers who either participated in those activities either on an ad-hoc basis (i.e. once or twice a year, or about once a month) or very often (i.e. almost every day). It may be that activities that are embedded within the curriculum and that engage students in tasks that require creative thinking on a regular but considered basis (e.g. as part of lessons taken once or twice a week) may be best for developing students' creative thinking skills. Beyond performance outcomes, students who participated in school activities about once or twice a week also reported higher levels of openness to intellect and creative-self efficacy – two attitudes supporting creative thinking – than their peers who participated more and less frequently.

Notes

[1] In decreasing share, the countries/economies with over 50% of students who performed below a baseline level (i.e. Level 2) in mathematics, reading and science and who also took the PISA 2022 Creative Thinking assessment are: Uzbekistan (71.4%), the Philippines (71.3%), Morocco (68.5%), the Dominican Republic (68.4%), the Palestinian Authority (63.5%), Jordan (62.9%), El Salvador (62.8%), Indonesia (59.0%), Albania** (56.2%), North Macedonia (55.8%), Baku (Azerbaijan) (50.9%) and Panama* (50.4%). These 12 countries and economies were amongst the 14 lowest performing countries in creative thinking.

[2] Relative performance refers to the residual performance attributable to creative thinking skill uniquely after accounting for performance in mathematics, reading or science, respectively, in cubic polynomial regressions performed across students at the national level.

[3] Students' socio-economic status is measured by the PISA index of socio-economic and cultural status (ESCS). The strength of the association between performance and socio-economic status is measured by the percentage of variation explained by socio-economic disparities. The strength of this association among OECD countries participating in the creative thinking assessment is 11.6% for creative thinking, compared to 15.9% for mathematics, 12.9% for reading and 14.6% for science, respectively.

[4] The only exception to this trend across OECD countries is participation in music classes/activities, where advantaged students participate more often than disadvantaged students.

References

OECD (2023), *PISA 2022 Results (Volume II): Learning During – and From – Disruption*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/a97db61c-en. [2]

OECD (2023), *Supporting Students to Think Creatively: What Education Policy Can Do*, OECD Publishing, Paris, https://issuu.com/oecd.publishing/docs/supporting_students_to_think_creatively_web_1_?fr=sMGE0ZjYxMjMxNTE. [1]

OECD (2022), *Thinking Outside the Box: The PISA 2022 Creative Thinking Assessment*, https://issuu.com/oecd.publishing/docs/thinking-outside-the-box (accessed on 4 March 2023). [3]

Annex A1. PISA 2022 Creative Thinking Framework

Defining the construct for the PISA 2022 assessment

The PISA 2022 definition of creative thinking

While closely related to the broader construct of creativity, creative thinking refers to the cognitive processes required to engage in creative work. It is a more appropriate construct to assess in the context of PISA as it is a malleable individual capacity that can be developed through practice and does not place an emphasis on how wider society values the resulting output. PISA defines creative thinking as “the competence to engage productively in the generation, evaluation and improvement of ideas that can result in original and effective solutions, advances in knowledge and impactful expressions of imagination”.

The PISA definition of creative thinking is aligned with the cognitive processes and outcomes associated with “little-c” creativity – in other words, it reflects the types of creative thinking that 15-year-old students around the world can reasonably demonstrate in “everyday” contexts. It emphasises that students need to learn to engage productively in generating ideas, reflecting upon ideas by valuing their relevance and novelty, and iterating upon ideas before reaching a satisfactory outcome. This definition of creative thinking applies to learning contexts that require imagination and the expression of one’s inner world, such as creative writing or the arts, as well as contexts in which generating ideas is functional to the investigation of problems or phenomena.

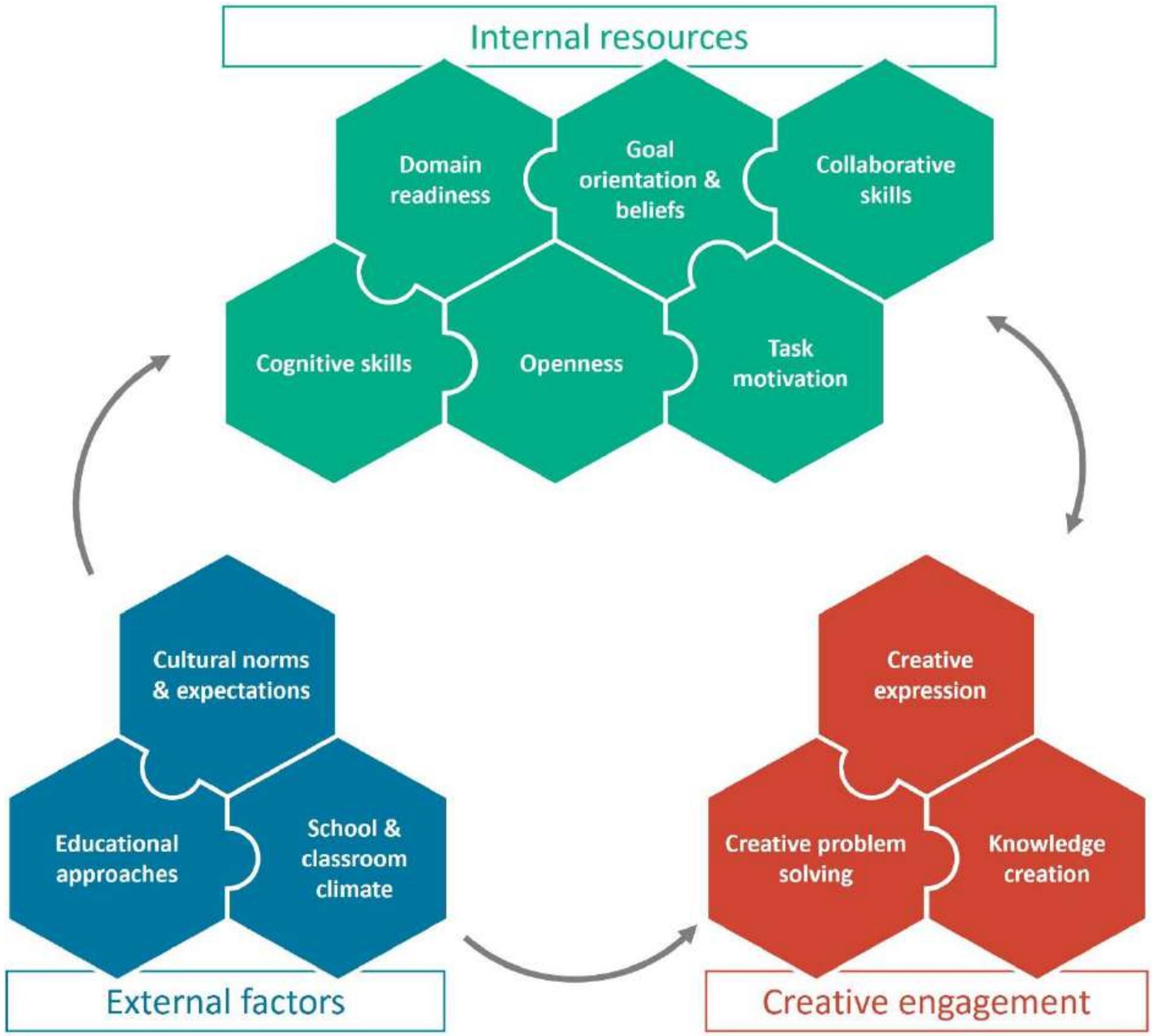
Unpacking creative thinking in the classroom

Confluent approaches to creativity emphasise that both “internal” and “external” resources are needed to successfully engage in creative work. To better understand children’s creative thinking and define what information is important to collect in the PISA assessment, it is necessary to contextualise these approaches in a way that is relevant to students in their everyday school life (Glaveanu et al., 2013[1]; Tanggaard, 2014[2]). This section describes what creative thinking in the classroom looks like and the interconnected internal and external factors that can promote or hinder it.

Schools can influence many of the internal resources students need to engage in creative thinking. Internal resources here essentially refer to the set of knowledge, skills and attitudes that enable creative thinking. These include: 1) cognitive skills; 2) domain readiness (i.e. domain-specific knowledge and experience); 3) openness to new ideas and experiences; 4) goal orientation and self-belief; 5) task motivation; and in some cases, 6) collaborative skills. In terms of external factors, features of students’ environments can also incentivise or hinder their capacity to engage in creative thinking. These include the classroom culture, the educational approach of schools and wider education systems, and broader cultural norms and expectations.

Schools are also important places in which students can think creatively, either as individuals or as part of a group, and where they can produce creative work. Creative achievement and progress in the classroom can take many forms, such as creative expression (communicating one’s thoughts and imagination through various media), knowledge creation (advancing knowledge and understanding through inquiry), or creative problem solving. Figure III.A1.1. summarises these elements that, together, define creative thinking in the classroom. The three sets of elements (internal resources, external factors, and creative achievement and progress) are strongly interconnected. For example, external factors include cultural norms and expectations, which in turn influence how students’ internal resources are developed and honed as well as the types of creative work that students might choose to produce. Each of the elements in Figure III.A1.1 are described in further detail in the following section.

Figure III.A1.1. Unpacking creative thinking in the classroom: Internal resources, external factors and types of creative engagement



Internal resources

Cognitive skills

Both convergent and divergent thinking (Guilford, 1956[3]) are widely recognised as important skills for creative thinking. Convergent thinking refers to the ability to apply conventional and logical reasoning to information (Cropley, 2006[4]). As such, convergent thinking aids in understanding the problem space and identifying and evaluating good ideas (Reiter-Palmon and Robinson, 2009[5]; Runco, 1997[6]). By contrast, divergent thinking refers to the ability to think of original ideas, to make flexible connections between ideas or pieces of information, and to apply fluency of association and ideation (Cropley, 2006[4]). It also refers to the ability to break out of "fixed" performance scripts – in other words, to try new approaches, to look at problems from different angles, and to discover new methods of "doing" (Schank and Abelson, 1977[7]; Duncker, 1972[8]). In essence, divergent thinking brings forth novel, unusual or surprising ideas.

Creative thinking is often described in terms of divergent thinking, and most assessments to-date have focused on measuring divergent thinking cognitive processes. However, convergent thinking cognitive processes are also important for engaging in creative work. For example, Getzels and Csikszentmihalyi (1976[9]) found that art students' success in "problem construction" was strongly correlated with measures of the originality and aesthetic value of their resulting paintings, and that these measures were also linked to long-term artistic success.

Domain readiness

Domain readiness conveys the idea that some prior domain knowledge and experience is needed to successfully produce creative work (Baer, 2016[10]). A better understanding of a domain is more likely to help with generating and evaluating ideas that are both novel and useful (Hatano and Inagaki, 1986[11]; Schwartz, 2005[12]). However, this relationship may not be strictly linear – well-established routines for deploying knowledge or skills within a domain may also result in idea fixation and a reluctance to think beyond those established routines.

Openness to experience and to intellect

Several studies have shown that creative people share a core set of tendencies, particularly the trait of "openness", part of the "Big Five" personality dimensions (Kaufman et al., 2010[13]; 2016[14]; McCrae, 1987[15]; Prabhu, Sutton and Sauser, 2008[16]; Werner et al., 2014[17]). In general, such empirical studies examining the personality and behaviour of creative individuals have typically employed questionnaire instruments that operationalise creativity as a relatively enduring and stable personality trait (Hennessey and Amabile, 2010[18]). Meta-analyses of studies on creativity and personality have also found that openness appears to be a common trait in creative achievers across domains, whereas other personality traits tend to interact with creativity only insofar as they benefit individuals within specific domains (e.g. "conscientiousness" seems to enhance scientific creativity but detract from performance in the arts) (Batey and Furnham, 2006[19]; Feist, 1998[20]).

Both "openness to experience" and "openness to intellect" are included under the broader openness trait. "Openness to experience" describes an individual's receptivity to engage with novel ideas, imagination and fantasy (Berzonsky and Sullivan, 1992[21]). Its predictive value for creative achievement across domains is likely due to its inclusion of cognitive (e.g. imagination), affective (e.g. curiosity) and behavioural aspects (e.g. adventurousness), and the links between curiosity and creativity have been further supported by several researchers (Chávez-Eakle, 2009[22]; Feist, 1998[20]; Guastello, 2008[23]; Kashdan and Fincham, 2002[24]).

"Openness to intellect" describes an individual's receptivity to appreciate and engage with abstract and complex information, primarily through reasoning (DeYoung, 2015[25]). In contrast to "openness to experience", which is particularly correlated with artistic creativity, the trait "openness to intellect" seems particularly correlated with scientific creativity (Kaufman et al., 2016[14]).

Goal orientation and creative self-beliefs

Persistence, perseverance and creative self-efficacy influence creative thinking by providing a strong sense of goal orientation and the belief that creative goals can be achieved. Investing effort towards one's goal and overcoming difficulty are essential for engaging in creative thinking, as they enable individuals to maintain concentration for long periods and deal with frustrations that arise (Cropley, 1990[26]; Torrance, 1988[27]; Amabile, 1983[28]).

Related to goal orientation is creative self-efficacy, which describes an individual's belief that they are capable of successfully producing creative work (Beghetto and Karwowski, 2017[29]). Researchers consider creative self-efficacy essential in determining whether an individual will sustain effort towards their goals in the face of resistance and ultimately succeed in performing tasks creatively (Bandura, 1997[30]). These beliefs can in turn be influenced by one's prior experience and performance history, mood and environment (Bandura, 1997[30]; Beghetto, 2006[31]).

Task motivation

The role of task motivation as a driver of creative work has been well documented, namely in the works of Teresa Amabile (1997[32]; 2016[33]; 2010[18]; 1983[28]). The basic notion is that, as with any task, an individual will not produce creative work unless they are sufficiently motivated to do so. This motivation can be both intrinsic and extrinsic.

Intrinsic task motivation drives individuals who find their work inherently meaningful or rewarding, for reasons such as enjoyment, self-interest or a desire to be challenged. This type of task engagement is relatively insensitive to incentives or other external pressures. The experience of "creative flow" – being fully immersed in a task and disregarding other needs – is a powerful driver of creativity because individuals in flow are intrinsically motivated to engage in a task (Csikszentmihalyi, 1996[34]; Nakamura and Csikszentmihalyi, 2002[35]).

On the other hand, extrinsic task motivation refers to external incentives, goals or pressures that motivate people to engage in a particular task. Although research emphasises the importance of intrinsic task motivation in creative performance, extrinsic motivators such as deadlines or recognition can also motivate people to persist in their creative endeavours (Eisenberger and Shanock, 2003[36]; Amabile and Pratt, 2016[33]).

Collaborative engagement

Creative work often results from interactions between individuals and their environment – including interactions with others. Research has also increasingly examined creative thinking as a collective endeavour, for example by examining the actions and benefits of teams in generating new knowledge (Thompson and Choi, 2006[37]; Prather, 2010[38]; Grivas and Puccio, 2011[39]; Scardamalia, 2002[40]). Collaboration can help individuals to explore and build upon the ideas of others as well as improve weaknesses in ideas. This can drive forward knowledge creation by facilitating the development of solutions to complex problems that are beyond the capabilities of any one person (Warhuus et al., 2017[41]).

External factors

Cultural norms and expectations

Creative work is embedded within social contexts that are inherently shaped by cultural norms and expectations. Cultural norms and expectations can influence the skills that individuals develop, the values that shape personality development, and the differences in performance expectations within societies (Niu and Sternberg, 2003[42]; Wong and Niu, 2013[43]; Lubart, 1998[44]). Some studies have investigated how cultural differences affect national measures of creativity and innovation, concluding that differences along the individualism-collectivism spectrum can significantly shape how creative work is defined and valued (Rinne, Steel and Fairweather, 2013[45]; Ng, 2003[46]).

Educational approaches

Cultural norms affect educational approaches, in particular the outcomes an education system values for its students and the content it prioritises in the curriculum. In some cases, these approaches might actively hinder creative thinking and achievement at school (Wong and Niu, 2013[43]). For example, the pressures of standardisation and accountability in educational testing systems often reduce opportunities for creative thinking in schoolwork (DeCoker, 2000[47]). Some have even claimed that increasingly narrow educational approaches and assessment methods are at the root of a "creaticide", i.e. death of creativity, affecting today's young people (Berliner, 2012[48]). Schools and educational systems therefore play an important role in combatting this effect and should seek to implement policies and practices that increase the opportunities and rewards for producing creative work.

Classroom climate

Beyond broader cultural norms and educational systems, certain classroom practices can also stifle creative thinking – for example, perpetuating the idea that there is only one correct way to learn or solve problems, cultivating attitudes of submission and fear of authority, promoting beliefs that originality is a rare quality, or discouraging students' curiosity and inquisitiveness (Nickerson, 2010[49]). Conversely, findings from organisational research have demonstrated that informal feedback, goal setting, teamwork, task autonomy, and appropriate recognition and encouragement to develop new ideas are all important enablers of creative thinking (Amabile, 2012[50]; Zhou and Su, 2010[51]).

Teachers' beliefs about creativity are also important – they need to value creative work and consider it a fundamental skill that should be developed in the classroom in order to promote creative thinking. Teachers can actively cultivate an environment that helps students learn when creative thinking is appropriate and how to take charge of their own creativity – for example, by encouraging students to set their own goals, identify promising ideas, and take responsibility for contributing to creative teamwork (Beghetto and Kaufman, 2010[52]; 2014[53]). Employing "questions of wonderment" – or encouraging students to try to understand the world and put forth their ideas about different phenomena – can also help to promote knowledge creation in the classroom (Bereiter and Scardamalia, 2010[54]). These approaches are all supported by teachers' beliefs that creative thinking is something that can be developed in the classroom, even if this development takes time.

Creative engagement

Creative products are both novel and useful, as defined within a particular social context. Examining the outputs of students' creative work can provide indicators of their capacity to think creatively, particularly in tasks where much of the creative thinking process is not visible (Amabile, 1996[55]; Kaufman and Baer, 2012[56]). Students can produce different kinds of "everyday" creative work at school, either as individuals or as part of a group. These forms of creative work in the classroom are multi-disciplinary and extend beyond traditional subjects.

Creative expression

Creative expression refers to both verbal and non-verbal forms of creative engagement where individuals communicate their thoughts, emotions and imagination to others. Verbal expression involves the use of language, including both written and oral communication, whereas non-verbal expression includes drawing, painting, modelling, music, and physical movement and performance.

Knowledge creation

Knowledge creation refers to the advancement of knowledge and understanding, with a focus on making progress rather than achievement, e.g. improving an idea rather than achieving the optimal solution or complete understanding. Knowledge creation refers not only to important discoveries or advances but also to the purposeful act of building upon and iterating on ideas, which can happen at all levels of society and across all knowledge domains (Scardamalia and Bereiter, 1999[57]).

Creative problem solving

Not all cases of problem solving require creative thinking: creative problem solving is a distinct class of problem solving characterised by novelty, unconventionality, persistence and difficulty during problem formulation (Newell, Shaw and Simon, 1962[58]). Creative thinking becomes particularly necessary when students are challenged to solve problems outside of their realm of expertise and where the techniques with which they are familiar do not work (Nickerson, 1998[59]).

Measuring creative thinking in the PISA test: Task design and scoring approach

The competency model of creative thinking

The competency model is composed of three distinct ideation processes (or facets) for measurement purposes in the PISA 2022 test. These three facets are: 1) generate diverse ideas; 2) generate creative ideas; and 3) evaluate and improve ideas. These reflect the PISA definition of creative thinking and encompass the cognitive skills required for creative thinking in the classroom. The competency model incorporates both divergent cognitive processes (the ability to generate diverse ideas and to generate creative ideas) and convergent cognitive processes (the ability to evaluate other people's ideas and identify improvements to those ideas).

"Ideas" in the context of the PISA assessment can take many forms. The test units provide a meaningful context and sufficiently open tasks in which students can demonstrate their capacity to produce different ideas and think outside of the box.

Generate diverse ideas

Typically, attempts to measure creative thinking have focused on the number of ideas that individuals are able to generate – often referred to as "ideational fluency". Going one step further is "ideational flexibility", or the capacity to generate ideas that are different to each other. When it comes to measuring the quality of ideas that an individual generates, some researchers have argued that fundamentally different ideas should be weighted more than similar ideas (Guilford, 1956[3]).

The facet "generate diverse ideas" of the competency model encompasses these ideas and refers to a student's capacity to think flexibly by generating multiple distinct ideas. Test items for this facet will present students with a stimulus and ask them to generate two or three appropriate ideas that are as different as possible from one another.

Generate creative ideas

The literature on creative thinking generally agrees that creative ideas and outputs are defined as being both novel and useful. Clearly, expecting 15-year-olds around the world to generate ideas that are completely unique or novel is neither feasible nor appropriate for the PISA assessment. In this context, originality is a useful concept as a proxy for measuring the novelty of ideas. Defined by Guildford (1950[60]) as "statistical infrequency", originality encompasses the qualities of newness, remoteness, novelty or unusualness, and generally refers to deviance from patterns that are observed within the general population at hand. In the PISA assessment context, originality is therefore a relative measure established with respect to the responses of other students who complete the same task.

The facet "generate creative ideas" focuses on a student's capacity to generate appropriate and original ideas. "Appropriate" means that ideas must comply with the task requirements and demonstrate a minimum level of usefulness. This dual criterion ensures the measurement of creative ideas – ideas that are both original and of use – rather than ideas that make random associations that are original but not meaningful. Test items for this facet will present students with a stimulus and ask them to develop one original idea.

Evaluate and improve ideas

Evaluative cognitive processes help to identify and remediate deficiencies in initial ideas as well as ensure that ideas or solutions are appropriate, adequate, efficient and effective (Cropley, 2006[4]). They often lead to further iterations of idea generation or the reshaping of initial ideas to improve a creative outcome. Evaluation and iteration are thus at the heart of the creative thinking process. Being able to provide feedback on the strengths and weaknesses of others' ideas is also an essential part of any collective knowledge creation effort.

The facet "evaluate and improve ideas" focuses on a student's capacity to evaluate limitations in ideas and improve their originality. To reduce problems of dependency across items, students were not asked to iterate upon their own ideas but rather to modify someone else's work. Test items for this facet present students with a given scenario and idea and ask them to suggest an original improvement, defined as a change that preserves the essence of the initial idea but that adds or incorporates original elements.

Domains of creative thinking

The literature on creative thinking suggests that the larger the number of domains included in an assessment of creative thinking, the better the coverage of the construct. However, certain practical and logistical constraints limit the number of possible domains that can be included in the PISA 2022 assessment of creative thinking. These constraints include:

- **The age of test takers.** 15-year-olds have limited knowledge and experience in many domains, meaning those included in the assessment must be familiar to most students around the world and must reflect realistic manifestations of creative thinking that 15-year-olds can achieve in a constrained test context.
- **The available testing time.** Students will sit a maximum of one hour on creative thinking items, meaning the range of possible domains must be limited to ensure sufficient data are collected from tasks in each domain.

As PISA aims to provide comparable measures of performance at the country level rather than the individual level, it is possible to apply a rotated test design in which students take on different combinations of tasks within domains.

- **The available testing technology.** The PISA test is administered on standard desktop computers with no touchscreen capability or Internet connection. Although the test platform supports a range of item types and response modes, including interactive tools and basic simulations, the choice of domains and the design of the tasks needed to take into consideration the technical limitations of the platform.

Taking these main constraints into account and building upon the literature exploring different domains of creativity, the PISA 2022 test included tasks situated within four distinct domains: 1) written expression; 2) visual expression; 3) social problem solving; and 4) scientific problem solving. The written and visual expression domains involve communicating one's imagination to others, and creative work in these domains tends to be characterised by originality, aesthetics, imagination, and affective intent and impact. In contrast, social and scientific problem solving involve investigating and solving open problems. They draw on a more functional employment of creative thinking that is a means to a better end, and creative work in these domains is characterised by ideas or solutions that are original, innovative, effective and efficient.

These four domains represent reasonable and sufficiently diverse coverage of the different types of "everyday" creative thinking activities in which 15-year-olds engage. Given that differences in cultural norms exist for certain forms of creative engagement as do differences in what is valued in education across the world, in addition to the fact that creative engagement in each domain is supported by some degree of domain readiness, we can also expect variation in student performance across domains. By having students work on more than one domain during the test, it is possible to gain insights on country-level strengths and weakness by domain of context. Each of the four domain contexts are described in further detail below.

Written expression

Creative writing involves communicating ideas and imagination through written language. Good creative writing requires that readers understand and believe in the author's imagination, including the rules of logic within the universe the author has created. Both fictional and non-fictional writing can be creative, and learning how to express oneself creatively can help students to develop effective and impactful communication skills that they will need throughout their lifetimes.

In the PISA test, students express their imagination in a variety of written formats. For example, students caption an image, propose ideas for a short story using a given text or visual as inspiration, or write a short dialogue between characters for a movie or comic book plot.

Visual expression

Visual expression involves communicating ideas and imagination through a range of different media. Creative visual expression has become increasingly important as the ubiquity of desktop publishing, digital imaging and design software means that nearly everyone will need to design, create or engage with visual communications at some point in their personal or professional lives.

In the PISA test, students express their imagination by using a digital drawing tool. The drawing tool does not enable free drawing, but students can create visual compositions by dragging and dropping elements from a library of images and shapes. Students were also able to resize, rotate and change the colour of elements. Students create visual designs for a variety of purposes, such as creating a clothing design, or a logo or poster for an event.

Social problem solving

Young people use creative thinking every day to solve personal, interpersonal and social problems. These problems can range from the small-scale, personal level (e.g. resolving a schedule conflict) to the wider school, community or even global level (e.g. finding ways to improve sustainable living). Creative thinking in this domain involves understanding different perspectives, addressing the needs of others, and finding innovative and functional solutions for the parties involved (Brown and Wyatt, 2010[61]).

In the PISA test, students solve open problems that have a social focus. These problems focus on issues that affect subsets of society (e.g. young people) or on issues that affect society at large (e.g. the use of global resources or the production of waste materials). Students were asked to propose ideas or solutions in response to a given scenario, or to suggest original ways to improve others' solutions.

Scientific problem solving

Scientific problem solving involves generating new ideas and understanding, designing experiments to probe hypotheses, and developing new methods or inventions (Moravcsik, 1981[62]). Students can also demonstrate creative thinking as they engage in a process of scientific inquiry by exploring and experimenting with different ideas or materials to make discoveries and advance their knowledge and understanding (Hoover, 1994[63]).

Although creative thinking in science is related to scientific inquiry, the tasks in this domain differ fundamentally from the PISA scientific literacy tasks. In this test, students were asked to generate multiple distinct ideas or solutions, or an original idea or solution, for an open problem for which there is no predefined correct response. In other words, the tasks measure students' capacity to produce diverse and original ideas, not their ability to reproduce scientific knowledge or understanding. For example, in a task asking students to formulate different hypotheses to explain a phenomenon, they would be rewarded for proposing multiple plausible hypotheses regardless of whether one of those hypotheses constituted the correct explanation for the phenomenon. Nonetheless, domain readiness may affect performance in this domain more than others, as most tasks that can be imagined imply a minimum level of knowledge of basic scientific principles.

In the PISA test, students engage with open problems that have a scientific or engineering basis. Students were asked to propose hypotheses to explain a given scenario, or to improve or generate new methods for solving problems.

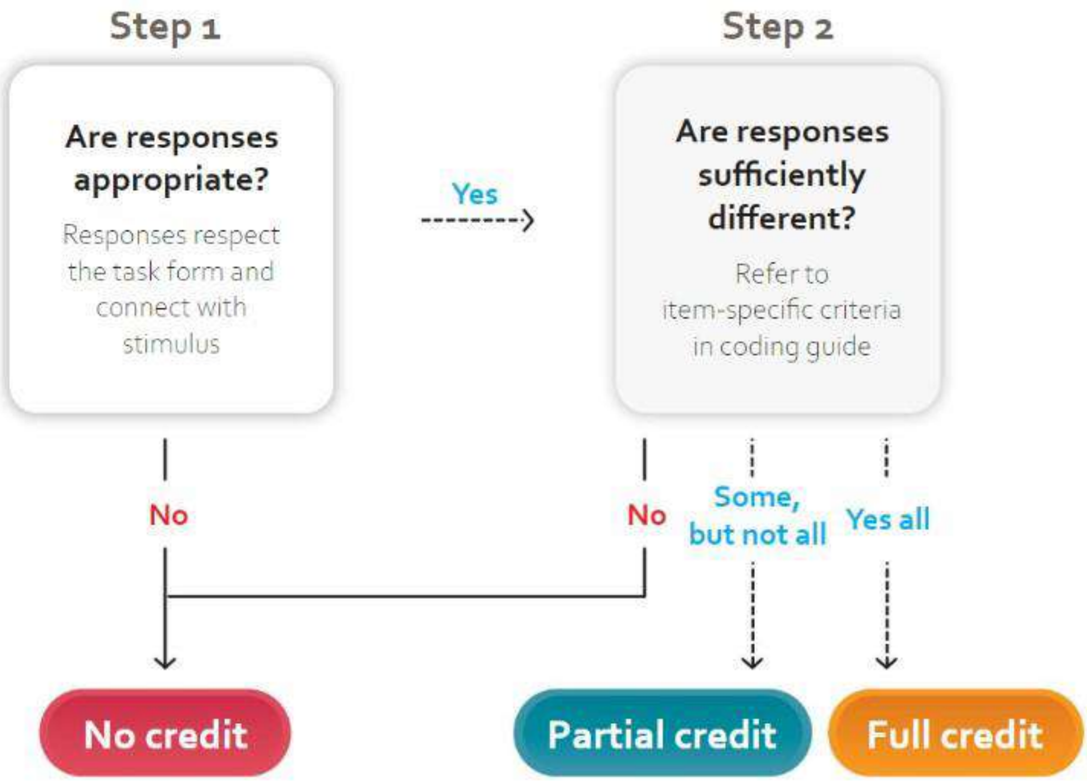
Scoring the tasks

Every task in the PISA test is open-ended, meaning there are essentially infinite ways of demonstrating creative thinking. Scoring for this assessment therefore relies on human judgement following detailed scoring rubrics and well-defined coding procedures. All items corresponding to the same facet of the competency model apply the same general coding procedure. However, as the form of response varies by domain and task (e.g. a title, a solution, a design, etc.), so do the item-specific criteria for evaluating whether an idea is different or original. The detailed coding guides describe the item-specific criteria for each item and provide annotated example responses to help human coders score consistently (see Annex C for excerpts of the item-specific coding criteria for select released items from the PISA 2022 Creative Thinking test described in Chapter 1).

Scoring of "generate diverse ideas" items

All items corresponding to the "generate diverse ideas" facet of the competency model required students to provide two or three responses. The general coding procedure for these items involves two steps, as summarised in Figure III.A1.2. First, coders must determine whether responses are appropriate. Appropriate in the context of this assessment means that student responses respect the required form and connect (explicitly or implicitly) to the task stimulus. Second, coders must determine whether responses are sufficiently different from one another based on item-specific criteria described in the coding guide.

Figure III.A1.2. General coding process for "generate diverse ideas" items



The item-specific criteria are as objective and inclusive as possible of the range of different potential responses. For example, for a written expression item, sufficiently different ideas must use words that convey a different meaning (i.e. are not synonyms). For items in the problem-solving domains, the coding guides list pre-defined response categories to help coders distinguish between similar and different ideas. The coding guides provide detailed example responses and explanations for how to code each example.

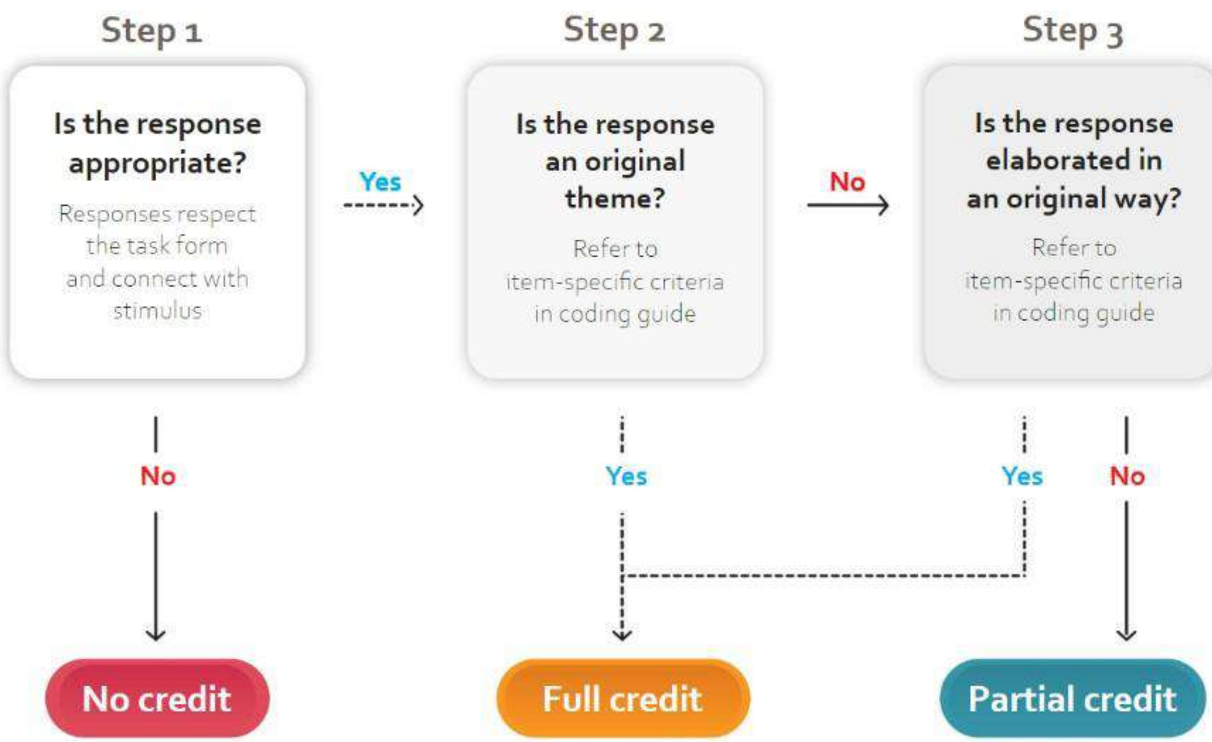
Full credit is assigned where all the responses required in the task are both appropriate and sufficiently different from each other. Partial credit is assigned in tasks requiring students to provide three responses, and where two or three responses are appropriate but only two are different from each other. No credit is assigned in all other cases.

Scoring of "generate creative ideas" items

All items corresponding to the facet "generate creative ideas" of the competency model require a single response. The general coding procedure for these items involves two or three steps, depending on the content of the response. First, as with all items, coders must determine whether the response is appropriate. Then, coders must determine whether the response is original by considering two criteria (see Figure III.A1.3).

An original idea is defined as a relatively uncommon idea with respect to the general pool of responses. The coding guide identifies one or more conventional themes for each item according to the patterns of genuine student responses revealed in multiple validation studies. If a response does not correspond to a conventional theme as described in the coding guide, it is directly coded as original. However, if an idea does correspond to a conventional theme, then coders must determine whether it is original based on its elaboration. The coding guide provides item-specific explanations and examples of original ways to elaborate on conventional themes. For example, a student might add an unexpected twist to a story idea that otherwise centres on a conventional theme.

Figure III.A1.3. General coding process for "generate creative ideas" and "evaluate and improve ideas" items



This two-fold originality criteria ensures that the scoring model takes into account both the general idea and the details of a response. While this approach does not single out the most original responses in the entire response pool, it does ensure that the coding process is less susceptible to culturally-sensitive grading styles that favour middle points or extremes, and it provides some mitigation against potential cultural bias in the identification of conventional themes across countries.

Full credit is assigned where the response is both appropriate and original. Partial credit is assigned where the response is appropriate only, and no credit is assigned in all other cases.

Scoring of "evaluate and improve ideas" items

All items corresponding to the facet "evaluate and improve ideas" of the competency model require a single response and generally ask students to adapt a given idea in an original way rather than coming up with an idea from scratch. The general coding procedure for these items involves the same steps as those for the "generate creative ideas" items, described above and in Figure III.A1.3.

However, appropriate responses for these items must be both relevant and constitute an improvement. The threshold for achieving the appropriateness criteria for these items is thus somewhat strengthened with respect to items measuring the other two facets, as responses must explicitly connect to the task stimulus and attempt to address its deficiencies. The coding guide provides item-specific criteria, examples and explanations to help orient coders. For responses considered appropriate, coders must establish the originality of the improvement by considering the same two originality criteria as for "generate creative ideas" items.

Full credit is assigned where the response is both appropriate and an original improvement. Partial credit is assigned where the response is only appropriate, and no credit is assigned in all other cases.

References

Amabile, T. (2012), *Componential Theory of Creativity*, http://www.hbs.edu/faculty/Publication%20Files/12-096.pdf. [50]

Amabile, T. (1997), "Motivating Creativity in Organizations: On Doing What You Love and Loving What You Do", *California Management Review*, Vol. 40/1, pp. 39-58, https://doi.org/10.2307/41165921. [32]

Amabile, T. (1996), "Creativity in Context: Update to the Social Psychology of Creativity (Boulder, CO", *Westview Press.Baer, J.(1998).The case for domain specificity of creativity.Creativity Research Journal*, Vol. 11. [55]

Amabile, T. (1983), "The social psychology of creativity: A componential conceptualization.", *Journal of Personality and Social Psychology*, Vol. 45/2, pp. 357-376, https://doi.org/10.1037/0022-3514.45.2.357. [28]

Amabile, T. and M. Pratt (2016), "The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning", *Research in Organizational Behavior*, Vol. 36, pp. 157-183, https://doi.org/10.1016/j.riob.2016.10.001. [33]

Baer, J. (2016), "Creativity Doesn't Develop in a Vacuum", *New Directions for Child and Adolescent Development*, Vol. 2016/151, pp. 9-20, https://doi.org/10.1002/cad.20151. [10]

Bandura, A. (1997), "Self-efficacy: The exercise of control. New York: W.H. Freeman and Company", *American Psychological Association*, Vol. 23. [30]

Batey, M. and A. Furnham (2006), "Creativity, Intelligence, and Personality: A Critical Review of the Scattered Literature", *Genetic, Social, and General Psychology Monographs*, Vol. 132/4, pp. 355-429, https://doi.org/10.3200/mono.132.4.355-430. [19]

Beghetto, R. (2006), "Creative Self-Efficacy: Correlates in Middle and Secondary Students", *Creativity Research Journal*, Vol. 18/4, pp. 447-457, https://doi.org/10.1207/s15326934crj1804_4. [31]

Beghetto, R. and M. Karwowski (2017), "Toward Untangling Creative Self-Beliefs", in *The Creative Self*, Elsevier, https://doi.org/10.1016/b978-0-12-809790-8.00001-7. [29]

Beghetto, R. and J. Kaufman (2014), "Classroom contexts for creativity", *High Ability Studies*, Vol. 25/1, pp. 53-69, https://doi.org/10.1080/13598139.2014.905247. [53]

Beghetto, R. and J. Kaufman (2010), *Nurturing Creativity in the Classroom*, Cambridge University Press. [52]

Bereiter, C. and M. Scardamalia (2010), ""Can Children Really Create Knowledge?"", *Canadian Journal of Learning and Technology*, Vol. 31/1. [54]

Berliner, D. (2012), "Narrowing curriculum, assessments, and conceptions of what it means to be smart in the U.S. schools: Creaticide by design", in *How Dogmatic Beliefs Harm Creativity and Higher-Level Thinking*. [48]

Berzonsky, M. and C. Sullivan (1992), "Social-Cognitive Aspects of Identity Style", *Journal of Adolescent Research*, Vol. 7/2, pp. 140-155, https://doi.org/10.1177/074355489272002. [21]

Brown, T. and J. Wyatt (2010), "Design Thinking for Social Innovation", *Stanford Social Innovation Review*, Vol. 8/I, pp. 31–35. [61]

Cropley, A. (2006), ""In Praise of Convergent Thinking"", *Creativity Research Journal*, Vol. Vol. 18/3, pp. pp. 391-404. [4]

Cropley, A. (1990), "Creativity and Mental Health in Everyday Life", *Creativity Research Journal*, Vol. 3/3, https://doi.org/10.1080/10400419009534351. [26]

Csikszentmihalyi, M. (1996), *Creativity: Flow and the Psychology of Discovery and Invention*, Harper Collins Publishers. [34]

DeCoker, G. (2000), "Looking at U.S. education through the eyes of Japanese teachers", *Phi Delta Kappan*, Vol. 81/10. [47]

DeYoung, C. (2015), "Openness/intellect: A dimension of personality reflecting cognitive exploration.", in *APA handbook of personality and social psychology, Volume 4: Personality processes and individual differences.*, American Psychological Association, Washington, https://doi.org/10.1037/14343-017. [25]

Duncker, K. (1972), *On problem-solving., Greenwood Press,*, https://books.google.fr/books/about/On_problem_solving.html?id=dJEoAAAAYAAJ&redir_esc=y (accessed on 27 March 2018). [8]

Eisenberger, R. and L. Shanock (2003), *Rewards, Intrinsic Motivation, and Creativity: A Case Study of Conceptual and Methodological Isolation*, https://doi.org/10.1080/10400419.2003.9651404. [36]

Feist, G. (1998), “A Meta-Analysis of Personality in Scientific and Artistic Creativity”, *Personality and Social Psychology Review*, Vol. 2/4, pp. 290-309, https://doi.org/10.1207/s15327957pspr0204_5. [20]

Getzels, J. (1976), *The Creative Vision: A Longitudinal Study Of Problem Finding in Art*, John Wiley & Sons. [9]

Glaveanu, V. et al. (2013), “Creativity as action: findings from five creative domains”, *Frontiers in Psychology*, Vol. 4, https://doi.org/10.3389/fpsyg.2013.00176. [1]

Grivas, C. and G. Puccio (2011), *The Innovative Team: Unleashing Creative Potential for Breakthrough Results*, Jossey-Bass. [39]

Guastello, S. (2008), “Creativity and personality”, in *The Routledge Companion to Creativity*, https://doi.org/10.4324/9780203888841-30. [23]

Guilford, J. (1956), “The structure of intellect.”, *Psychological Bulletin*, Vol. 53/4, pp. 267-293, https://doi.org/10.1037/h0040755. [3]

Guilford, J. (1950), “Creativity.”, *American Psychologist*, Vol. 5/9, pp. 444-454, https://doi.org/10.1037/h0063487. [60]

H. W. Stevenson, H. (ed.) (1986), *Two courses of expertise*, W H Freeman/Times Books/ Henry Holt & Co. [11]

Hennessey, B. and T. Amabile (2010), “Creativity”, *Annual Review of Psychology*, Vol. 61/1, pp. 569-598, https://doi.org/10.1146/annurev.psych.093008.100416. [18]

Hoover, S. (1994), “Scientific problem finding in gifted fifth-grade students”, *Roeper Review*, Vol. 16/3, pp. 156-159, https://doi.org/10.1080/02783199409553563. [63]

Kashdan, T. and F. Fincham (2002), *Facilitating creativity by regulating curiosity.*, https://doi.org/10.1037/0003-066X.57.5.373. [24]

Kaufman, J. and J. Baer (2012), “Beyond New and Appropriate: Who Decides What Is Creative?”, *Creativity Research Journal*, Vol. 24/1, pp. 83-91, https://doi.org/10.1080/10400419.2012.649237. [56]

Kaufman, J. et al. (2010), “Personality and Self-Perceptions of Creativity across Domains”, *Imagination, Cognition and Personality*, Vol. 29/3, pp. 193-209, https://doi.org/10.2190/ic.29.3.c. [13]

Kaufman, S. et al. (2016), “Openness to Experience and Intellect Differentially Predict Creative Achievement in the Arts and Sciences”, *Journal of Personality*, Vol. 84/2, pp. 248-258, https://doi.org/10.1111/jopy.12156. [14]

Lubart, T. (1998), “Creativity Across Cultures”, in *Handbook of Creativity*, Cambridge University Press, https://doi.org/10.1017/cbo9780511807916.019. [44]

McCrae, R. (1987), “Creativity, divergent thinking, and openness to experience.”, *Journal of Personality and Social Psychology*, Vol. 52/6, pp. 1258-1265, https://doi.org/10.1037/0022-3514.52.6.1258. [15]

Moravcsik, M. (1981), “Creativity in science education”, *Science Education*, Vol. 65/2, pp. 221-227, https://doi.org/10.1002/sce.3730650212. [62]

Nakamura, J. and M. Csikszentmihalyi (2002), “The Concept of Flow Optimal Experience and Its Role in Development”, *Handbook of positive psychology*. [35]

Newell, A., J. Shaw and H. Simon (1962), “The processes of creative thinking.”, in *Contemporary approaches to creative thinking: A symposium held at the University of Colorado.*, Atherton Press, New York, https://doi.org/10.1037/13117-003. [58]

Ng, A. (2003), “A Cultural Model of Creative and Conforming Behavior”, *Creativity Research Journal*, Vol. 15/2-3, pp. 223-233, https://doi.org/10.1080/10400419.2003.9651414. [46]

Nickerson, R. (2010), “How to Discourage Creative Thinking in the Classroom”, in *Nurturing Creativity in the Classroom*, Cambridge University Press, https://doi.org/10.1017/cbo9780511781629.002. [49]

Nickerson, R. (1998), “Enhancing Creativity”, in *Handbook of Creativity*, Cambridge University Press, https://doi.org/10.1017/cbo9780511807916.022. [59]

Niu, W. and R. Sternberg (2003), “Societal and school influences on student creativity: The case of China”, *Psychology in the Schools*, Vol. 40/1, pp. 103-114, https://doi.org/10.1002/pits.10072. [42]

Prabhu, V., C. Sutton and W. Sauser (2008), “Creativity and Certain Personality Traits: Understanding the Mediating Effect of Intrinsic Motivation”, *Creativity Research Journal*, Vol. 20/1, pp. 53-66, https://doi.org/10.1080/10400410701841955. [16]

Prather, C. (2010), *Manager’s Guide to Fostering Innovation and Creativity in Teams*. [38]

Reiter-Palmon, R. and E. Robinson (2009), ""Problem identification and construction: What do we know, what is the future?"", *Psychology of Aesthetics, Creativity, and the Arts*, Vol. Vol. 3/1, pp. pp. 43-47. [5]

Rinne, T., G. Steel and J. Fairweather (2013), "The Role of Hofstede's Individualism in National-Level Creativity", *Creativity Research Journal*, Vol. 25/1, pp. 129-136, https://doi.org/10.1080/10400419.2013.752293. [45]

Runco, M. (1997), *The Creativity Research Handbook*. [6]

Scardamalia, M. and C. Bereiter (1999), "Schools as knowledge building organizations.", *Today's children, tomorrow's society: The developmental health and wealth of nations*. [57]

Schank, R. and R. Abelson (1977), *Scripts, Plans, Goals, and Understanding : An Inquiry into Human Knowledge Structures*, L. Erlbaum Associates. [7]

Schwartz, D. (2005), ""Efficiency and Innovation in Transfer"", *Transfer of learning from a modern, multidisciplinary perspective*, Vol. 3, pp. 1-51. [12]

Smith, B. (ed.) (2002), *Collective Cognitive Responsibility for the Advancement of Knowledge*, Open Court. [40]

Tanggaard, L. (2014), *Fooling Around: Creative Learning Pathways*, Information Age Publishing. [2]

Thompson, L. and H. Choi (eds.) (2006), *Creativity and Innovation in Organizational Teams*, Psychology Press, https://doi.org/10.4324/9781410615732. [37]

Torrance, P. (1988), "The Nature of Creativity as Manifest in its Testing", in *The Nature of Creativity: Contemporary Psychological Perspectives*. [27]

Villalba, E. (ed.) (2009), *Creativity and personality*, European Commission Joint Research. [22]

Warhuus, J. et al. (2017), "From I to We: collaboration in entrepreneurship education and learning?", *Education + Training*, Vol. 59/3, pp. 234-249, https://doi.org/10.1108/et-08-2015-0077. [41]

Werner, C. et al. (2014), "The Chinese Version of the Revised Creativity Domain Questionnaire (<scp>CDQ</scp>-R): First Evidence for its Factorial Validity and Systematic Association with the Big Five", *The Journal of Creative Behavior*, Vol. 48/4, pp. 254-275, https://doi.org/10.1002/jocb.51. [17]

Wong, R. and W. Niu (2013), "Cultural Difference in Stereotype Perceptions and Performances in Nonverbal Deductive Reasoning and Creativity", *The Journal of Creative Behavior*, Vol. 47/1, pp. 41-59, https://doi.org/10.1002/jocb.22. [43]

Zhou, J. and Y. Su (2010), "A Missing Piece of the Puzzle: The Organizational Context in Cultural Patterns of Creativity", *Management and Organization Review*, Vol. 6/3, pp. 391-413, https://doi.org/10.1111/j.1740-8784.2010.00192.x. [51]

Annex A2. The PISA target population, the PISA samples, and the definition of schools

Please refer to Annex A2 of *PISA 2022 Results (Volume I): The State of Learning and Equity in Education* (OECD, 2023[1]).

References

OECD (2023), *Annex A2. The PISA target population, the PISA samples, and the definition of schools*, OECD Publishing, Paris, https://doi.org/10.1787/007f7d8e-en. [1]

Annex A3. Technical notes on analyses in this volume

Standard errors, confidence intervals, significance test and p-values

The statistics in this report represent estimates based on samples of students, rather than values that could be calculated if every student in every country had answered every question. Consequently, it is important to measure the degree of uncertainty of the estimates. In PISA, each estimate has an associated degree of uncertainty, which is expressed through a standard error. The use of confidence intervals provides a way to make inferences about the population parameters (e.g. means and proportions) in a manner that reflects the uncertainty associated with the sample estimates. If numerous different samples were drawn from the same population, according to the same procedures as the original sample, then in 95 out of 100 samples the calculated confidence interval would encompass the true population parameter. For many parameters, sample estimators follow a normal distribution and the 95% confidence interval can be constructed as the estimated parameter, plus or minus 1.96 times the associated standard error.

In many cases, readers are primarily interested in whether a given value in a particular country is different from a second value in the same or another country, e.g. whether girls in a country perform better than boys in the same country. In the tables and figures used in this report, differences are labelled as statistically significant when a difference of any given size (or larger), in either direction, would be observed less than 5% of the time in samples, if there were actually no difference in corresponding population values. Throughout the report, significance tests were undertaken to assess the statistical significance of the comparisons made.

Statistical significance of differences between subgroup means, after accounting for other variables

For many tables, subgroup comparisons were performed both on the observed difference (before accounting for other variables) and after accounting for other variables, such as the PISA index of economic, social and cultural status of students. The adjusted differences were estimated using linear regression and tested for significance at the 95% confidence level. Significant differences are marked in bold in the tables and figures throughout this report and its annexes.

Range of ranks (confidence interval for rankings of countries)

An estimate of the rank of a country mean, across all country means, can be derived from the estimates of the country means from student samples. However, because mean estimates have some degree of uncertainty, this uncertainty should also be reflected in the estimate of the rank. While mean estimates from samples follow a normal distribution, this is not the case of the rank estimates derived from these. Therefore, in order to construct a confidence interval for ranks, simulation methods were used.

Data are simulated assuming that alternative mean estimates for each relevant country follow a normal distribution around the estimated mean, with a standard deviation equal to the standard error of the mean. Some 1 000 simulations are carried out and, based on the alternative mean estimates in each of these simulations, 1 000 possible estimates for each country are produced.

There are two steps to estimating the confidence sets of ranks. For each country, all possible differences in score estimates are considered between the reference country and all other participating countries. Then for every country, confidence sets of ranks are computed with respect to all other participating countries (with respect to all other OECD countries in the case of the OECD country ranking). Using these individual confidence sets, a marginal confidence set is computed with a confidence level of 95%. Given this, the marginal confidence sets that are fully above or fully below zero (i.e. where differences are significantly different from zero) are used to determine confidence sets for the ranking of a country.

The ranking that results from these marginal confidence sets is obtained using a stepwise multiple testing procedure. This implies that first, some countries will be ranked higher or lower compared to the reference country as described above. In the following steps, the rank of the remaining countries accounts for the countries that were ranked higher or lower in previous steps, until all countries are ranked with respect to the reference country. These are the ranks reported in Table III.A7.1 in Annex A7. For further details on this procedure, see Mogstad et al. (2023[1]).

The main difference between the range of ranks (e.g. Table III.A7.1) and the comparison of countries' mean performance (e.g. Table III.2.1) is that the former takes into account the multiple comparisons involved in ranking countries/economies, while the latter does not. Therefore, sometimes there is a slight difference between the range of ranks and counting the number of countries above a given country, based on pairwise comparisons of the selected countries' performance. For instance, OECD countries Lithuania, Spain and Czechia have similar mean performance and the same set of countries whose mean score is not statistically different from theirs, based on Table III.2.1; but the range of ranks amongst OECD countries can be restricted to be with 95% confidence between 11th and 18th for Lithuania and between 12th and 18th for Spain and Czechia (Table III.A7.1). When interest lies in examining countries' rankings, this range of ranks should be used.

Analyses of relative performance in creative thinking

For some analyses in this volume, the relative performance of students in creative thinking in a country/economy was computed (see Table III.B1.2.4). Relative scores in creative thinking refer to the difference in students' creative thinking score in a country/economy compared to the average score of international students with similar mathematics, reading or science performance. These relative performance scores are based on the residuals obtained from pooled cubic polynomial regressions, across all participating countries/economies, of student performance in creative thinking over their performance in mathematics, reading or science. Positive relative scores therefore indicate that students performed relatively better than expected in creative thinking given their performance in mathematics, reading or science. Differences were tested for significance at the 95% confidence level. Significant differences are marked in bold in the tables and figures throughout this report and its annexes.

Cubic polynomial regressions were used for these analyses instead of linear regressions, as the relationship between performance in mathematics, reading and science, on the one hand, and creative thinking on the other, was assumed not to be linear.

Relative differences in creative thinking performance between subgroup means, after accounting for performance in mathematics, reading or science

In some cases, relative performance analyses focus on subgroup comparisons (e.g. Table III.B1.3.6 or Table III.B1.3.13). For these analyses, as above, the relative performance of a subgroup refers to the residual performance in the creative thinking test after accounting for student performance in mathematics, reading or science within that subgroup. As above, these residuals are obtained from cubic polynomial regressions; however, these are performed across students at the national level for each country/economy rather than pooled across all participating countries/economies.

Positive relative score differences indicate that a subgroup performed relatively better than expected in creative thinking given their performance in mathematics, reading or science, compared to other subgroups of interest.

Differences were tested for significance at the 95% confidence level and significant differences are marked in bold in the tables and figures throughout this report and its annexes.

Statistics based on multilevel models

Statistics based on multilevel models include variance components (between- and within-school variance) and the index of inclusion derived from these components (i.e. the index of academic inclusion and the index of social inclusion (see Table III.B1.3.1)). Multilevel models are generally specified as two-level regression models (student and school levels), with normally distributed residuals, and estimated with maximum likelihood estimation. Where the dependent variable is creative thinking performance, the estimation uses 10 plausible values for each student's performance on the creative thinking scale. Models were estimated using the Stata (version 18) "mixed" module.

The index of inclusion is defined and estimated as:

$$100 * \frac{\sigma_w^2}{\sigma_w^2 + \sigma_b^2}$$

where $\sigma\frac{2}{w}$ and $\sigma\frac{2}{b}$, respectively, represent the within- and between-variance estimates.

For statistics based on multilevel models (such as the estimates of variance components) the standard errors are not estimated with the usual replication method, which accounts for stratification and sampling rates from finite populations. Instead, standard errors are "model-based": their computation assumes that schools, and students within schools, are sampled at random (with sampling probabilities reflected in school and student weights) from a theoretical, infinite population of schools and students, which complies with the model's parametric assumptions. The standard error for the estimated index of inclusion is calculated by deriving an approximate distribution for it from the (model-based) standard errors for the variance components, using the delta method.

Odds ratios

The odds ratio is a measure of the relative likelihood of a particular outcome across two groups. The odds ratio for observing the outcome when an antecedent is present is simply:

$$\mathrm{OR} = {}^{(p\,11/p12)}\Big/_{(p21/p22)}$$

where $p11/p12$ represents the "odds" of observing the outcome when the antecedent is present, and $p21/p22$ represents the "odds" of observing the outcome when the antecedent is not present.

Logistic regression can be used to estimate the log ratio: the exponentiated logit coefficient for a binary variable is equivalent to the odds ratio. A "generalised" odds ratio, after accounting for other differences across groups, can be estimated by introducing control variables in the logistic regression.

Figures in bold in the data tables presented in Annex B1 of this report indicate that the odds ratio is statistically significantly different from 1 at the 95% confidence level. To construct a 95% confidence interval for the odds ratio, the estimator is assumed to follow a log-normal distribution, rather than a normal distribution.

Average percentage correct (success at the item level)

The analyses in Chapter 4 of this volume are based on the average percentages of correct responses for different subsets of items at the country/economy level. They thus use the item-level dataset that includes information on whether students achieved partial or full credit on each item, as well as additional process-level data (e.g. time spent on item, number of actions). The same dataset is used to compute the indicators of engagement used in this volume, described in Annex A8.

Items in the PISA 2022 Creative Thinking assessment measure one of three possible ideation processes (generating diverse ideas, generating original ideas, and evaluating and improving ideas) and are contextualised in one of four possible domains (written expression, visual expression, social problem solving and scientific problem solving). Analysing student performance on subsets of test items across countries/economies makes it possible to identify systematic differences in success rates when tackling different types of tasks.

To compute the average percentage of correct responses in Tables III.B1.4.1, III.B1.4.2, III.B1.4.5, III.B1.4.6, III.B1.4.9 and III.B1.4.10, we use a dataset in wide format (one row per student, with one column per item for each of the variables). For each student, the number of correct answers provided for items in the test are divided by the total number of items to which the student responded (non-reached items are counted as missing). For example, if the student worked on 10 items and responded correctly to 5, a ratio of 0.5 is obtained. This ratio is then averaged across all students in each country using the student weights and displayed as a percentage in the tables. The same operation is repeated by groups of items (i.e. all items corresponding to generate creative ideas) by restricting the items included in the calculation to the items in the focal group.

“Correct” responses for the purpose of these analyses may include any partial or full credit responses or may be limited to full credit responses only. Most tables that compute the average percentage of correct responses includes both types of measure.

Relative success on subsets of items (differences in the average percentage correct)

Results from relative analyses of students on different subsets of items are displayed in Tables III.B1.4.3, III.B1.4.4, III.B1.4.7 and III.B1.4.8. To simplify the estimation, the item-level dataset was converted from the wide format (one observation per student and one variable for each item) to a long format (for each student, the number of observations is equal to the number of items the student has worked on and there is only one variable for all items – see Table III.A3.1 below for an illustration). In the long format, the unit of analysis is the item, and the weight for each item is obtained by rescaling the student weights so that the sum of the item weights in the long format is equal to the sum of the student weights in the wide format. It should be noted that analysis based on data organised according to either the wide or long format provide similar but not identical results because the different weighting affects the results. However, observed differences are around 1 percentage point and do not qualitatively affect the results.

Table III.A3.1. Example of data in wide format

Student ID	Full credit item 1	Full credit item 2	Full credit item 3	Full credit item 4	Student weight
123456	1	0		1	0.531
324576	0	0	0	0	0.342
412134	1	0	1	1	0.212
987162	0	0		1	0.131

Table III.A3.2. Example of data in long format

Student ID	Item ID	Full credit	Item weight
123456	1	1	0.0123
123456	2	0	0.0311
123456	3		0.0451
123456	4	1	0.0271
324576	1	0	0.0123
324576	2	0	0.0311
…			

The relative success of students across tasks corresponding to different ideation processes and/or domains is estimated using a logit model, with two different specifications. In the first specification (before accounting for the international difficulty of the tasks), the logit model includes as regressors only a dummy variable for the target process or domain, and a variable indicating what booklet the item is in. In the second specification (after accounting for the international difficulty of the tasks), the model also includes a variable indicating the RP62 value (the estimated difficulty of the item across all countries). Accounting for the item RP62 in the regression takes into consideration that tasks in some domains and targeting certain ideation processes are generally more difficult than others, and thus have a lower likelihood of full credit responses.

The percentages shown in the relevant tables indicate the predicted probability of the outcome (full credit or partial credit) for the items in the target subset (domain or process) and the items in all other subsets. The difference between the two predicted probabilities is an indicator of whether students in the country/economy were more successful on the items in the target subset than on the items in the other subsets (in case of a positive difference) or less successful on the items in the target subset than on the items in the other subsets (in case of a negative difference).

Differences in success on subsets of items between subgroups, after accounting for performance in mathematics and reading

The results in Tables III.B1.4.7, III.B1.4.8, III.B1.4.11 and III.B1.4.12 compare the average percentage of correct responses of boys and girls, and advantaged and disadvantaged students, respectively, across items belonging to different subsets (i.e. ideation processes or domain contexts). The results are based on logit regressions, each of which include data only for the target subset of items. For example, if the table refers to gender differences in the average percentage correct for the visual domain, only items in the visual domain are included in the regression). The regressors in these analyses are the gender or socio-economic status of the students, depending on the focal subgroup, as well as all plausible values in reading and in mathematics and a variable indicating what booklet the item is in.

The percentages shown in the relevant tables indicate the predicted probability of the outcome (average percentage correct in the item subset, i.e. domain or process) for boys and girls, or for advantaged and disadvantaged students, respectively. A positive difference in the tables by gender (or by socio-economic status) indicates that boys (or advantaged students) are more likely to receive full credit in items in the target item subset.

References

Mogstad, M. et al. (2023), “Inferences for ranks with applications to mobility across neighbourhoods and academic achievement across countries”, *The Review of Economic Studies*, Vol. 91/1, pp. 476-518, https://doi.org/10.1093/restud/rdad006. [1]

Annex A4. Quality assurance

Please refer to Annex A4 of *PISA 2022 Results (Volume I): The State of Learning and Equity in Education* (OECD, 2023[1]).

References

OECD (2023), *Annex A4. Quality assurance*, OECD Publishing, Paris, https://doi.org/10.1787/3571108a-en. [1]

Annex A5. The construction of the reporting scale and data adjudication for creative thinking

The construction of the reporting scale

The results of the PISA 2022 assessment are reported in a numerical scale consisting of PISA score points. This section summarises the test-development and scaling procedures used to ensure that PISA score points are comparable across countries.

Assessment framework and test development

The first step in defining a reporting scale in PISA is developing a framework for the assessed domain. This framework provides a definition of what it means to be proficient in the domain; delimits and organises the domain according to different dimensions; and suggests the kind of test items and tasks that can be used to measure what students can do in the domain within the constraints of the PISA design. The PISA 2022 Creative Thinking framework was developed by a group of international experts and agreed upon by the participating countries. More information on the PISA 2022 Creative Thinking framework can be found in Annex A1 of this volume, or in the PISA 2022 assessment and analytical framework (OECD, 2023[1]).

The second step is the development of the test questions (i.e. items) to assess students' proficiency. A consortium of testing organisations under contract to the OECD on behalf of participating governments develops new items for the PISA innovative domain. The expert group that developed the framework reviews these proposed items to confirm that they meet the requirements and specifications of the framework.

The third step is a qualitative review of the testing instruments by all participating countries and economies to ensure the items' overall quality and appropriateness in their own national/jurisdictional context. These ratings are considered when selecting the final pool of items for the assessment. Selected items are then translated and adapted to create national/jurisdictional versions of the testing instruments. These versions are verified by the PISA consortium.

The verified national/jurisdictional versions of the items are then presented to a sample of 15-year-old students in all participating countries and economies as part of a field trial. This is to ensure that they meet stringent quantitative standards of technical quality and international comparability. In particular, the field trial serves to verify the psychometric equivalence of items across countries and economies (see also Annex A6).

After the field trial, material is considered for rejection, revision or retention in the pool of potential items. The international expert group for each domain then formulates recommendations as to which items should be included in the main assessments. The final set of selected items is also subject to review by all countries and economies. This selection was balanced across the various dimensions specified in the framework and spans various levels of difficulty so that the entire pool of items measures performance across the component skills and the range of item contexts and student abilities.

Test assembly for the PISA 2022 Main Study

32 items were retained in the final pool of items for the creative thinking test. These items were organised into test units that varied in terms of the facets targeted (i.e. generate diverse ideas, generate creative ideas, and evaluate and improve ideas), the domain context (i.e. written expression, visual expression, social problem solving, or scientific

problem solving) and the duration of the unit (guidelines of between 5 and 15 minutes). Some units included a single item and some units included multiple items, although dependencies between items within units was minimised.

Constructed-response tasks accounted for 92% of the items administered as part of the creative thinking test. Tasks typically called for a written response, ranging from a few words (e.g. cartoon caption or scientific hypothesis) to a short text (e.g. creative ending to a story or explanation of a design idea). Some constructed-response items instead called for a visual design response (e.g. designing a poster combining a set of given shapes and stamps) that was supported by a simple drawing editor tool. The test also included two items that were part of an interactive simulation-based task (although these were subsequently dropped from the scaling – see below section on data adjudication) and two hybrid, multiple-choice items where students had the possibility to select a previously suggested idea from the same unit or to generate a new idea.

The creative thinking units were organised into five mutually exclusive 30-minute blocks or clusters. The clusters were rotated according to an integrated design (see Chapter 3 of *PISA 2022 Technical Report* (OECD, 2023[2])). About 28% of the sample of PISA students were administered the creative thinking assessment – these students who took the creative thinking assessment spent one hour on creative thinking test items with the remaining hour of testing time assigned to one of the other core domains (mathematics, reading or scientific literacy).

Proficiency scales for PISA domains

Proficiency scores in creative thinking are based on student responses to items that represent the assessment framework for each domain (see previous section). While different students saw different questions, the test design, which ensured a significant overlap of items across different test forms, made it possible to construct proficiency scales that are common to all students. In general, the PISA frameworks assume that a single continuous scale can be used to report overall proficiency in a domain, but this assumption is further verified during scaling (see following section).

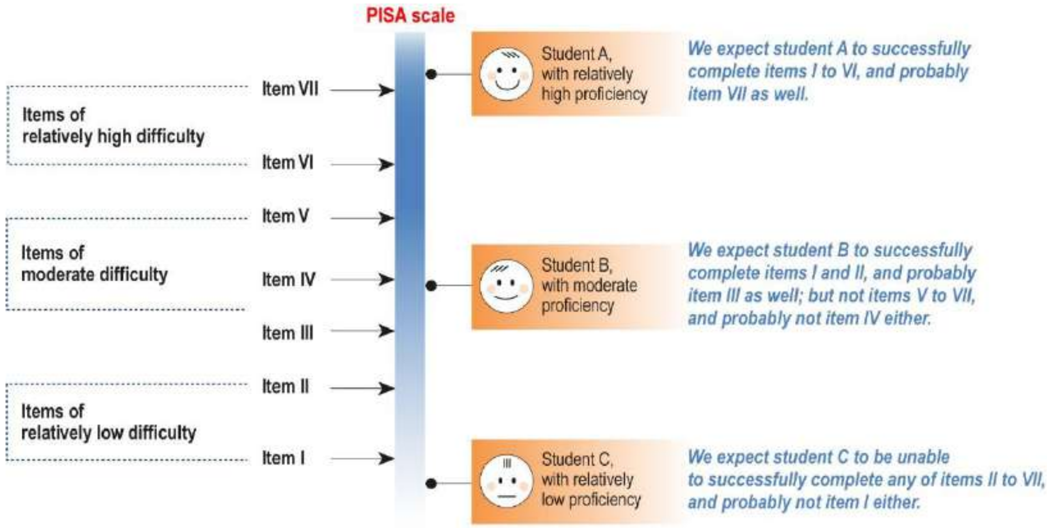
PISA proficiency scales are constructed using item-response-theory models in which the likelihood that the test-taker responds correctly to any question is a function of the question's characteristics and of the test-taker's position on the scale. In other words, the test-taker's proficiency is associated with a particular point on the scale that indicates the likelihood that he or she responds correctly to any question. Higher values on the scale indicate greater proficiency, which is equivalent to a greater likelihood of responding correctly to any question.

In the item-response-theory models used in PISA, the test item characteristics are summarised by two parameters that represent task difficulty and task discrimination. The first parameter, task difficulty, is the point on the scale where there is at least a 50% probability of a correct response by students who score at or above that point; higher values correspond to more difficult items. For the purpose of describing proficiency levels that represent mastery, PISA often reports the difficulty of a task as the point on the scale where there is at least a 62% probability of a correct response by students who score at or above that point.

The second parameter, task discrimination, represents the rate at which the proportion of correct responses increases as a function of student proficiency. For an idealised highly-discriminate item, close to 0% of students respond correctly if their proficiency is below the item difficulty and close to 100% of students respond correctly as soon as their proficiency is above the item difficulty. In contrast, for weakly-discriminate items, the probability of a correct response still increases as a function of student proficiency, but only gradually.

A single continuous scale can therefore show both the difficulty of questions and the proficiency of test-takers (see Figure III.A5.1). By showing the difficulty of each question on this scale, it is possible to identify the level of proficiency in the domain that the question demands. By showing the proficiency of test-takers on the same scale, it is possible to describe each test-taker's level of skill or literacy by the type of tasks that they can perform correctly most of the time.

Figure III.A5.1. Relationship between questions and student performance on a scale



Estimates of student proficiency are based on the kinds of tasks that students are expected to perform successfully. This means that students are likely to be able to successfully answer questions located at or below the level of difficulty associated with their own position on the scale. Conversely, they are unlikely to be able to successfully answer questions above the level of difficulty associated with their position on the scale.

The higher a student's proficiency level is located above a given test question, the more likely they can answer the question successfully. The discrimination parameter for this particular test question indicates how quickly the likelihood of a correct response increases. The further the student's proficiency is located below a given question, the less likely they are able to answer the question successfully. In this case, the discrimination parameter indicates how fast this likelihood decreases as the distance between the student's proficiency and the question's difficulty increases.

Data adjudication and approach to scaling the creative thinking data for reporting

In June 2023, the Core A Contractor (responsible for the overall management of contractors and implementation of the PISA Surveys – see Annex D) presented the Technical Advisory Group (TAG) with the PISA 2022 creative thinking data and preliminary psychometric analyses for data adjudication. Following the initial feedback of the TAG on the scalability of the data given the relatively low inter-item correlations and the creation of plausible values, the PISA Secretariat conducted further analyses of the creative thinking data, including modifying some of the scoring rules with the goal of increasing the validity of inferences drawn from the creative thinking data, and improving the scalability and comparability across countries.

Following a thorough review of the data, the following changes were implemented:

- **Four items were dropped from the scaling.** The four items identified for exclusion were drawn from two units (one from visual expression, and one from scientific problem solving) and were all in the same test cluster. These four items showed poor discrimination and high omit rates, likely due to their position within the cluster.
- **The scoring rules for 14 items were modified.** All "generate creative ideas" and "evaluate and improve" items were reviewed following the main survey in terms of the distribution of double-digit codes across countries. The scoring process for these items required coders to use a second digit to indicate the primary theme of each response (i.e. responses corresponding to Conventional Theme 1 were coded either 11 or 21, depending on whether the response was awarded full credit [21] or partial credit [11]). Responses coded with values of 1-3 as their second digit (i.e. 11, 12, 13 or 21, 22, 23) thus represented ideas that corresponded with the initial conventional themes designated in the coding guide. The double-digit codes intended to serve

as a mechanism through which to review the distribution of codes across countries following the data collection and, if needed, adjust the themes designated as conventional following the field trial and main survey. The number of conventional themes were modified for 14 of the 18 items corresponding to "generate creative ideas" and "evaluate and improve ideas" based on the results of the main survey to improve the validity of the scoring rules for these items and to align the scoring with the framework (i.e. originality as statistical infrequency, with respect to the responses of other students who completed the same task).

- **Responses submitted in fewer than 15 seconds were invalidated (i.e. converted to missing responses).** For most items in the creative thinking test, students must generate a written or visual output in response to a written or visual stimulus (i.e. task prompt with instructions and material for inspiration). The construct of creative thinking also aims to measure the cognitive processes associated with idea generation, evaluation and improvement, which are considered to be slow and thoughtful processes rather than reflective of opportunistic or rapid processes. For most items in the test, responses submitted within 15 seconds of viewing the item cannot be considered reflective of creative thinking processes. A review of the timing data for the items also showed a clear bimodal distribution of response submission, with one peak prior to 15 seconds and another peak a significant time afterward. This modification was applied to all items, with the exception of three: in two cases, students were able to select a response to a previous question akin to a multiple-choice mechanism; and in the other item, students were asked to generate a very short written output. In these three cases, it was judged that students could submit a response that reflected creative thinking processes within 15 seconds, thus no minimum response time was imposed.

In October 2023, the PISA Secretariat, the Core A Contractor and the TAG reconvened for the data adjudication of the creative thinking data following the further analyses conducted by the PISA Secretariat, and to finalise the reporting approach. The TAG recommended to report the creative thinking data according to a non-linear transformation of the "theta" scale, using the test-characteristic curve for a hypothetical test using the final pool of 32 creative thinking items and based on international item parameters. The advantages of this approach include:

- **Reporting student performance according to a bounded scale** (between 0-60, reflecting the maximum sum-score of all items) that is the same for all countries. This solution maintains the possibility of reporting performance on a scale, but signals a clear difference to the PISA scales used for the other domains; the broader "grain" size of the creative thinking scale signals its relative lower reliability compared to the other PISA scales (a 1-point change in the creative thinking scale reflects about 10% of a standard deviation).
- **Scores can be easily interpreted in terms of the number of items correct on this specific test** (rather than a more general reflection of students' creative thinking ability applied to other performance tests), drawing attention to the actual test content and the framework that guided its development and facilitating the interpretation of the relatively high frequency of low scores in this test (i.e. students scored 0 on the test, rather than not having any creative thinking skill).
- **Test scores differ more where the test has more information about students**, i.e. in those regions of the creative thinking scale where a greater number of item-difficulty estimates are located, and therefore where more information is available to differentiate student performance on the scale.
- **The international database still includes 10 "plausible scores" per student**.

References

OECD (2023), *PISA 2022 Creative Thinking framework*, OECD Publishing, Paris, https://doi.org/10.1787/471ae22e-en. [1]

OECD (2023), *Test Development for the Core Domains*, OECD Publishing, Paris, https://www.oecd.org/pisa/data/pisa2022technicalreport/PISA-2022-Technical-Report-Ch-03-PISA-2022-Development-Core-Domains.pdf. [2]

Annex A6. Construction of indices from the student, school leader, teacher and parent context questionnaires

Explanation of the indices

This section explains the indices derived from the PISA 2022 student, school, well-being and information and communications technology (ICT) familiarity questionnaires used in this volume. Several PISA measures reflect indices that summarise responses from students or school representatives (typically principals) to a series of related questions. The questions were selected from a larger pool on the basis of theoretical considerations and previous research. The *PISA 2022 Assessment and Analytical Framework* (OECD, 2023[1]) provides an in-depth description of this conceptual framework. Item response theory (IRT) modelling and classical test theory were used to test the theoretically expected behaviour of the indices and to validate their comparability across countries. For a detailed description of the methods, see the section "Statistical criteria for reporting on scaled indices" in this chapter, and the *PISA 2022 Technical Report* (OECD, 2024[2]).

This volume uses three types of indices: simple indices, complex composite indices, and scale indices. In addition to these indices, several single items of the questionnaires are used in this volume. The volume also uses data collected on students' performance in mathematics, reading and science, and in creative thinking. These assessments are described in the *PISA 2022 Assessment and Analytical Framework* (OECD, 2023[1]), the *PISA 2022 Technical Report* (OECD, 2024[2]) and in Volume I, II and III of *PISA 2022 Results* (OECD, 2023[3]; OECD, 2023[4]).

Simple indices are constructed through the arithmetic transformation or recoding of one or more items in the same way across assessments. Here, item responses are used to calculate meaningful indices, such as the recoding of the four-digit ISCO-08 codes into "Highest parents' socio-economic index (HISEI)" or teacher-student ratio based on information from the school questionnaire.

Complex composite indices are based on a combination of two or more indices. The PISA index of economic, social and cultural status (ESCS) is a composite score derived from three indicators related to family background.

Scale indices are constructed by scaling multiple items. Unless otherwise indicated, the two-parameter logistic model (2PLM) (Birnbaum, 1968[5]) was used to scale items with only two response categories (i.e. dichotomous items), while the generalised partial credit model (GPCM) (Muraki, 1992[6]) was used to scale items with more than two response categories (i.e. polytomous items).[1] Values of the index correspond to standardised Warm likelihood estimates (WLE) (Warm, 1989[7]).

For details on how each scale index was constructed, see the *PISA 2022 Technical Report* (OECD, 2024[2]). In general, the scaling was done in two stages:

1. The item parameters were estimated based on all students from approximately equally weighted countries and economies;[2] only cases with a minimum number of three valid responses to items that are part of the index were included.
2. For new scale indices, the Warm likelihood estimates were then standardised so that the mean of the index value for the OECD student population was zero and the standard deviation was one (countries were given approximately equal weight in the standardisation process[2]).

Sequential codes were assigned to the different response categories of the questions in the sequence in which the latter appeared in the student, school, ICT or well-being questionnaire. For reversed items, these codes were inverted for the purpose of constructing indices or scales.

Negative values for an index do not necessarily imply that respondents answered negatively to the underlying questions (e.g. reporting no support from teachers or no school safety risks). A negative value merely indicates that a respondent answered more negatively than other respondents did on average across OECD countries. Likewise, a positive value on an index indicates that a respondent answered more favourably, or more positively, on average, than other respondents in OECD countries did (e.g. reporting more support from teachers or more school safety risks).

Some terms in the questionnaires were replaced in the national versions of the student, school, ICT or well-being questionnaire by the appropriate national equivalent (marked through brackets < > in the international versions of the questionnaires). For example, the term < qualification at ISCED level 5A > was adapted in the United States* to “Bachelor’s degree, post-graduate certificate program, Master’s degree program or first professional degree program”. All the context questionnaires, including information on nationally adapted terms, and the PISA international database, including all variables, are available through www.oecd.org/pisa.

Statistical criteria for reporting on scaled indices

The internal consistency of scaled indices and the invariance of item parameters are the two approaches that were used to decide on the reporting of indices. All indices reported in this volume met the criteria of both approaches. Indices were omitted for countries and economies where one or more of the criteria were not met. For countries/economies with more than one language version (e.g. Finland offered versions of the student questionnaire in Finnish and Swedish), the criteria were judged independently for each language version.[3] Details about the scaling procedures and the construct validation of all context questionnaire data are provided in the *PISA 2022 Technical Report* (OECD, 2024[2]).

Internal consistency of scaled indices

The internal consistency was used in PISA 2022 to examine the reliability of scaled indices and as a criterion for reporting. Internal consistency refers to the extent to which the items that make up an index are inter-related. Cronbach’s Alpha was used to check the internal consistency of each scale within countries/economies and to compare it across countries/economies. The coefficient of Cronbach’s Alpha ranges from 0 to 1, with higher values indicating higher internal consistency. Similar and high values across countries/economies indicate reliable measures across countries/economies. Commonly accepted cut-off values are 0.9 for excellent, 0.8 for good, and 0.7 for acceptable internal consistency. Indices are not reported for countries and economies with values below 0.6.

Cross-country comparability of scaled indices

The invariance of item parameters was used in PISA 2022 to examine the cross-country comparability of scaled indices and as a criterion for reporting. It determined whether the item parameters of an index could be assumed to be the same or invariant across countries/economies and across language versions (international item parameter).

In a first step, item parameters were estimated using data from all individuals with available data from all countries/economies. In a second step, the fit of the international parameters for each item was evaluated for each country/economy and language version using the root mean square deviance (RMSD). Values close to zero signal a good item fit, indicating that the international model accurately describes student responses within countries/economies and across language versions. In 2022 PISA used an even more conservative approach than in previous assessments: any country/economy and language version that received a value above 0.25 was flagged. In 2018 and 2015, a cut-off of 0.3 was used. For any flagged item specific parameters were calculated. Steps were repeated until all items exhibited RMSD values below 0.25.

For each index, a country/economy needed to have at least three items with international parameters to be considered comparable to the results of other countries/economies and language versions. Indices are not reported for countries/economies in which one or more language version had fewer than three items with international parameters. For the reporting on trends for indices, a country/economy needed to have at least three trend items with international parameters in order to be considered comparable to the results of the previous assessment to which the current assessment was linked. Results for the trends of indices were not reported for countries/economies in which one or more language groups had fewer than three trend items with international parameters for the index.

The different indices used in this volume are described in the following sections. Those countries/economies and language versions that received specific item parameters are highlighted. The *PISA 2022 Technical Report* (OECD, 2024[2]) provides more details on the cross-country comparability of indices, including the items concerned and the specific item parameters for each country/economy and language version listed.

Complex composite indices

The PISA index of economic, social and cultural status (ESCS)

The PISA index of economic, social and cultural status (ESCS) is a composite score derived, as in previous assessments, from three indicators related to family background: parents' highest education, in years (PAREDINT), parents' highest occupational status (HISEI) and home possessions (HOMEPOS).

Parents' highest level of education, in years (PAREDINT)

The index of the highest education of parents, in years, was based on the median cumulative years of education associated with completion of the highest level of education attained by parents (HISCED). Parents' highest level of education was derived from students' responses to questions about their parents' education (ST005 and ST006 for mother's level of education, and ST007 and ST008 for father's level of education). Responses were classified according to ISCED-11 (UNESCO, 2012[8]) using the following categories: (1) Less than ISCED Level 1, (2) ISCED level 1 (primary education), (3) ISCED level 2 (lower secondary), (4) ISCED level 3.3 (upper secondary education with no direct access to tertiary education), (5) ISCED level 3.4 (upper secondary education with direct access to tertiary education), (6) ISCED level 4 (post-secondary non-tertiary), (7) ISCED level 5 (short-cycle tertiary education [at least two years]), (8) ISCED level 6 (Bachelor's or equivalent first or long first-degree programme [three to more than four years]), (9) ISCED level 7 (Master's or equivalent long first-degree programme [at least five years]) and (10) ISCED level 8 (Doctoral or equivalent level). In the event that students' responses to the two questions about their mothers' and fathers' level of education conflicted (e.g. if a student indicated in ST006 that their mother has a postsecondary qualification but indicated in ST005 that their mother had not completed lower secondary education), the higher education level provided by the student was used. This differs from the PISA 2018 procedure where the lower level was used. Indices with these categories were provided for a student's mother (MISCED) and father (FISCED). In addition, the index of parents' highest level of education (HISCED) corresponded to the higher ISCED level of either parent.

The index of parents' highest level of education was recoded into the estimated number of years of education (PAREDINT). This international conversion was determined by using the PISA 2018 measure of cumulative years of education associated with parents' completion of the highest level of education across countries/economies for each ISCED level. The correspondence is available in the *PISA 2022 Technical Report* (OECD, 2024[2]).

Parents' highest occupational status (HISEI)

Occupational data for both the student's father and the student's mother were obtained from responses to open-ended questions (ST014 and ST015). The responses were coded to four-digit ISCO codes (ILO, 2007) and then mapped to the international socio-economic index of occupational status (ISEI) using the 2008 version of both (Ganzeboom and Treiman, 2003[9]). Three indices were calculated based on this information: father's occupational status (BFMJ2); mother's occupational status (BMMJ1); and the highest occupational status of parents (HISEI), which corresponds to the higher ISEI score of either parent or to the only available parent's ISEI score. For all three indices, higher ISEI scores indicate higher levels of occupational status.

Home possessions (HOMEPOS)

Home possessions were used as a proxy measure for family wealth. In PISA 2022, students reported the availability of household items at home, including books at home and country-specific household items that were seen as appropriate measures of family wealth in the country's context. HOMEPOS is a summary index of all household and possession items (ST250, ST251, ST253, ST254, ST255, ST256). Some HOMEPOS items used in PISA 2018 were removed in PISA 2022 while new ones were added (e.g. new items developed specifically with low-income countries in mind). Furthermore, some HOMEPOS that were previously dichotomous (yes/no) items were revised to polytomous items (1, 2, 3, etc.) making it possible to capture a greater variation in responses. Note that all countries/economies and language versions received unique item parameters for the country/economy-specific items (i.e. no international parameters were estimated for these items) and that for some items, the response categories were collapsed to align with the response categories used in previous assessments (see Tables 19.15 and 19.16 of the *PISA 2022 Technical Report* (OECD, 2024[2]) for details).

For the purpose of computing the PISA index of economic, social and cultural status (ESCS), values for students with missing data on one of the three components (PAREDIND, HISEI or HOMEPOS) were imputed (see (OECD, 2020[10]; Avvisati, 2020[11]; OECD, 2024[2]) for details). If students had missing data for more than one component, the ESCS was not computed; a missing value was assigned instead. In PISA 2022, ESCS was computed by attributing equal weight to the three components. The final ESCS variable is standardised, so that 0 is the score of an average OECD student and 1 is the standard deviation across approximately equally weighted OECD countries.[2]

ESCS scores for PISA 2012, PISA 2015 and PISA 2018 were recomputed to be comparable to the respective scores for PISA 2022. More details are provided in the *PISA 2022 Technical Report* (OECD, 2024[2]).

Student Questionnaire – Simple indices & derived variables based on IRT scaling

Gender (ST004D01T)

The gender of a student which was obtained from school records from the student sampling data and validated by comparing to the student's responses in the questionnaire (ST004).

Mother's level of education (MISCED)

Student responses to questions ST005 and ST006 regarding their mothers' education were used to derive the mother's level of education (MISCED) index, where education level ranged from "1" less than ISCED level 1 to "10" ISCED level 8, as noted in Table 19.7 of the *PISA 2022 Technical Report* (OECD, 2024[2]).

Father's level of education (FISCED)

Student responses to questions ST007 and ST008 regarding their fathers' education were used to derive the father's level of education (FISCED) index, where education level ranged from "1" less than ISCED level 1 to "10" ISCED level 8, as noted in Table 19.7 as above (OECD, 2024[2]).

Highest level of education of parents (HISCED)

Students' responses to questions ST005, ST006, ST007, and ST008 regarding their mothers' and fathers' education were used to derive the index of highest education level of parents (HISCED). The index is equal to the highest ISCED level of either parent.

Highest education of parents in years (PAREDINT)

The index of the highest education of parents in years, PAREDINT, was based on the median cumulative years of education associated with completion of the highest level of parental education (HISCED). Cumulative years of education values used in PISA 2018 were assigned to each ISCED level (see Table 19.7 of the *PISA 2022 Technical Report* (OECD, 2024[2])).

Mother's occupational code

Students' responses to the fill-in question ST014 about their mothers' occupation were human-coded based on the International Standard Classification of Occupations (ISCO)-08 classification system, resulting in the mother's occupational code (4-digit ISCO; ILO, 2007) index, OCOD1. These 4-digit codes range from 0000 to 9705. Codes 0000 to 9629 are occupations from the ISCO-08 classification system. Codes 9701-9705 were used to classify responses that fell outside of the ISCO-08 classification system. Specifically, the code 9701 indicates "stay-at-home parent", 9702 indicates "student", and 9703 indicates "social beneficiary (e.g., unemployed, retired, sick)". Lastly, "I don't know" responses were coded 9704 and vague responses (e.g., a good job, a well-paid job) were coded 9705.

Father's occupational code

Students' responses to the fill-in question ST015 about their fathers' occupation were human-coded based on the ISCO-08 classification system, resulting in the father's occupational code (4-digit ISCO) index, OCOD2. These 4-digit ISCO-08 codes range from 0000 to 9705. Codes 0000 to 9629 are occupations from the ISCO-08 classification. Codes 9701-9705 were used to classify responses that fell outside of the ISCO-08 classification. Specifically, the code 9701 indicates "stay-at-home parent", 9702 indicates "student", and 9703 indicates "social beneficiary (e.g., unemployed, retired, sick)". Lastly, "I don't know" responses were coded 9704 and vague responses (e.g., a good job, a well-paid job) were coded 9705.

Mother's occupational status (BMMJ1)

The mother's occupational status index, BMMJ1, was derived from the OCOD1 index and international socio-economic index of occupational status (ISEI) (Ganzeboom and Treiman, 2003[9]) scores. The 4-digit ISCO-08 occupation codes in OCOD1 were mapped onto ISEI ratings.

Father's occupational status (BFMJ2)

The father's occupational status index, BFMJ2, was derived from the OCOD2 index and international socio-economic index of occupational status (ISEI) scores. The 4-digit ISCO-08 occupation codes in OCOD2 were mapped onto ISEI occupational status scores.

Highest parental occupational status (HISEI)

This highest parental occupational status index (HISEI) was based on the 4-digit ISCO-08 occupational codes that were human coded from students' responses to questions ST014 and ST015 about their mother and father's occupations, respectively. The index was equal to the higher of the mother's (BMMJ1) and father's (BFMJ2) ISEI scores.

Study programme level and orientation (ISCEDP)

PISA collects data on study programmes available to 15-year-old students in each country/economy. This information is obtained through the student tracking form and the Student Questionnaire (ST002). In the final database, all national programmes are included in a separate DV (PROGN) where the first six digits represent the National Centre code, and the last two digits are the nationally specific programme code. All study programmes were classified using the International Standard Classification of Education (ISCED 2011).[4]

The study programme level and orientation index (ISCEDP) is a three-digit index that describes whether students were at the lower or upper secondary level and (ISCED 2 or ISCED 3) and whether their programmes were general or vocational and sufficient for level completion with direct access to tertiary or post-secondary non-tertiary education. ISCEDP values and labels can be found in Table 19.8 of the *PISA 2022 Technical Report* (OECD, 2024[2]).

Highest expected educational level (EXPECEDU), or Expected end of education

Students' responses to of a list of possible educational levels they expect to complete in question ST327 were transformed into the index of "Highest Expected Educational Level". This DV has been newly created for 2022. Values on the index can range from "Less than ISCED level 2" to "ISCED level 8". Scores are assigned as shown in Table 19.9 of the *PISA 2022 Technical Report* (OECD, 2024[2]).

Expected occupation (OCOD3) and Expected occupation status (BSMJ)

Students' responses to the fill-in question ST329 about what kind of job they expect to have when they are about 30 years old were human-coded based the ISCO-08 classification system, resulting in the index "Expected Occupation (OCOD3)". These ISCO codes were then mapped to the international socioeconomic index of occupational status (ISEI) (Ganzeboom and Treiman, 2003[9]) in variable BSMJ. Higher scores on this variable indicate higher levels of a student's expected occupational status.

Clear idea about future job (SISCO)

The students who had a clear idea about their future job index (SISCO) was based on the human-coded open-ended expected occupation index, OCOD3, which was derived from question ST329. Students who had no clear idea about their future jobs were considered those who indicated "I do not know" or gave a vague answer such as "a good job", "a quiet job", "a well-paid job", "an office job" in response to question ST329. In the OCOD3 index, "I don't know" responses were coded 9704 and vague responses were coded 9705. Examples of invalid responses include students who did not answer the question or gave an answer, such as a smiley face. Specifically, a value of "0" is assigned on the index if OCOD3 values are 9704 or 9705, and a value of "1" is assigned if OCOD3 values are 0000 to 9703.

Job expectations in the cultural and creative sectors (CSSJOBS)

Students' responses to the fill-in question ST329 about what kind of job they expect to have when they are about 30 years old were human-coded based the ISCO-08 classification system, resulting in the index "Expected Occupation (OCOD3)". These ISCO codes were then mapped to the classification of Cultural and Creative Sectors (CSS) proposed by Galian et al. (2021[12]) in the dichotomous variable CSSJOBS. Among students who had a clear idea about their future job, a value of "1" is assigned to those who expect to work a job in the Cultural and Creative Sectors, and a value of "0" otherwise. The correspondence table is reproduced below (Table III.A6.1).

Table III.A6.1. Classification of occupations within the Cultural and Creative Sectors

264 Authors, journalists and linguists	265 Creative and performing artists	343 Artistic, cultural and culinary associate professionals	352 Telecommunications and Broadcasting Technicians
2641 Authors and related writers	2651 Visual artists	3431 Photographers	3521 Broadcasting and Audiovisual Technicians
2642 Journalists	2652 Musicians, singers and composers	3435 Oher artistic and cultural associate professionals	3522 Telecommunications Engineering Technicians
	2653 Dancers and choreographers		
	2654 Film, stage and related directors and producers		

	2655 Actors		
	2656 Announcers on radio, television and other media		
	2659 Creative and performing artists not elsewhere classified		

Source: Galian, Licata and Stern-Plaza (2021[12]), *Social Protection in the Cultural and Creative Sector: Country Practices and Innovations.*

Students with at least one parent who works a job in the cultural and creative sectors (PACSSJOBS)

The same mapping of occupation in the Cultural and Creative Sectors was applied to student's mother's and father's occupational code. A value of "1" is assigned to students who have either one of their parents working an occupation in the cultural and creative sectors, or both. A value of "0" is assigned to students who have none of their parent working an occupation in the cultural and creative sectors.

Job expectations at a high skill level (HSKJOBS)

Students' responses to the fill-in question ST329 about what kind of job they expect to have when they are about 30 years old were human-coded based the ISCO-08 classification system, resulting in the index "Expected Occupation (OCOD3)". These ISCO codes were then mapped to the classification of "highly skilled jobs", which correspond to jobs in the major-groups 1 and 2 in the ISCO-08 classification. Among students who had a clear idea about their future job, a value of "1" is assigned to those who expect to work a job in the major groups 1 and 2, and a value of "0" otherwise.

Immigrant background (IMMIG)

Information on the country of birth of the students and their parents was collected from students (ST019). Three binary country-specific indices indicate whether the student (COBN_S), mother (COBN_M) and father (COBN_F) were born in the country of assessment or elsewhere. The index on immigrant background (IMMIG) is calculated from these indices, and has the following categories: (1) native students (those students who had at least one parent born in the country of assessment); (2) second-generation students (those born in the country of assessment but whose parent[s] were born in another country); and (3) first-generation students (those students born outside the country of assessment and whose parents were also born in another country). Students with missing responses for either the student or for both parents were given missing values for this variable.

Language spoken at home (LANGN)

Students also indicated what language they usually spoke at home, and the database includes a variable (LANGN) containing country/economy-specific code for each language.

Home possessions (HOMEPOS)

In the HOMEPOS scale (which included questions ST250, ST251, ST253, ST254, ST255, and ST256), students indicated whether their household possessed certain items (e.g., "A room of your own", "Educational software or apps") or how many of an item their household possessed (e.g., "Rooms with a ", "Cars, vans, or trucks"). This scale included 31 items, including four country/economy specific items (ST250Q06JA, ST250Q07JA, ST251Q08JA, and ST251Q09JA) that were seen as local measures of family wealth within the country/economy's context.[5] In addition, students answered how many books (ST255) and digital devices with screens (ST253) were in their home. Note that all groups received unique item parameters for the country/economy-specific items (i.e., no international parameters were estimated for these items) and that for some items, the response categories were collapsed to align with the response categories used in previous cycles. Table 19.15 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale, while Table 19.16 in the same report shows how the response categories for each item were recoded prior to scaling.

Sense of belonging (BELONG)

Students' ratings of their agreement with six statements (e.g., "I feel like I belong at school.", "I feel lonely at school.") in question ST034 were scaled into the index of "Sense of belonging". Note that this scale used a within-construct matrix sampling design and that it was linked to the BELONG scale in PISA 2018. Each of the six items included in this scale had four response options ("Strongly agree", "Agree", "Disagree", "Strongly disagree"). Table 19.24 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling and which items are trend items.

Growth mindset (GROSAGR)

Students' ratings of their agreement with a range of statements indicative of their mindset (e.g., "Your intelligence is something about you that you cannot change very much.", "Some people are just not good at mathematics, no matter how hard they study.") in question ST263 were scaled into the index of "Growth mindset". Each of the four items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree", "Strongly agree"). Table 19.25 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling.

Assertiveness (ASSERAGR)

Students' ratings of their agreement with statements about a range of behaviours indicative of assertiveness (e.g., "I take initiative when working with my classmates.", "I find it hard to influence people.") in question ST305 were scaled into the index of "Assertiveness". Note that this scale used a within- construct matrix sampling design. Each of the 10 items included in this scale had five response options ("Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree"). Table 19.31 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling. Table 19.32 in the same report (OECD, 2024[2]) shows the percent of students in each country/economy that did not receive a scale score for ASSERAGR due to extreme straight-lining or, for comparison, for not having enough responses (i.e., less than three responses for the scale). In both cases, the scale scores were replaced with "99" in the SPSS file and ".M" in the SAS file.

Cooperation (COOPAGR), or Co-operation

Students' ratings of their agreement with statements about a range of behaviours indicative of cooperation (e.g., "I work well with other people.", "I get annoyed when I have to compromise with others.") in question ST343 were scaled into the index of "Cooperation". Note that this scale used a within-construct matrix sampling design. Each of the 10 items included in this scale had five response options ("Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree"). Table 19.33 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling. Table 19.34 of the same report (OECD, 2024[2]) shows the percent of students in each country/economy that did not receive a scale score for COOPAGR due to extreme straight-lining or, for comparison, for not having enough responses (i.e., less than three responses for the scale). In both cases, the scale scores were replaced with "99" in the SPSS file and ".M" in the SAS file.

Curiosity (CURIOAGR)

Students' ratings of their agreement with statements about a range of behaviours indicative of curiosity (e.g., "I like to know how things work.", "I am more curious than most people I know.") in question ST301 were scaled into the index of "Curiosity". Note that this scale used a within-construct matrix sampling design. Each of the 10 items included in this scale had five response options ("Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree"). Table 19.35 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling. Table 19.36 of the same report (OECD, 2024[2]) shows the percent of students in each country/economy that did not receive a scale score for CURIOAGR due to extreme straight-lining or, for comparison, for not having enough responses (i.e., less than three responses for the scale). In both cases, the scale scores were replaced with "99" in the SPSS file and ".M" in the SAS file.

Emotional control (EMOCOAGR)

Students' ratings of their agreement with statements about a range of behaviours indicative of emotional control (e.g., "I keep my emotions under control.", "I get mad easily.") in question ST313 were scaled into the index of "Emotional control". Note that this scale used a within-construct matrix sampling design. Each of the 10 items included in this scale had five response options ("Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree"). Table 19.37 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling. Table 19.38 of the same report (OECD, 2024[2]) shows the percent of students in each country/economy that did not receive a scale score for EMOCOAGR due to extreme straight-lining or, for comparison, for not having enough responses (i.e., less than three responses for the scale). In both cases, the scale scores were replaced with "99" in the SPSS file and ".M" in the SAS file.

Perseverance (PERSEVAGR), or Persistence

Students' ratings of their agreement with statements about a range of behaviours indicative of perseverance (e.g., "I keep working on a task until it is finished.", "I give up after making mistakes.") in question ST307 were scaled into the index of "Perseverance". Note that this scale used a within-construct matrix sampling design. Each of the 10 items included in this scale had five response options ("Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree"). Table 19.41 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling. Table 19.42 of the same report (OECD, 2024[2]) shows the percent of students in each country/economy that did not receive a scale score for PERSEVAGR due to extreme straight-lining or, for comparison, for not having enough responses (i.e., less than three responses for the scale). In both cases, the scale scores were replaced with "99" in the SPSS file and ".M" in the SAS file.

Stress resistance (STRESAGR)

Students' ratings of their agreement with statements about a range of behaviours indicative of stress resistance (e.g., "I remain calm under stress.", "I get nervous easily.") in question ST345 were scaled into the index of "Stress resistance". Note that this scale used a within-construct matrix sampling design. Each of the 10 items included in this scale had five response options ("Strongly disagree", "Disagree", "Neither agree nor disagree", "Agree", "Strongly agree"). Table 19.43 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling. Table 19.44 of the same report (OECD, 2024[2]) shows the percent of students in each country/economy that did not receive a scale score for STRESAGR due to extreme straight-lining or, for comparison, for not having enough responses (i.e., less than three responses for the scale). In both cases, the scale scores were replaced with "99" in the SPSS file and ".M" in the SAS file.

Creative pedagogies (CREATSCH), or Pedagogies encouraging creative thinking

Students' ratings of their agreement with statements about the degree to which creative thinking is fostered and supported in their school and class environment (e.g., "My teachers value students' creativity.", "At school, I am given a chance to express my ideas.") in question ST335 were scaled into the index of "Creative pedagogies". Note that this scale used a within-construct matrix sampling design. Each of the six items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree", "Strongly agree"). Table 19.52 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Creative thinking self-efficacy (CREATEFF), or Creative self-efficacy

Students' ratings of how confident they felt about having to do a range of tasks reflective of creative thinking skills (e.g., "Coming up with creative ideas for school projects", "Inventing new things") in question ST334 were scaled into the index of "Creative self-efficacy". Note that this scale used a within-construct matrix sampling design. Each of the 10 items included in this scale had four response options ("Not at all confident", "Not very confident", "Confident", "Very confident"). Table 19.53 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Creativity and openness to intellect (CREATOP), or Openness to intellect

Students' ratings of their agreement with statements regarding their own views on their openness to intellect (e.g., "Doing something creative satisfies me.", "I like games that challenge my creativity.") in question ST340 were scaled into the index of "Creativity and openness to intellect". Note that this scale used a within-construct matrix sampling design. Each of the 10 items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree", "Strongly agree"). Table 19.54 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Imagination and adventurousness (IMAGINE)

Students' ratings of their agreement with statements regarding their own views on their imagination and adventurousness (e.g., "I have difficulty using my imagination.", "Coming up with new ideas is satisfying to me.") in question ST342 were scaled into the index of "Imagination and adventurousness". Note that this scale used a within-construct matrix sampling design. Each of the seven items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree", "Strongly agree"). Table 19.55 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling.

Openness to art and reflection (OPENART), or Openness to art and experience

Students' ratings of their agreement with statements regarding their own views on their openness to art and experience into the index of "Openness to art and reflection". Each of the five items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree", "Strongly agree"). Table 19.56 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Participation in creative activities at school (CREATAS), or Participation in activities at school

Students' ratings of how often they participated in creative activities that were available in their school (e.g., "Art classes/activities (e.g., painting, drawing)", "Debate club") in question ST337 were scaled into the index of "Participation in creative activities at school". Note that the activities sampled in this question are the same as the activities in the "outside of school" version of this question (CREATOOS – ST338). Each of the eight items included in this scale had five substantive response options ("Never or almost never", "About once or twice a year", "About once or twice a month", "About once or twice a week", "Every day or almost every day") and an additional response option “Not available at school” which was recoded as missing prior to scaling. Table 19.57 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates how the response categories were recoded prior to scaling.

Participation in creative activities outside of school (CREATOOS), or Participation in activities outside of school

Students’ ratings of how often they participated in creative activities outside of school (e.g., “Art classes/activities (e.g., painting, drawing)”, “Debate club”) in question ST338 were scaled into the index of “Participation in creative activities outside of school”. Note that the activities sampled in this question are the same as the activities in the “at school” version of this question (CREATAS – ST337). Each of the eight items included in this scale had five substantive response options (“Never or almost never”, “About once or twice a year”, “About once or twice a month”, “About once or twice a week”, “Every day or almost every day”) and an additional response option “Not available” which was recoded as missing prior to scaling. Table 19.58 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates how the response categories were recoded prior to scaling.

ICT Questionnaire – Simple indices & derived variables based on IRT scaling

Availability and usage of ICT outside of school (ICTAVHOM)

The availability of ICT outside of school was gathered from IC171 where students’ frequency ratings of how often they use various digital resources outside of school (e.g., “Desktop or laptop computer”, “Smartphone”) was used for the index of “ICT use outside of school”. Each of the six items in this question included six response options (“Never or almost never”, “About once or twice a month”, “About once or twice a week”, “Every day or almost every day”, “Several times a day”, “This resource is not available to me outside of school”). For each of the six items, a score of “0” was assigned when students choose the “This resource is not available to me outside of school” response options and all other responses were coded “1”. The index was calculated as the sum of “0” and “1” designations across the six items that were marked with a value other than “This resource is not available to me at school”, thus ranging from 0-6. Items 2-4 were included in various previous versions of the ICT Questionnaire.

ICT availability outside school (ICTHOME)

Students’ frequency ratings of how often they use various digital resources outside of school (e.g., “Desktop or laptop computer”, “Smartphone (i.e., mobile phone with internet access)”) in question IC171 were scaled into the index of “ICT availability outside school”. Each of the six items included in this scale had six response options (“Never or almost never”, “About once or twice a month”, “About once or twice a week”, “Every day or almost every day”, “Several times a day”, “This resource is not available to me outside of school”). “This resource is not available to me outside of school” was recoded as 0, while the five other response options were recoded as 1 prior to scaling. Table 19.86 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Use of ICT in enquiry-based learning activities (ICTENQ)

Students’ frequency ratings of how often they use digital resources for various school-related activities (e.g., “Create a multi-media presentation with pictures, sound or video”, “Track the progress of your own work or projects”) in question IC174 were scaled into the index of “Use of ICT in enquiry-based learning activities”. Each of the 10 items included in this scale had five response options (“Never or almost never”, “About once or twice a year”, “About once or twice a month”, “About once or twice a week”, “Every day or almost every day”). Table 19.89 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Frequency of ICT activity – Weekday (ICTWKDY)

Students' frequency ratings of how often they did various leisure activities using ICT during a typical week day (e.g., "Play video-games (using my smartphone, a gaming console or an online platform or apps)", "Look for practical information online (e.g., find a place, book a train ticket, buy a product)") in question IC177 were scaled into the index of "Frequency of ICT activity – Weekday". Each of the seven items included in this scale had six response options ("No time at all, "Less than 1 hour a day", "Between 1 and 3 hours a day", "More than 3 hours and up to 5 hours a day", "More than 5 hours and up to 7 hours a day", "More than 7 hours a day"). Table 19.92 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Frequency of ICT activity – Weekend (ICTWKEND)

Students' frequency ratings of how often they did various leisure activities using ICT during a typical weekend day (e.g., "Play video-games (using my smartphone, a gaming console or an online platform or apps)", "Look for practical information online (e.g., find a place, book a train ticket, buy a product)") in question IC178 were scaled into the index of "Frequency of ICT activity – Weekend". Each of the seven items included in this scale had six response options ("No time at all, "Less than 1 hour a day", "Between 1 and 3 hours a day", "More than 3 hours and up to 5 hours a day", "More than 5 hours and up to 7 hours a day", "More than 7 hours a day"). Table 19.93 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Parent Questionnaire – Simple indices & derived variables based on IRT scaling

Creativity and openness to intellect (CREATOPN), or Parents' openness to intellect

Parents' ratings of their agreement with statements regarding their views on their own creativity and openness to intellect (e.g., "I am very creative.", "I enjoy projects that require creative solutions.") in question PA188 were scaled into the index of "Creativity and openness to intellect". Each of the nine items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree," "Strongly agree"). Table 19.124 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling.

Openness to creativity: Other's report (CREATOR), or Parents' perception of their child's openness to intellect

Parents' ratings of their agreement with statements regarding their views about their child's creativity (e.g., "My child is very creative.", "My child enjoys projects that require creative solutions.") in question PA189 were scaled into the index of "Openness to creativity: Other's report". Each of the eight items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree," "Strongly agree"). Table 19.125 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

School Questionnaire – Simple indices & derived variables based on IRT scaling

Creative extra-curricular activities (CREACTIV)

School principals were asked in SC053 to report what extra-curricular activities their schools offered to 15- year-old students. The two response categories were "Yes" and "No" for the 10 items. The index of creative extra-curricular activities at school (CREACTIV) was computed as the total number of the following 3 activities that occurred at school: i) band, orchestra or choir (SC053Q01TA); ii) school play or school musical (SC053Q02TA); and iii) art club or art activities (SC053Q09TA). The index ranges from 0 to 3. Additionally, a separate DV (SC053D11TA) combines all the customizations across countries to SC053C11TA (see the *PISA 2022 Technical Report* (OECD, 2024[2]) for more information).

Extra-curricular activities offered (ALLACTIV)

School principals were asked in SC053 to report what extra-curricular activities their schools offered to 15- year-old students (e.g., “School play or school musical”, “Mathematics club”). The two response categories for the 10 items in the scale were “Yes” and “No”. Higher scale score values indicate that more extracurricular activities were offered by the school, while lower scale score values indicate that fewer extracurricular activities were offered. Table 19.136 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling.

Beliefs about creativity (BCREATSC)

Principals were asked in SC204 to indicate their level of agreement with statements regarding their beliefs about creativity (e.g., “Creativity can be trained.”, “There are many different ways to be creative.”). The four response categories for the four items in the scale were “Strongly disagree”, “Disagree”, “Agree”, and “Strongly agree”. Higher scale score values indicate that principals endorse, to a greater extent, beliefs about the malleability of creativity and an expansive view of what it means to be creative. Lower scale score values indicate that principals endorse these beliefs to a lesser extent. Table 19.149 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Creative school activities offered (ACTCRESC), or Availability of activities at school

Principals were asked in SC207 to indicate how often creative activities are offered in their school (e.g., “Creative writing classes/activities”, “Debate”). The five substantive response categories for the eight items in the scale were “Never or almost never”, “About once or twice a year”, “About once or twice a month”, “About once or twice a week”, and “Every day or almost every day”. There was an additional response category, “Not available at our school”, which was recoded as missing prior to scaling. Higher scale score values indicate a greater frequency of creative activities being offered in school, while lower scale score values indicate creative activities are offered on a less frequent basis. Table 19.150 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates how the response categories were recoded prior to scaling.

Creative school environment (CREENVSC), or School principal's perception of pedagogies encouraging creative thinking

Principals were asked in SC205 to indicate their level of agreement with statements regarding the encouragement of creative thinking by teachers and through activities at the school (e.g., “Teachers in our school value students’ creativity.”, “Class activities in our school help students think about new ways to solve complex tasks.”). The four response categories for the six items in the scale were “Strongly disagree”, “Disagree”, “Agree”, and “Strongly agree”. Higher scale score values indicate more agreement with the overall view that students’ creativity is encouraged in the school, while lower scale score values indicate less agreement with this view. Table 19.151 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Openness culture/climate (OPENCUL), or School principals' perception of school openness to creativity

Principals were asked in SC208 to indicate the extent to which they agree or disagree with statements regarding their students’ orientation towards openness and creativity (e.g., “Most students at my school are creative.”, “Most students at my school enjoy learning new things.”). The four response categories for the nine items in the scale were “Strongly disagree”, “Disagree”, “Agree”, and “Strongly agree”. Higher scale score values indicate that students have a greater orientation towards openness and creativity, while lower scale score values indicate they have less orientation towards openness and creativity. Table 19.152 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Teacher Questionnaire - Simple indices & derived variables based on IRT scaling

Openness to creativity (OPENCTTC), or Teachers' openness to intellect

Teachers' ratings of their agreement with statements about their openness to creative activities (e.g., "I enjoy projects that require creative solutions.", "I express myself through art.") in question TC234 were scaled into the index of "Openness to intellect and creativity". Each of the eight items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree", "Strongly agree"). Table 19.184 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale. It also indicates which items were reverse-coded prior to scaling.

Creative values (CREATVAL), or Teacher's beliefs about the importance of developing student creativity

Teachers' ratings of their agreement with statements about their values regarding creativity (e.g., "It is important that students are able to make creative works like drawing and painting.", "It is important for students to solve science problems creatively.") in question TC235 were scaled into the index of "Creative values". Each of the six items included in this scale had four response options ("Strongly disagree", "Disagree", "Agree", "Strongly agree"). Table 19.185 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Teachers' use of creative pedagogies (CREATPED)

Teachers' ratings of how much importance they place on using creative pedagogies in class (e.g., "Finding ideas through brainstorming", "Debating ideas or current issues") in question TC236 were scaled into the index of "Teachers' use of creative pedagogies". Each of the seven items included in this scale had four response options ("No importance", "Very little importance", "Some importance", "A lot of importance"). Table 19.186 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Teachers' work autonomy (AUTONOMY)

Teachers' ratings of how much control they have over various decisions at their school (e.g., "Determining course content", "Disciplining students") in question TC246 were scaled into the index of "Teachers' work autonomy". Each of the seven items included in this scale had four response options ("No control", "Some control", "A lot of control", "Full control"). Table 19.191 of the *PISA 2022 Technical Report* (OECD, 2024[2]) shows the item wording and item parameters for the items in this scale.

Single items

In addition to the indices listed above, the following single items were used in this report:

- Student gender (ST004)
- Beliefs about the nature of creativity (ST339)
- Growth mindset on creativity and intelligence (ST263)
- Students' attitudes towards others and perspective taking (ST303)
- Use of digital resources for leisure and learning (ST326)
- Availability of extra-curricular activities at school (SC053)
- Assessment practices at school (SC034)
- Parents' beliefs about creativity (PA187)
- Teachers' beliefs about creativity (TC233)

Notes

[1] To keep the 2022 trend scales linked to PISA 2012 comparable, the Rasch model (Rasch, 1960[13]) was used to scale the dichotomous items, while the partial credit model (PCM) was used to scale the polytomous items, in line with the models used in PISA 2012.

2 Due to missing data from the countries/economies, countries/economies were only approximately equally weighted.

3 Different language versions were only analysed independently, if the version was distributed to a sample of over 150 and the sum of the weights was over 300. The sum of weights for all cases within a country/economy add up to a constant of 5 000 but varied on a scale-by-scale basis because missing responses varied across scales.

4 The International Standard Classification of Education (ISCED) is used in international educational statistics to classify levels in education systems worldwide. A link to the 2011 framework, ISCED 2011, used in PISA 2022 can be found at https://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf

5 Separate simple DVs (ST250D06JA, ST250D07JA, ST251D08JA, ST251D09JA) combine all the customisations across countries/economies to ST250C06JA, ST250C07JA, ST251C08JA, and ST251C09JA, respectively. See the PISA 2022 Technical Report for more information (OECD, 2024[2]).

References

Avvisati, F. (2020), "The measure of socio-economic status in PISA: a review and some suggested improvements", *Large-scale Assessments in Education*, Vol. 8/1, https://doi.org/10.1186/s40536-020-00086-x. [11]

Galian, C., M. Licata and M. Stern-Plaza (2021), "Social protection in the Cultural and Creative Sector: Country practices and innovations", in *ILO Working Paper*, ILO, Geneva, https://doi.org/10.13140/RG.2.2.25912.67842. [12]

Ganzeboom, H. and D. Treiman (2003), "Three Internationally Standardised Measures for Comparative Research on Occupational Status", in *Advances in Cross-National Comparison*, Springer US, Boston, MA, https://doi.org/10.1007/978-1-4419-9186-7_9. [9]

Muraki, E. (1992), "A GENERALIZED PARTIAL CREDIT MODEL: APPLICATION OF AN EM ALGORITHM", *ETS Research Report Series*, Vol. 1992/1, https://doi.org/10.1002/j.2333-8504.1992.tb01436.x. [6]

Novick, F. (ed.) (1968), *Some latent trait models and their use in inferring an examinee's ability*, Addison-Wesley, Menlo Park. [5]

OECD (2024), *PISA 2022 Technical Report*, OECD, https://doi.org/10.1787/01820d6d-en. [2]

OECD (2023), *PISA 2022 Assessment and Analytical Framework*, OECD, https://doi.org/10.1787/dfe0bf9c-en. [1]

OECD (2023), *PISA 2022 Results (Volume I)*, OECD, https://doi.org/10.1787/53f23881-en. [3]

OECD (2023), *PISA 2022 Results (Volume II)*, OECD, https://doi.org/10.1787/a97db61c-en. [4]

OECD (2020), *PISA 2018 Technical Report*, OECD publishing, Paris, https://www.oecd.org/pisa/data/pisa2018technicalreport/. [10]

Rasch, G. (1960), *Probabilistic models for some intelligence and attainment tests*, Nielsen and Lydiche. [13]

UNESCO (2012), *International Standard Classification of Education ISCED 2011*. [8]

Warm, T. (1989), "Weighted likelihood estimation of ability in item response theory", *Psychometrika*, Vol. 54/3, pp. 427-450, https://doi.org/10.1007/bf02294627. [7]

Annex A7. Ranking countries' and economies' performance in PISA

The goal of PISA is to provide useful information to educators and policy makers on the strengths and weaknesses of their country's education system, their progress made over time, and opportunities for improvement. When ranking countries' and economies' student performance in PISA, it is important to consider the social and economic context of schooling. Moreover, many countries and economies score at similar levels in the PISA test; small differences that are not statistically significant or practically meaningful should not be considered (see Reader's Guide).

Table III.A7.1. shows an estimate for each country and economy of where its mean performance ranks among all other countries and economies that participated in the PISA 2022 Creative Thinking assessment as well as, for OECD countries, among all OECD countries. Because mean-score estimates are derived from samples and are thus associated with statistical uncertainty, it is often not possible to determine an exact ranking for all countries and economies. However, it is possible to identify the range of possible rankings for the country's or economy's mean performance. Only the differences that are statistically significant should be considered when comparing mean performance across countries/economies [see Box 1 in Reader's Guide]). This range of rankings can be wide, particularly for countries/economies whose mean scores are similar to those of many other countries/economies.

Table III.A7.1. also includes the results of provinces, regions, states or other subnational entities within the country for countries where the sampling design supports such reporting. For these subnational entities, a ranking order was not estimated. However, the mean score and its confidence interval allow the performances of subnational entities and countries/economies to be compared.

Table III.A7.1. Creative thinking performance at national and subnational levels [1/3]

	Mean score	95% Confidence interval	Range of ranks			
			All countries/economies		OECD countries	
			Upper rank	Lower rank	Upper rank	Lower rank
Singapore	41.0	40.6 - 41.3	1	1		
*Alberta (Canada)**	39.6	38.1 - 41.0				
*Ontario (Canada)**	39.1	38.4 - 39.8				
Korea	38.1	37.3 - 38.8	2	4	1	3
*British Columbia (Canada)**	38.0	36.6 - 39.3				
Canada*	37.9	37.5 - 38.4	2	4	1	3
Australia*	37.3	36.8 - 37.8	2	5	1	4
*Quebec (Canada)**	36.5	35.5 - 37.5				
New Zealand*	36.4	35.9 - 37.0	4	8	3	7
Estonia	35.9	35.3 - 36.4	5	10	4	9
Finland	35.8	35.2 - 36.4	5	10	4	9
*Manitoba (Canada)**	35.7	34.6 - 36.9				
*Nova Scotia (Canada)**	35.7	34.0 - 37.4				
Denmark*	35.5	35.0 - 36.0	5	11	4	10
Prince Edward Island (Canada)	35.5	32.0 - 39.0				
Saskatchewan (Canada)	35.2	34.0 - 36.3				
Latvia*	35.1	34.5 - 35.6	6	12	5	10
Flemish Community (Belgium)	35.0	34.2 - 35.7				
Belgium	34.9	34.4 - 35.4	6	12	5	11
French Community (Belgium)	34.9	34.1 - 35.7				
Madrid (Spain)	34.8	33.9 - 35.7				
Castile and Leon (Spain)	34.6	32.8 - 36.3				
New Brunswick (Canada)	34.6	32.4 - 36.7				
Poland	34.4	33.9 - 35.0	8	12	7	11
Galicia (Spain)	34.3	32.5 - 36.2				
*Newfoundland and Labrador (Canada)**	34.1	31.6 - 36.6				
Asturias (Spain)	34.1	31.7 - 36.4				
Portugal	33.9	33.3 - 34.5	9	16	9	14
Trento (Italy)	33.5	32.9 - 34.1				
Navarre (Spain)	33.5	31.3 - 35.7				
Cantabria (Spain)	33.4	31.1 - 35.6				
Aragon (Spain)	33.2	31.5 - 34.8				
German-speaking Community (Belgium)	33.1	29.3 - 36.9				
Murcia (Spain)	32.9	31.3 - 34.6				
Lithuania	32.9	32.3 - 33.4	12	21	11	18
Spain	32.8	32.3 - 33.2	13	21	12	18
Czechia	32.6	32.1 - 33.2	12	23	12	18
Chinese Taipei	32.6	31.9 - 33.4	12	24		
La Rioja (Spain)	32.6	30.8 - 34.4				
Germany	32.5	31.7 - 33.3	12	24	12	19
Comunidad Valenciana (Spain)	32.5	31.5 - 33.5				
France	32.4	31.8 - 33.0	13	24	12	19
Netherlands*	32.4	31.5 - 33.3	12	25	11	20

Table III.A7.1. Creative thinking performance at national and subnational levels [2/3]

	Mean score	95% Confidence interval	Range of ranks			
			All countries/economies		OECD countries	
			Upper rank	Lower rank	Upper rank	Lower rank
Extremadura (Spain)	32.3	31.0 - 33.7				
Israel	32.3	31.5 - 33.0	13	25	12	20
Catalonia (Spain)	32.2	31.1 - 33.4				
Bolzano (Italy)	32.1	30.0 - 34.2				
Balearic Islands (Spain)	32.1	31.0 - 33.2				
Bogota (Colombia)	32.0	30.6 - 33.4				
Canary Islands (Spain)	31.9	30.3 - 33.5				
Basque Country (Spain)	31.9	30.8 - 33.0				
Andalusia (Spain)	31.7	30.7 - 32.7				
Castile-La Mancha (Spain)	31.7	30.3 - 33.2				
Macao (China)	31.6	31.2 - 32.0	15	27		
*Hong Kong (China)**	31.6	30.9 - 32.3	13	28		
Italy	31.4	30.8 - 32.0	15	28	15	22
Malta	31.3	30.9 - 31.8	16	28		
Hungary	30.9	30.3 - 31.6	19	29	17	23
Chile	30.7	30.0 - 31.3	20	30	19	23
Croatia	30.5	29.8 - 31.1	22	30		
Iceland	30.5	30.0 - 30.9	22	30	19	24
Kostanay region (Kazakhstan)	30.2	28.2 - 32.2				
Slovenia	30.0	29.5 - 30.4	25	32	20	25
North-Kazakhstan region (Kazakhstan)	29.9	28.2 - 31.5				
Slovak Republic	29.2	28.4 - 30.0	26	34	22	25
Mexico	29.0	28.4 - 29.6	29	34	23	25
Almaty (Kazakhstan)	28.9	27.0 - 30.9				
Serbia	28.7	28.0 - 29.4	30	37		
Uruguay	28.6	28.0 - 29.3	30	37		
Astana (Kazakhstan)	28.6	26.7 - 30.5				
United Arab Emirates	28.4	28.1 - 28.7	30	37		
Qatar	27.7	27.2 - 28.1	32	39		
Costa Rica	27.5	26.9 - 28.1	32	40	26	27
Central (Mongolia)	27.2	26.5 - 27.9				
Pavlodar region (Kazakhstan)	27.0	24.9 - 29.1				
Greece	27.0	26.3 - 27.7	35	41	26	28
Ukrainian regions (18 of 27)	26.9	25.7 - 28.1	32	42		
Akmola region (Kazakhstan)	26.5	24.5 - 28.5				
South (Brazil)	26.3	25.3 - 27.3				
Romania	26.2	25.3 - 27.2	35	43		
Karagandy region (Kazakhstan)	26.1	24.3 - 27.9				
Melilla (Spain)	26.1	23.0 - 29.2				
Ceuta (Spain)	26.1	22.3 - 29.8				
Colombia	25.6	24.6 - 26.5	37	44	27	28
Jamaica*	25.5	24.5 - 26.6	37	45		
East-Kazakhstan region (Kazakhstan)	25.2	23.3 - 27.1				

Table III.A7.1. Creative thinking performance at national and subnational levels [3/3]

	Mean score	95% Confidence interval	Range of ranks			
			All countries/economies		OECD countries	
			Upper rank	Lower rank	Upper rank	Lower rank
Malaysia	25.1	24.4 - 25.9	38	45		
Mongolia	24.9	24.3 - 25.5	38	45		
Southeast (Brazil)	24.8	23.9 - 25.7				
Middle-West (Brazil)	24.0	22.0 - 26.1				
Moldova	23.9	23.3 - 24.6	40	53		
Mangistau region (Kazakhstan)	23.9	22.3 - 25.5				
West-Kazakhstan region (Kazakhstan)	23.9	22.2 - 25.5				
Kazakhstan	23.8	23.3 - 24.4	40	53		
Brunei Darussalam	23.7	23.4 - 24.1	44	53		
Cyprus	23.7	23.3 - 24.1	44	53		
Peru	23.5	22.8 - 24.1	44	53		
Brazil	23.3	22.7 - 23.9	44	53		
Saudi Arabia	23.3	22.7 - 23.9	44	53		
Khangai (Mongolia)	23.3	21.8 - 24.8				
Panama*	23.2	22.5 - 23.9	44	53		
Aktobe region (Kazakhstan)	23.0	21.8 - 24.3				
El Salvador	23.0	22.3 - 23.7	44	53		
Baku (Azerbaijan)	22.8	22.2 - 23.4	44	53		
Almaty region (Kazakhstan)	22.5	20.7 - 24.3				
Shymkent (Kazakhstan)	22.1	20.4 - 23.9				
Atyrau region (Kazakhstan)	21.2	19.6 - 22.8				
Thailand	20.9	20.2 - 21.7	54	56		
Bulgaria	20.7	20.0 - 21.5	54	56		
Northeast (Brazil)	20.5	19.5 - 21.5				
Jordan	20.2	19.5 - 20.9	54	58		
Zhambyl region (Kazakhstan)	20.0	18.4 - 21.6				
North (Brazil)	19.9	18.3 - 21.5				
Kyzyl-Orda region (Kazakhstan)	19.7	18.0 - 21.3				
North Macedonia	19.1	18.7 - 19.6	56	59		
Indonesia	19.0	18.2 - 19.7	56	59		
Palestinian Authority	18.5	17.8 - 19.1	57	59		
Western (Mongolia)	18.2	17.1 - 19.4				
Turkestan region (Kazakhstan)	17.9	15.9 - 19.9				
Dominican Republic**	15.5	15.0 - 16.0	60	63		
Morocco	15.5	14.3 - 16.6	60	63		
Uzbekistan	14.5	14.0 - 15.0	60	63		
Philippines	14.2	13.2 - 15.2	60	64		
Albania**	13.1	12.5 - 13.6	63	64		

* Caution is required when interpreting estimates because one or more PISA sampling standards were not met. ** Caution is required when comparing estimates with other countries/economies as a strong linkage to the international PISA creative thinking scale could not be established (see Reader's Guide, Annex A2 and Annex A4).
Notes: Only countries and economies with available data are shown. Provinces, regions, states or other subnational entities are shown in italics.
Range-of-rank estimates are computed based on mean and standard-error-of-the-mean estimates for each country/economy and take into account multiple comparisons amongst countries and economies at similar levels of performance. For an explanation of the method, see Annex A3. For subnational entities, a rank order was not estimated.
Countries and economies are ranked in descending order of the mean performance in creative thinking.
Source: OECD, PISA 2022 Database, Tables III.B1.2.1 and III.B2.1.

StatLink https://stat.link/k2tq1m

Annex A8. Student engagement with the PISA 2022 Creative Thinking assessment

Performance on school tests reflects what students know and can do. They also show how quickly students process information and how motivated they are to do well on the test. To encourage students who sit the PISA test to do their best through to the end of the assessment, schools and students are reminded how important the study is for their country. At the beginning of the test session, the test administrator reads a script that includes the following sentence:

> *"This is an important study because it will tell us about what you have been learning and what school is like for you. Because your answers will help influence future educational policies in <country and/or education system>, we ask you to do the very best you can."*

However, many students view PISA as a low-stakes assessment: they can refuse to participate in the test with no negative consequences and do not receive any feedback on their performance. There is a risk, therefore, that students do not do their best on the test (Wise and DeMars, 2010[1]).

Several studies in the United States have found that student performance on assessments, such as the United States national assessment of educational progress (NAEP), depends on how they are administered. One study shows that students did not perform as well in regular low-stakes conditions as when students received financial rewards tied to their performance or were told their results would count towards their grades (Wise and DeMars, 2005[2]). In contrast, a study in Germany found no difference in effort or performance measures between students who sat a PISA-based mathematics test under the standard PISA test-administration conditions and students who sat the test in alternative high-stakes conditions tied to performance (Baumert and Demmrich, 2001[3]). In the latter study, experimental conditions included promising feedback on performance, providing monetary incentives contingent on performance, and letting students know that the test would count towards their grades. The difference in conclusions reached by these two studies suggests that students' motivation on low-stakes tests such as PISA differs significantly across countries. The only existing multi-country study on the effect of incentives on test performance found that offering students monetary incentives to do well on a test such as PISA – something that is not possible within regular PISA procedures – led to improved performance among students in the United States while students in Shanghai (China) performed equally well with or without incentives (Gneezy et al., 2017[4]).

Differences in student engagement in a given test often reveal important variations in test-administration conditions. For example, in 2018, students predominantly concentrated in a small number of schools in a few regions of Spain exhibited anomalous response patterns, performed below expectations, and reported low levels of engagement with the test. Further investigation revealed that the regions in which these schools were located had conducted their high-stakes exams for 10th-grade students earlier in the year than in the past. This meant that the testing period for these exams coincided with the end of the PISA testing window. Students were more negatively disposed towards PISA in schools where the PISA testing day was closer to that of high-stakes exams (OECD, 2020[5]).

Summing up, differences in countries' and economies' mean scores in PISA, and comparisons between PISA 2022 results and results from prior assessments may reflect differences not only in what students know and can do but how motivated they were to do their best. Put differently, PISA does not measure students' maximum potential but what students actually do in situations where their individual performance is monitored only as part of their group's performance.

This annex computes several indicators of student engagement with the PISA 2022 Creative Thinking items, specifically. The indicators in this annex rely on non-invasive behavioural indicators (i.e. students' interactions with the test forms). Other indicators of engagement with the PISA test more broadly, using PISA 2022 data from the mathematics, reading and science assessments as well as from the student questionnaire module, are described in Annex A8 of the PISA 2022 Results (Volume I) report (OECD, 2023[6]). As with the indicators described in that annex, the intention of constructing indicators of engagement is not to suggest adjustments to PISA mean scores or performance distributions but to provide richer context for interpreting cross-country differences and trends in performance.

Behavioural indicators of disengagement with the creative thinking items

A number of approaches have been developed to assess differences in students' motivation in low-stakes tests (Buchholz, Cignetti and Piacentini, 2022[7]) between individuals or groups (e.g. across countries and economies), some of which are based on behavioural indicators. Behavioural indicators are based on the idea that when respondents are disengaged, they do not provide a response that reflects their best judgement or capabilities to the questions asked in the test.

In general, creative work requires task engagement (OECD, 2023[8]). Unlike simple knowledge recognition or reproduction tasks, most tasks in the PISA 2022 Creative Thinking test require students to develop and submit a written or a visual artefact. The complexity of this artefact may vary, from one or a few words to more extended written or visual compositions. In all cases, students must invest time and effort in reading the task prompt, understanding the stimulus material, and actively constructing a response in the format required. This, in turn, implies a minimum level of engagement with and time spent on each task.

In order to examine test-taking effort and potentially identify students who demonstrate disengagement with the creative thinking items, three sets of indicators have been constructed. These include:

- Students who rapidly move through a test item without spending a sufficient amount of time to provide a valid response ("rapid responders");
- Students who spend a short amount of time on an item, relative to other students in the same country, and who do not submit a valid response ("relative rapid responders");[1]
- Students who do not submit a valid response (i.e. missing responses) after spending any length of time on an item.

The first two indicators combine time-on-task information with information on the quality (or lack thereof) of student responses. Measures of engagement based on time-on-task suppose that there is a minimum amount of time that students should spend on any given item to be able to purposefully engage with the content of that item and be able to provide a valid response that is reflective of students' capabilities. In the context of creative thinking, complex cognitive processing takes time. For example, a meta-analysis of performance in divergent thinking tasks concluded that performance increased linearly with more time spent on task, up to a certain point where performance gains slowed (Paek et al., 2021[9]). It is therefore reasonable to assume that, in general, students who do not spend a minimum period of time on a task will not have been able to adequately engage in the processes of creative thinking. In turn, both non-responses (i.e. missing responses) and responses submitted by students that were not reflective of any skill in creative thinking (i.e. responses that achieved no credit) might be considered to be invalid.

The third indicator relies only on the absence of valid responses as an indicator of disengagement. It supposes that students who do not submit a response to a given item are disengaged as they have made no attempt to provide a response.

Rapid responding behaviours

The first indicator examined here identifies "rapid responding behaviours". This refers to students who, after being shown one item, quickly move onto the next item without submitting a valid response. For this indicator, the time-on-task threshold is uniformly set to 30 seconds for all items included in the analysis: if students do not spend more than 30 seconds on an item and either do not submit a response (i.e. missing) or submit a response that achieves no credit (i.e. an inappropriate response), then students are considered to exhibit rapid responding behaviour for that item.

On average across OECD countries, rapid responding behaviours were demonstrated on around 4% of items seen by students (Table III.A8.1). In some countries and economies, this percentage was significantly higher. For example, students demonstrated this behaviour on over 15% of all items they saw in Albania and Cyprus. By task grouping (ideation process and domain context).

Table III.A8.2 and Table III.A8.5 show the percentage of rapid responding behaviours across countries/economies by ideation process and by domain context. In general, students exhibited slightly more rapid responding behaviours when tackling evaluate and improve tasks (4.3% of tasks encountered) than generate creative ideas (3.5%) or generate diverse ideas tasks (3.6%) (Table III.A8.2). In most countries and economies, the share of rapid responding behaviours was relatively consistent across task types by ideation process, with differences in the frequency of such behaviours rarely exceeding 2 percentage points between two ideation processes.

When it comes to the domain context, rapid responding behaviours were most frequently observed in visual expression tasks (5.9 % tasks encountered) and least often in social problem-solving tasks (3.3%), on average across the OECD – although differences across domains were also small, in general (Table III.A8.5). In a few countries/economies, differences in the share of rapid responding behaviours observed across tasks in different domains exceeded 5 percentage points. In North Macedonia and Baku (Azerbaijan), students exhibited rapid responding behaviour in over 20% of the items in the visual domain, but around 8 percentage points less frequently in written expression tasks. In Cyprus and Albania students show the highest rate of rapid responding behaviours in the context of scientific problem-solving tasks. By student characteristics (gender and socio-economic status)

On average across all task groupings, girls and advantaged students record significantly less rapid responding behaviours than boys and disadvantaged students, respectively (Tables III.A8.8, III.A8.11, III.A8.14, III.A8.17). In general, boys exhibit rapid responding behaviours on around 2 percentage point more items than girls. Gender differences vary across tasks in different domain contexts, being on average higher in written expression tasks and visual expression tasks and lower in scientific and social problem-solving tasks. Particularly large gender differences in rapid responding behaviours across all items are observed in Albania (around 10 percentage points), and Palestinian Authority (around 9 percentage points).

Interestingly in North Macedonia, while students exhibited rapid responding behaviours in around 14% of all visual expression tasks encountered, there are no significant differences in the rate of these behaviours between boys and girls for these tasks – despite significant gender differences observed in tasks across the other three domains.

On average across the OECD, advantaged students exhibit around 4 percentage point less rapid responding behaviours on all items than disadvantaged students. Disadvantaged students tend to display these behaviours most frequently in evaluate and improve ideas items than in generate creative ideas or generate diverse ideas tasks compared to their advantaged peers.

Across domain contexts, differences between the share of students from advantaged and disadvantaged backgrounds who exhibit rapid responding behaviours is remarkably consistent (between 3 and 4 percentage points) on average across the OECD. However, patterns vary considerably in each country/economy (Table III.A8.17).

Rapid responding behaviours relative to national peers

The threshold for identifying the "minimum" amount of time to spend on a task that is conducive to productive engagement may also be set in relation to the characteristics and demands of a given task, and/or in relation to the effort of other students within the same country/economy. Features that may influence the minimum time required include the required response format (e.g. a single word answer vs. a visual composition vs. an extended paragraph), the familiarity of the task content, and the length of the task instructions and stimuli material. In addition to the characteristics of tasks, adaptations of task content into different languages will also impact the length and potential complexity of the task instructions. Moreover, for most items in the test, students are required to produce a written artefact as a response: the time required to produce such responses may be influenced by the relative complexity and form of the national language.

In sum, more lengthy and complex content will take longer to process and produce than simpler and shorter content. The second indicator of engagement examined here operationalises rapid responding behaviours differently to the first indicator, namely by identifying rapid responses relative to the national sample. For each item, students in the bottom quarter of time-on-task are considered to have spent relatively little time on an item compared to peers within their country/economy. Students in the bottom quarter of time-on-task are considered to exhibit “relatively rapid responding behaviour” for an item if they either do not submit a response (i.e. missing) or if they submit a response that achieves no credit (i.e. an inappropriate response). This indicator takes into account the fact that the minimum threshold of “reasonable” time spent on a task may differ across country and language groupings.

On average across OECD countries, relatively rapid responding behaviours were demonstrated on 14% of items seen by students (Table III.A8.1). It should be expected that the indicator of relative rapid responding behaviours is higher across countries and economies than the indicator of rapid responding behaviours, given that the “minimum” time threshold is set higher than 30 seconds. Nonetheless, large differences in the share of relatively rapid responding behaviours can be observed across countries/economies. In Albania, students demonstrated this behaviour in 39% of all tasks they encountered, and in North Macedonia, Baku (Azerbaijan), Bulgaria and Jordan students did so in more than a fourth of all tasks encountered. Conversely, in Latvia*, Macao (China), Kazakhstan, Singapore and Estonia, students in the bottom quarter of time on task showed relatively rapid responding behaviours in less than 10% of all items they encountered.

By task grouping (ideation process and domain context)

Table III.A8.3 and Table III.A8.6 show the percentage of relatively rapid responding behaviours across countries/economies by ideation process and by domain context. In general, students exhibited slightly less relatively rapid responding behaviours when tackling generate creative ideas tasks (12% of tasks encountered) than in generate diverse ideas tasks (15%) or evaluate and improve ideas tasks (14%) (Table III.A8.3). In most countries and economies, the share of rapid responding behaviours was relatively consistent across task types by ideation process.

When it comes to the domain context, relatively rapid responding behaviours were least frequently observed in visual expression tasks (11% tasks encountered) and most frequently observed in scientific problem-solving tasks (16%), (Table III.A8.6).In few countries/economies, however – Palestinian Authority, North Macedonia, Albania, Panama, Baku (Azerbaijan) and Uzbekistan – students exhibited relatively rapid responding behaviours more frequently in the visual expression domain than in the other domains.

By student characteristics (gender and socio-economic status)

As shown when examining differences by student characteristics in rapid responding behaviours, girls and advantaged students record significantly less relatively rapid responding behaviours than boys and disadvantaged students, respectively, on average across the OECD (Tables III.A8.9, III.A8.12, III.A8.15, III.A8.18). In general, boys exhibit relatively rapid responding behaviours on around 5 percentage point more items than girls (when considering items across all task groupings). Particularly large gender differences in relatively rapid responding behaviours across all items are observed in Palestinian Authority (19 percentage points) and Albania (around 17 percentage points).

Gender differences in relatively rapid responding vary the most across tasks in different domain contexts, with differences in the behaviour of boys and girls reaching around 6 percentage points in written expression tasks and less than 3 percentage points in scientific problem-solving tasks. In 26 countries and economies, there were no significant differences in the share of relatively rapid responding behaviours in the scientific problem-solving domain.

In social problem solving, the gender difference in this indicator is the largest in the Palestinian Authority (13 percentage points), Qatar (12 percentage points) and the United Arab Emirates (10 percentage points).

On average across the OECD, advantaged students exhibit around 11 percentage point less relatively rapid responding behaviours on all items than disadvantaged students. Differences in relatively rapid responding behaviours between advantaged and disadvantaged students are particularly large in Bulgaria (around 22 percentage points on average), Romania (over 20 percentage points), and Israel (around 18 percentage points).

Disadvantaged students tend to display these behaviours less frequently in generate diverse ideas items (difference of about 10 percentage points) than in the other two processes, compared to their advantaged peers. Across domain contexts, differences between the share of students from advantaged and disadvantaged backgrounds who exhibit relatively rapid responding behaviours are highest in scientific problem-solving tasks (about 13 percentage points), on average across the OECD, and lowest in visual expression tasks (7 percentage points). However, as with the indicator for rapid responding behaviours, patterns vary considerably in each country/economy (Table III.A8.18).

Non-responding behaviours

The third indicator of engagement examined here refers to non-responding behaviours – or in other words, the percentage of items for which students in a country/economy did not submit any response. A lower share of non-responding behaviours indicates that students within a country/economy have at least made some attempt to engage with tasks, although this measure is not sensitive to other forms of satisficing behaviours that might also indicate disengagement (e.g. off task-exploration, inappropriate responses, random guessing). On the other hand, this indicator includes students who spent a sufficient amount of time on an item but who were unable to attempt any response (i.e. students of low proficiency).

Students across the OECD did not submit a response to around 6% of all test items they viewed, on average (Table III.A8.1). Similar to the other indicators discussed above, the share of non-responding behaviours across countries and economies varies significantly. In 20 participating countries/economies, non-responding behaviours are observed on over 10% of all items encountered by students. Large shares of missing responses on items encountered are observed in Baku (Azerbaijan) (23%), Albania (21%), Jamaica* (18%) and North Macedonia (18%). Less than 2% of items encountered by student in Singapore had no response submitted – a very small share of all tasks encountered by students.

By task grouping (ideation process and domain context)

Table III.A8.4 and Table III.A8.7 show the percentage of non-responding behaviours across countries/economies by ideation process and by domain context. In general, students did not give a response most frequently to items asking them to evaluate and improve ideas (8% of tasks encountered) than generate creative ideas (5% tasks) or generate diverse ideas (6% tasks) (Table III.A8.3). The percentage of non-responses is particularly large for evaluate and improve items in Baku (Azerbaijan) (26 percentage points), Albania (24 percentage points), North Macedonia (21 percentage points) and Jamaica (21 percentage points).

When it comes to tasks across different domain contexts, students did not provide a response most frequently for scientific problem-solving tasks by some margin: across OECD countries, students did not provide a response for nearly 9% of tasks encountered in this domain, compared to 5% tasks in the social problem solving domain (Table III.A8.7). In some countries/economies, students did not provide a response for over one fifth of all items encountered in a domain: this was the case for students in Albania and Baku (Azerbaijan) in the written expression domain; for students in Philippines, Morocco, Albania, Baku (Azerbaijan), Uzbekistan in the visual expression domain (with percentage reaching 36% in Uzbekistan); and for students in North Macedonia, Albania, Baku (Azerbaijan), Cyprus, Jamaica and Bulgaria in the scientific problem-solving domain.

By student characteristics (gender and socio-economic status)

As with the first two indicators of engagement examined in this annex, girls also record less non-responses than boys – although on average across the OECD, differences between boys and girls in this indicator are small (albeit significant). Nonetheless, gender differences of over 8 percentage points in favour of girls in this indicator, when considering all items together, can still be observed in Palestinian Authority and Albania. However, when examining non-responding behaviours between boys and girls on different task types, in some cases differences are not significant: for example, in evaluate and improve items and in the two problem-solving domain contexts (Table III.A8.10 and Table III.A8.13). In fact, in Latvia*, girls provide significantly more non-responses than boys in the problem-solving domains.

In most countries/economies, differences in non-responding behaviours are largest between boys and girls in the written expression domain followed by the visual expression domain (or vice versa). However, in Albania differences between boys and girls are largest in the social problem-solving domain, and in Saudi Arabia, Brunei Darussalam, Chinese Taipei, Macao (China), Qatar, Uzbekistan and France, differences are largest in the scientific problem-solving domain (Table III.A8.13).

In terms of differences in non-responding behaviours amongst students with different socio-economic backgrounds, disadvantaged students exhibit this behaviour in around 7 percentage point more items than advantaged students. Disadvantaged students tend to display these behaviours most frequently in evaluate and improve ideas items (difference of 8 percentage points) than in generate creative ideas (difference of 5 percentage points) or generate diverse ideas tasks (difference of 6 percentage points), compared to their advantaged peers. Across domain contexts, differences between the share of students from advantaged and disadvantaged backgrounds who exhibit non-responding behaviours are highest in scientific problem-solving tasks, on average across the OECD, and lowest in visual expression tasks. However, as with the indicator for rapid responding behaviours, patterns vary considerably in each country/economy (Table III.A8.19).

Table III.A8.1. How much effort did students invest in the PISA test? Annex A8 tables

StatLink https://stat.link/v8ynau

Note

[1] Three items were excluded from the analysis of rapid and relative rapid responding behaviours based on the response type required, as it was considered that some students could reasonably respond to the items within a short period of time. For two of these three items, students were able to select a response to a previous question akin to a multiple-choice mechanism. For the other remaining excluded item, students were asked to generate a very short written artefact. These three items are the same as those that were excluded from the post data-adjudication treatment of invalidating responses submitted within 15 seconds as described in the *PISA 2022 Technical Report* (OECD, 2023[10]).

References

Baumert, J. and A. Demmrich (2001), “Test motivation in the assessment of student skills: The effects of incentives on motivation and performance”, *European Journal of Psychology on Education*, Vol. 16/3, pp. 441-462, https://doi.org/10.1007/bf03173192. [3]

Buchholz, J., M. Cignetti and M. Piacentini (2022), “Developing measures of engagement in PISA”, *OECD Education Working Papers*, https://doi.org/10.1787/19939019. [7]

Gneezy, U. et al. (2017), *Measuring Success in Education: The Role of Effort on the Test Itself*, National Bureau of Economic Research, Cambridge, MA., https://doi.org/10.3386/w24004. [4]

OECD (2023), *Annex A8: How much effort do students put into the PISA test?*, OECD Publishing, Paris, https://doi.org/10.1787/53f23881-en. [6]

OECD (2023), *PISA 2022 Creative Thinking framework*, OECD Publishing, Paris, https://doi.org/10.1787/471ae22e-en. [8]

OECD (2023), *PISA 2022 Innovative Domain Test Design and Test Development*, OECD Publishing, Paris, https://www.oecd.org/pisa/data/pisa2022technicalreport/PISA-2022-Technical-Report-Ch-18-PISA-Proficiency-Scale-Construction-Domains-Creative-Thinking.pdf. [10]

OECD (2020), *Annex A9. A note about Spain in PISA 2018: Further analysis of Spain’s data by testing date (updated on 23 July 2020)*, OECD Publishing, Paris, https://www.oecd.org/pisa/PISA2018-AnnexA9-Spain.pdf. [5]

Paek, S. et al. (2021), “Is more time better for divergent thinking? A meta-analysis of the time-on-task effect on divergent thinking”, *Thinking Skills and Creativity*, Vol. 41, pp. 1-15, https://doi.org/10.1016/j.tsc.2021.100894. [9]

Wise, S. and C. DeMars (2010), “Examinee noneffort and the validity of program assessment results”, *Educational Assessment*, Vol. 15/1, pp. 27-41, https://doi.org/10.1080/10627191003673216. [1]

Wise, S. and C. DeMars (2005), “Low examinee effort in low-stakes assessment: Problems and potential solutions”, *Educational Assessment*, Vol. 10/1, pp. 1-17, https://doi.org/10.1207/s15326977ea1001_1. [2]

Annex B1. Results for countries and economies

The following tables are available in electronic form only. Please click on the StatLink after each table to access them.

Table III.B1.1. Student performance in creative thinking: Chapter 2 annex tables

Table III.B1.2.1	Mean score and variation in creative thinking performance
Table III.B1.2.2	Percentage of students at each proficiency level in creative thinking
Table III.B1.2.3	Correlation of creative thinking score with performance in mathematics, reading and science
Table III.B1.2.4	Students' score in creative thinking, compared to the average score of international students with similar mathematics, reading, and science achievement

StatLink https://stat.link/opbe7a

Table III.B1.2. Variation in student performance in creative thinking: Chapter 3 annex tables

Table III.B1.3.1	Between- and within-school variation in creative thinking score, mathematics and students' socio-economic status
Table III.B1.3.2	Creative thinking performance, by gender
Table III.B1.3.3	High achievers and top performers in creative thinking performance, by gender
Table III.B1.3.4	Percentage of students at each proficiency level in creative thinking, by gender
Table III.B1.3.5	Gender differences in mean score in creative thinking, mathematics, reading and science
Table III.B1.3.6	Score-point difference in creative thinking of girls relative to expected performance with similar performance in mathematics, reading or science
Table III.B1.3.7	Student socio-economic status and performance in creative thinking
Table III.B1.3.8	Relationship between student socio-economic status and performance in creative thinking, mathematics, reading and science
Table III.B1.3.9	Immigrant background and performance in creative thinking
Table III.B1.3.10	Difference in creative thinking performance, by immigrant background, after accounting for student and school socio-economic background and language spoken at home
Table III.B1.3.11	Percentage of students at each proficiency level in creative thinking, by immigrant background
Table III.B1.3.12	Immigrant background differences in mean score in creative thinking, mathematics, reading and science
Table III.B1.3.13	Score-point difference in creative thinking of immigrant students relative to expected performance with similar performance in mathematics, reading or science
Table III.B1.3.14	Percentage of students in general or vocational (and pre-vocational) programmes
Table III.B1.3.15	Creative thinking performance, by student and school characteristics
Table III.B1.3.16	Relationship between performance in creative thinking, mathematics, reading and science and student and school characteristics
Table III.B1.3.17	Difference in creative thinking performance by school characteristic, after accounting for student and school socio-economic background

StatLink https://stat.link/vucm9b

Table III.B1.3. Student performance in creative thinking: Chapter 4 annex tables

Table III.B1.4.1	Performance in creative thinking across ideation processes
Table III.B1.4.2	Performance in creative thinking across domain contexts
Table III.B1.4.3	Relative performance in creative thinking across ideation processes, by country/economy
Table III.B1.4.4	Relative performance in creative thinking across domains contexts, by country/economy
Table III.B1.4.5	Performance in creative thinking across ideation processes, by gender
Table III.B1.4.6	Performance in creative thinking across domain contexts, by gender

Table III.B1.4.7	Relative gender gap in creative thinking across ideation processes, by country/economy
Table III.B1.4.8	Relative gender gap in creative thinking across domains contexts, by country/economy
Table III.B1.4.9	Performance in creative thinking across ideation processes, by socio-economic status
Table III.B1.4.10	Performance in creative thinking across domain contexts, by socio-economic status
Table III.B1.4.11	Relative performance in creative thinking of advantaged and disadvantaged students across ideation processes, by country/economy
Table III.B1.4.12	Relative performance in creative thinking of advantaged and disadvantaged students across domains contexts, by country/economy
Table III.B1.4.13	Difference in average percent of correct responses of creative thinking items, by socio-economic status

StatLink https://stat.link/lv2hsp

Table III.B1.4. Student attitudes and beliefs towards creative thinking: Chapter 5 annex tables

Table III.B1.5.1	Beliefs about the nature of creativity
Table III.B1.5.2	Beliefs about the nature of creativity, by student and school characteristics per item
Table III.B1.5.3	Beliefs about the nature of creativity and performance in creative thinking
Table III.B1.5.4	Growth mindset on creativity and intelligence
Table III.B1.5.5	Growth mindset on creativity and intelligence, by student and school characteristics per item
Table III.B1.5.6	Growth mindset on creativity and intelligence, and performance in creative thinking
Table III.B1.5.7	Index of creative self-efficacy
Table III.B1.5.8	Index of creative self-efficacy, by student and school characteristics
Table III.B1.5.9	Index of creative self-efficacy, by student and school characteristics per item
Table III.B1.5.10	Index of creative self-efficacy and performance in creative thinking
Table III.B1.5.11	Index of openness to intellect
Table III.B1.5.12	Index of openness to intellect, by student and school characteristics
Table III.B1.5.13	Index of openness to intellect, by student and school characteristics per item
Table III.B1.5.14	Index of openness to intellect and performance in creative thinking
Table III.B1.5.15	Index of openness to art and experience
Table III.B1.5.16	Index of openness to art and experience, by student and school characteristics
Table III.B1.5.17	Index of openness to art and experience, by student and school characteristics per item
Table III.B1.5.18	Index of openness to art and experience and performance in creative thinking
Table III.B1.5.19	Index of imagination and adventurousness
Table III.B1.5.20	Index of imagination and adventurousness, by student and school characteristics
Table III.B1.5.21	Index of imagination and adventurousness, by student and school characteristics per item
Table III.B1.5.22	Index of imagination and adventurousness and performance in creative thinking
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Table III.B1.5.24	Index of persistence, by student and school characteristics
Table III.B1.5.25	Index of persistence, by student and school characteristics, per item
Table III.B1.5.26	Index of persistence and performance in creative thinking
Table III.B1.5.27	Index of cooperation
Table III.B1.5.28	Index of cooperation and performance in creative thinking
Table III.B1.5.29	Index of curiosity
Table III.B1.5.30	Index of curiosity, by student and school characteristics
Table III.B1.5.31	Index of curiosity, by student and school characteristics, per item
Table III.B1.5.32	Index of curiosity and performance in creative thinking
Table III.B1.5.33	Students' attitudes towards others and perspective taking
Table III.B1.5.34	Students' attitudes towards others and perspective taking, by student and school characteristics, per item
Table III.B1.5.35	Perspective taking and performance in creative thinking
Table III.B1.5.36	Index of assertiveness
Table III.B1.5.37	Index of assertiveness and performance in creative thinking
Table III.B1.5.38	Index of stress resistance
Table III.B1.5.39	Index of stress resistance and performance in creative thinking
Table III.B1.5.40	Index of emotional control
Table III.B1.5.41	Index of emotional control and performance in creative thinking

Table III.B1.5.42	Correlation between indices supporting creative thinking, by country
Table III.B1.5.43	Student expectations about the end of education
Table III.B1.5.44	Creative thinking performance per expected end of education
Table III.B1.5.45	expected end of education and performance in creative thinking
Table III.B1.5.46	Change in creative thinking performance across expected ends of education
Table III.B1.5.47	Job expectations in the cultural and creative sectors
Table III.B1.5.48	Job expectations in the cultural and creative sectors, by student and school characteristics
Table III.B1.5.49	Job expectations in the cultural and creative sectors and creative thinking performance
Table III.B1.5.50	Students with at least one parent who works a job in the cultural and creative sectors
Table III.B1.5.51	Parent working a job in the cultural and creative sectors and creative thinking performance
Table III.B1.5.52	Job expectations at a high skill level
Table III.B1.5.53	Job expectations at a high skill level, by student and school characteristics
Table III.B1.5.54	Job expectations at a high shill level and creative thinking performance
Table III.B1.5.55	Parents' beliefs about creativity
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Table III.B1.5.59	Parents' openness to intellect, by parent, student and school characteristics
Table III.B1.5.60	Parents' openness to intellect, by parent, student and school characteristics, per item
Table III.B1.5.61	Parents' openness to intellect, and their child's performance in creative thinking
Table III.B1.5.62	Parents' perception of their child's openness to intellect
Table III.B1.5.63	Parents' perception of their child's openness to intellect, by parent, student and school characteristics
Table III.B1.5.64	Parents' perception of their child's openness to intellect, by parent, student and school characteristics, per item
Table III.B1.5.65	Parents' perception of their child's openness to intellect, and their child's performance in creative thinking

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Table III.B1.5. School environment and creative thinking: Chapter 6 annex tables

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Table III.B1.6.2	Index of student participation in creative activities outside of school
Table III.B1.6.3	Index of pedagogies encouraging creative thinking
Table III.B1.6.4	Use of digital resources for leisure and learning
Table III.B1.6.5	Creative thinking performance by response categories of participation in art classes/activities (e.g. painting, drawing) in school
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Table III.B1.6.8	Creative thinking performance by response categories of participation in the debate <club> in school
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Table III.B1.6.12	Creative thinking performance by response categories of participation in computer programming classes/activities in school
Table III.B1.6.13	Creative thinking performance and use of digital resources for learning activities at school
Table III.B1.6.14	Creative thinking performance and use of digital resources for learning activities before and after school
Table III.B1.6.15	Creative thinking performance and use of digital resources for learning activities on weekends
Table III.B1.6.16	Creative thinking performance and use of digital resources for leisure at school
Table III.B1.6.17	Creative thinking performance and use of digital resources for leisure before and after school
Table III.B1.6.18	Creative thinking performance and use of digital resources for leisure on weekends
Table III.B1.6.19	Index of student participation in creative activities inside of school, by student and school characteristics
Table III.B1.6.20	Student participation in creative activities inside of school, by student and school characteristics and per item
Table III.B1.6.21	Index of student participation in creative activities outside of school, by student and school characteristics
Table III.B1.6.22	Index of pedagogies encouraging creative thinking, by student and school characteristics
Table III.B1.6.23	Student participation in creative activities outside of school, by student and school characteristics and per item

Table III.B1.6.24	Student perception of pedagogies encouraging creative thinking, by student and school characteristics and per item
Table III.B1.6.25	Use of digital resources for learning and leisure and performance in creative thinking
Table III.B1.6.26	Index of student participation in creative activities inside of school and performance in creative thinking
Table III.B1.6.27	Index of student participation in creative activities outside of school and performance in creative thinking
Table III.B1.6.28	Index of pedagogies encouraging creative thinking and performance in creative thinking
Table III.B1.6.29	Index of student participation in creative activities inside of school and index of creative self-efficacy
Table III.B1.6.30	Index of student participation in creative activities inside of school and openness to intellect
Table III.B1.6.31	Index of ICT availability outside school
Table III.B1.6.32	Index of use of ICT in enquiry-based learning activities
Table III.B1.6.33	Index of ICT activity during a week day for leisure
Table III.B1.6.34	Index of ICT activity during a weekend day for leisure
Table III.B1.6.35	Index of ICT availability outside school and performance in creative thinking
Table III.B1.6.36	Index of use of ICT in enquiry-based learning activities and performance in creative thinking
Table III.B1.6.37	Index of ICT activity during a week day for leisure and performance in creative thinking
Table III.B1.6.38	Index of ICT activity during a weekend day for leisure and performance in creative thinking
Table III.B1.6.39	Availability of general activities at school
Table III.B1.6.40	Index of creative activities offered to students
Table III.B1.6.41	Index of school principal perception of pedagogies encouraging creative thinking
Table III.B1.6.42	Index of school principals' beliefs about creativity
Table III.B1.6.43	Index of school openness to creativity
Table III.B1.6.44	Frequency of assessment practices
Table III.B1.6.45	Availability of general activities at school, by school characteristics and per item
Table III.B1.6.46	School activities offered to students, by school characteristics and per item
Table III.B1.6.47	Index of school principal perception of pedagogies encouraging creative thinking, by school characteristics
Table III.B1.6.48	Index of school openness to creativity, by school characteristics
Table III.B1.6.49	Index of beliefs about creativity, by school characteristics
Table III.B1.6.50	School principal perception of pedagogies encouraging creative thinking, by school characteristics and per item
Table III.B1.6.51	Beliefs about creativity, by school characteristics and per item
Table III.B1.6.52	Index of school openness to creativity, by school characteristics and per item
Table III.B1.6.53	Frequency of assessment practices, by school characteristics and per item
Table III.B1.6.54	Index of school principal perception of pedagogies encouraging creative thinking and performance in creative thinking
Table III.B1.6.55	Index of beliefs about creativity and performance in creative thinking
Table III.B1.6.56	Index of school openness and performance in creative thinking
Table III.B1.6.57	Frequency of assessment and performance in creative thinking
Table III.B1.6.58	Index of teachers' attitudes about creativity
Table III.B1.6.59	Index of teachers' openness to intellect and art
Table III.B1.6.60	Index of teachers' beliefs about the importance of developing student creativity
Table III.B1.6.61	Index of teachers' use of pedagogies encouraging creative thinking
Table III.B1.6.62	Index of teacher autonomy
Table III.B1.6.63	Teachers' beliefs about creativity, by gender and share of students from socioeconomically disadvantaged homes per item
Table III.B1.6.64	Index of teachers' openness to intellect and creativity, by gender and share of students from socioeconomically disadvantaged homes per item
Table III.B1.6.65	Index of teachers' openness to intellect, by gender and share of students from socioeconomically disadvantaged homes per item
Table III.B1.6.66	Index of teachers' beliefs about the importance of developing student creativity, by gender and share of students from socioeconomically disadvantaged homes per item
Table III.B1.6.67	Index of teachers' beliefs about the importance of developing student creativity, by gender and share of students from socioeconomically disadvantaged homes per item
Table III.B1.6.68	Index of teachers' use of creative pedagogies, by gender and share of students from socioeconomically disadvantaged homes
Table III.B1.6.69	Index of teachers' use of creative pedagogies, by gender and share of students from socioeconomically disadvantaged homes
Table III.B1.6.70	Creative thinking performance per time spent playing video games during weekdays
Table III.B1.6.71	Creative thinking performance per time spent browsing social networks during weekdays
Table III.B1.6.72	Creative thinking performance per time spent browsing the Internet for fun during weekdays

Table III.B1.6.73	Creative thinking performance per time spent looking for practical information online during weekdays
Table III.B1.6.74	Creative thinking performance per time spent communicating and sharing digital content on social networks during weekdays
Table III.B1.6.75	Creative thinking performance per time spent reading, listening to or viewing informational materials to learn how to do something during weekdays
Table III.B1.6.76	Creative thinking performance per time spent creating or editing digital content during weekdays
Table III.B1.6.77	Creative thinking performance per time spent playing video games on weekends
Table III.B1.6.78	Creative thinking performance per time spent browsing social networks on weekends
Table III.B1.6.79	Creative thinking performance per time spent browsing the Internet for fun on weekends
Table III.B1.6.80	Creative thinking performance per time spent looking for practical information online on weekends
Table III.B1.6.81	Creative thinking performance per time spent communicating and sharing digital content on social networks on weekends
Table III.B1.6.82	Creative thinking performance per time spent reading, listening to or viewing informational materials to learn how to do something on weekends
Table III.B1.6.83	Creative thinking performance per time spent creating or editing digital content on weekends
Table III.B1.6.84	Pedagogies encouraging creative thinking and item difficulty
Table III.B1.6.85	Creative activities at school and item difficulty

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Annex B2. Results for regions within countries

The following tables are available in electronic form only. Please click on the StatLink after each table to access them.

Table III.B2.1. Creative thinking performance results for regions within countries

Table III.B2.1	Mean score and variation in creative thinking performance
Table III.B2.2	Percentage of students at each proficiency level in creative thinking
Table III.B2.3	Creative thinking performance, by gender
Table III.B2.4	Percentage of students at each proficiency level in creative thinking, by gender
Table III.B2.5	Student socio-economic status and performance in creative thinking
Table III.B2.6	Creative thinking performance, by immigrant background
Table III.B2.7	Percentage of students at each proficiency level in creative thinking, by immigrant background
Table III.B2.8	Performance in creative thinking across domain contexts
Table III.B2.9	Performance in creative thinking across ideation processes
Table III.B2.10	Beliefs about the nature of creativity
Table III.B2.11	Index of creative self-efficacy
Table III.B2.12	Index of curiosity
Table III.B2.13	Students' attitudes towards others and perspective taking
Table III.B2.14	Index of student participation in creative activities inside of school
Table III.B2.15	Index of student perception of creative pedagogies
Table III.B2.16	Index of ICT activity during a weekend day for leisure
Table III.B2.17	Availability of creative activities at school

StatLink https://stat.link/1n6x4z

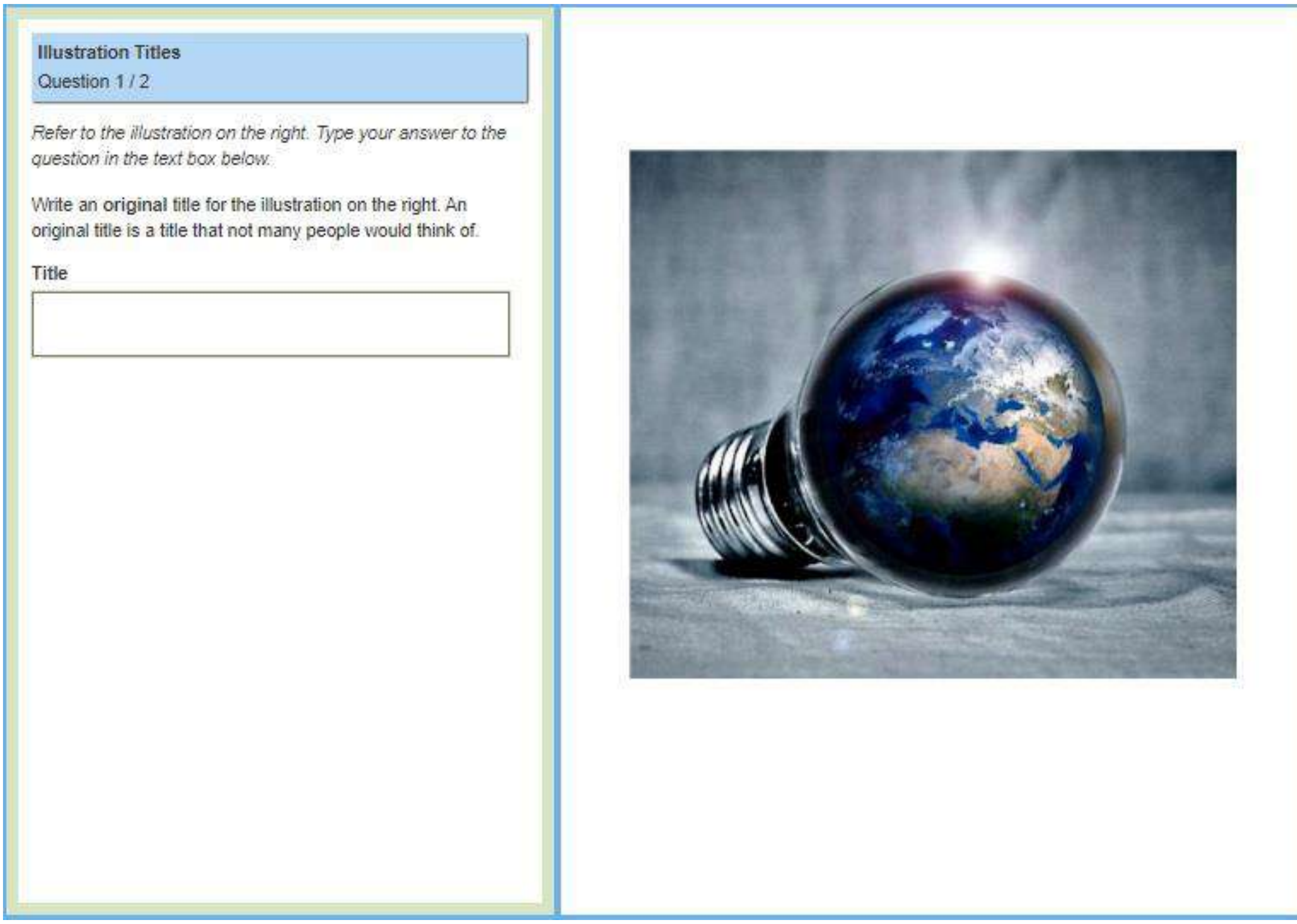
Annex C. Technical information for the released items from the PISA 2022 Creative Thinking assessment

Several creative thinking units and items were released from the main survey of the PISA 2022 assessment. Chapter 1 presents selected released items from 9 of the 18 units developed for the PISA 2022 Creative Thinking test, and in some cases, also presents example student responses at different credit levels (full, partial or none).

In this Annex, like in Chapter 1, screenshots of the interface used in PISA 2022 are shown to give readers an understanding of how students interacted with the assessment and its items. This Annex also summarises the technical information (item ID, ideation process, domain context, item format, item-specific coding criteria and proficiency level) for each of the released items described in Chapter 1. Interactive versions of all of these units are also available at www.oecd.org/pisa.

Unit T300: Illustration Titles

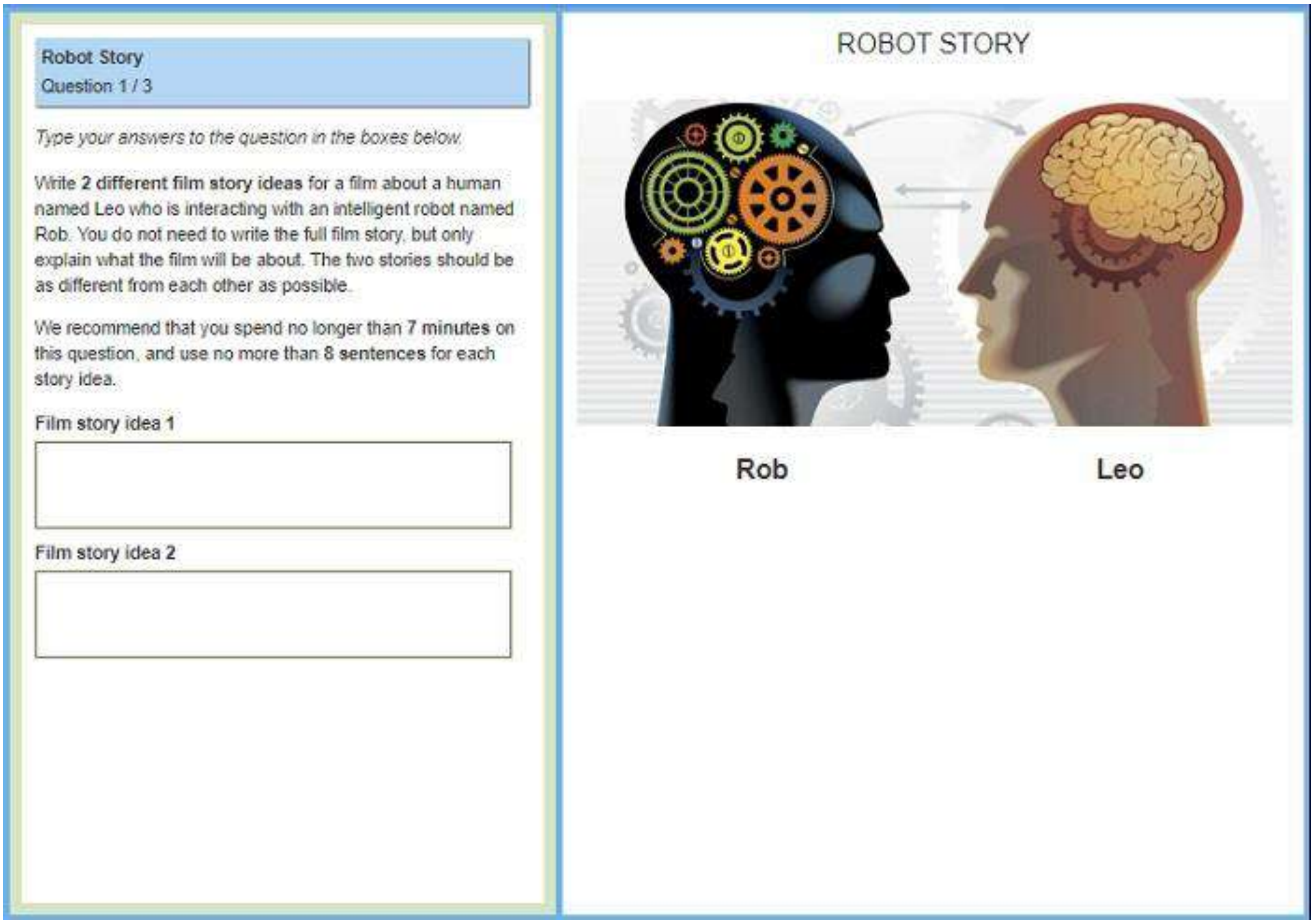
Illustration Titles: Released item #1 (DT300Q02)



Unit Name – Item #	Illustration Titles – DT300Q02
Domain context	Written expression
Ideation process	Generate diverse ideas
Item format	Constructed response - human scored
Coding criteria	In written expression tasks, differences in ideas are based on elements of the form requested, rather than on pre-defined categories. In this case, students are asked to provide their responses in the form of a title for a given illustration, and elements of this form are described in the coding guide. Appropriate titles (ideas that are on task and on topic) can be different in **two** ways: • based on **underlying focus** – each title makes clearly different associations to the stimulus, so the subjects of each are clearly different: OR • based on **method of implementation** – the titles have a similar underlying focus but implement linguistic or literary devices to change the representation of ideas. Linguistic or literary devices may include (but are not limited to): ○ some titles consist of a literal description of the image or its components, and other titles consist of abstract associations or figurative expressions; ○ each title reflects a different perspective or interpretation of the illustration as a whole, or of a component in the illustration; ○ the titles use punctuation, capitalisation, spelling or other grammatical elements to create distinct meanings.
Proficiency levels	4 (full credit) 1 (partial credit)

Unit T570: Robot Story

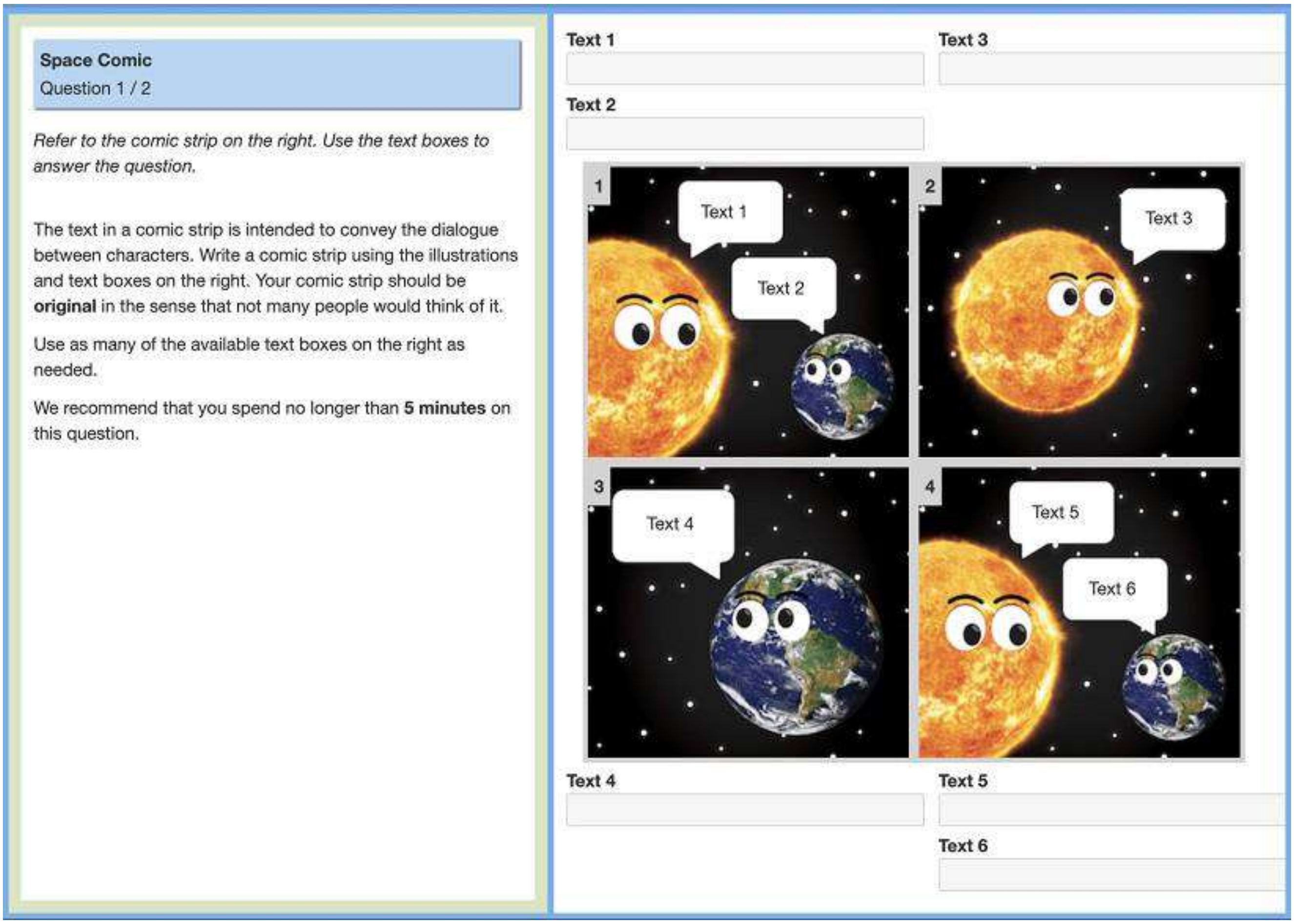
Robot Story: Released item #1 (DT570Q01)



Unit Name – Item #	Robot Story – DT570Q01
Domain context	Written expression
Ideation process	Generate diverse ideas
Item format	Constructed response - human scored
Coding criteria	In written expression tasks, differences in ideas are based on elements of the form requested, rather than on pre-defined categories. In this case, students are asked to provide their responses in the form of a story idea for a film, and elements of this form are described in the coding guide. Appropriate story ideas (ideas that are on task and on topic) can be different in **two** ways: • based on **underlying focus** – each story idea makes clearly different associations to the stimulus, so the subject of each plot is clearly different; OR • based on **method of implementation** – the story ideas convey similar plots but implement story elements to change the representation of ideas. Story elements may include (but are not limited to): ○ each story is conveyed from a different perspective, affecting how the plot is represented; ○ each story has a different setting that changes how the characters interact or the significance of objects or events; ○ each story conveys different relationships between characters, affecting how they interact or changing the significance of events; ○ the actions and/or choices of the characters in each story are different, causing the plots to unfold differently; ○ the attributes of the characters in each story are different, changing their motivations or the role they play in the story (e.g. background, abilities, personality).
Proficiency level	4 (full credit)

Unit T240: Space Comic

Space comic: Released item #1 (DT240Q01)



Unit Name – Item #	Space Comic – DT240Q01
Domain context	Written expression
Ideation process	Generate creative ideas
Item format	Constructed response - human scored
Coding criteria	The coding guide defines conventional themes for all items corresponding to the "generate creative ideas" ideation process. There are two conventional themes for this item: • **Conventional Theme 1:** Dialogue focusing on heat/temperature, weather, or seasons, but excluding discussions about environmental degradation or global warming; • **Conventional Theme 2:** Dialogue focusing on environmental degradation or global warming. Appropriate responses (on task and on topic) corresponding to a conventional theme were awarded partial credit unless combined with an innovative approach or implementation. Appropriate responses corresponding to an original theme (i.e. not one of the conventional themes) were awarded full credit.
Proficiency levels	5 (full credit) 2 (partial credit)

Unit T370: 2983

2983: Released item #1 (DT370Q01)

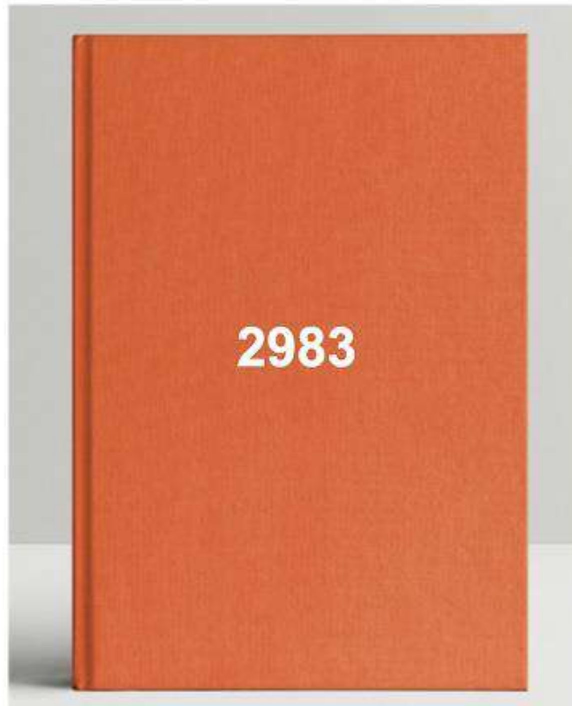
2983
Question 1 / 1

Refer to the book cover on the right. Type your answer to the question in the text box below.

Write an **original** story idea for the book with the cover on the right. An original story idea is a story idea that not many people would think of. You do not need to write the full story, but only describe what the book could be about.

We recommend that you spend no longer than **5 minutes** on this question, and use no more than **8 sentences**.

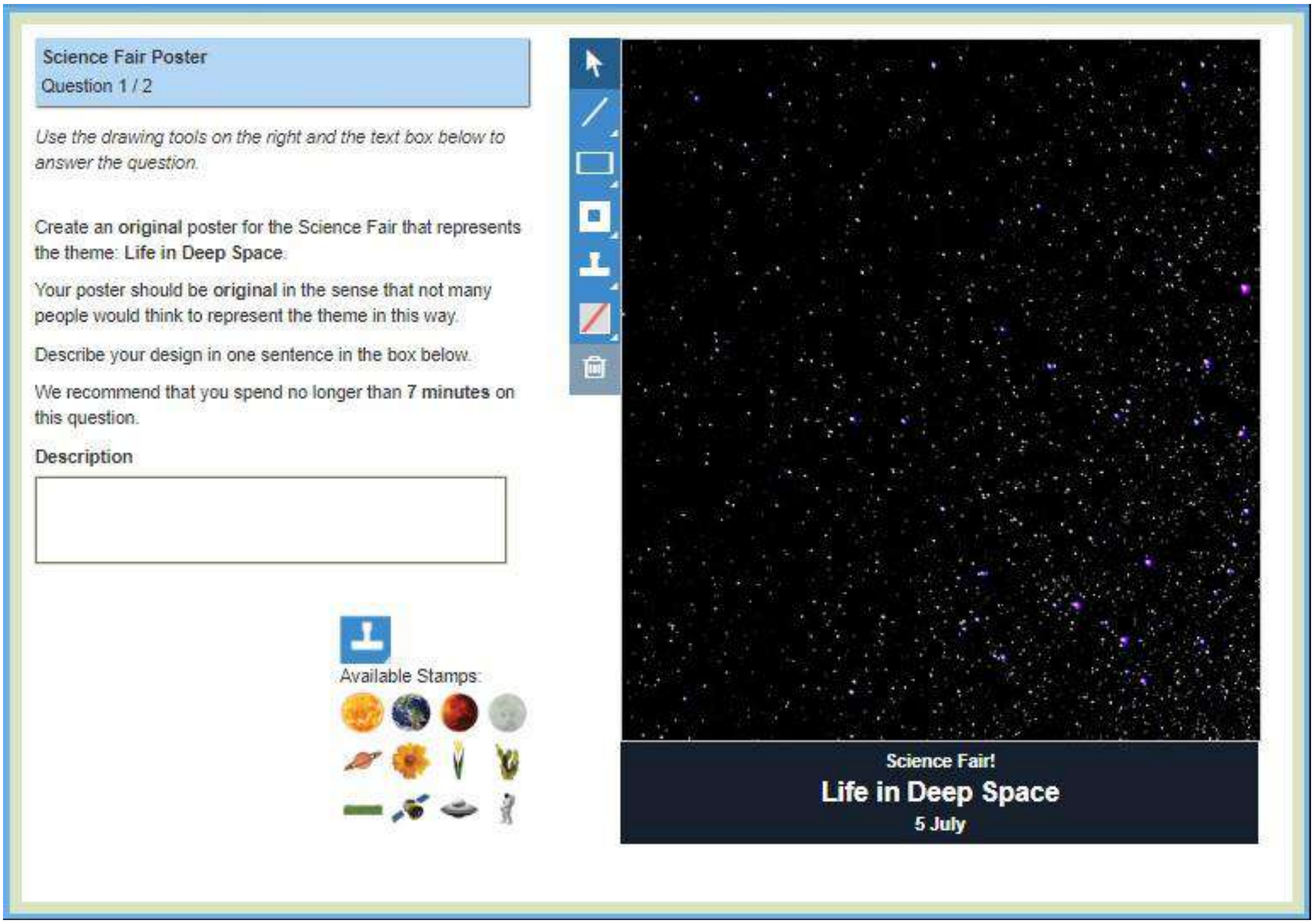
Story idea



Unit Name – Item #	**2983 – DT370Q01**
Domain context	Written expression
Ideation process	Generate creative ideas
Item format	Constructed response - human scored
Coding criteria	The coding guide defines conventional themes for all items corresponding to the “generate creative ideas” ideation process. There are two conventional themes for this item: • **Conventional Theme 1:** A positive or neutral account of what life is like for humans in the future (i.e. the year 2983); • **Conventional Theme 2:** The number as a designation or identification for a person, a place, or an object (such as an address, a serial number, model number, or other identification number). Appropriate responses (on task and on topic) corresponding to a conventional theme were awarded partial credit unless combined with an innovative approach or implementation. Appropriate responses corresponding to an original theme (i.e. not one of the conventional themes) were awarded full credit.
Proficiency levels	4 (full credit) 3 (partial credit)

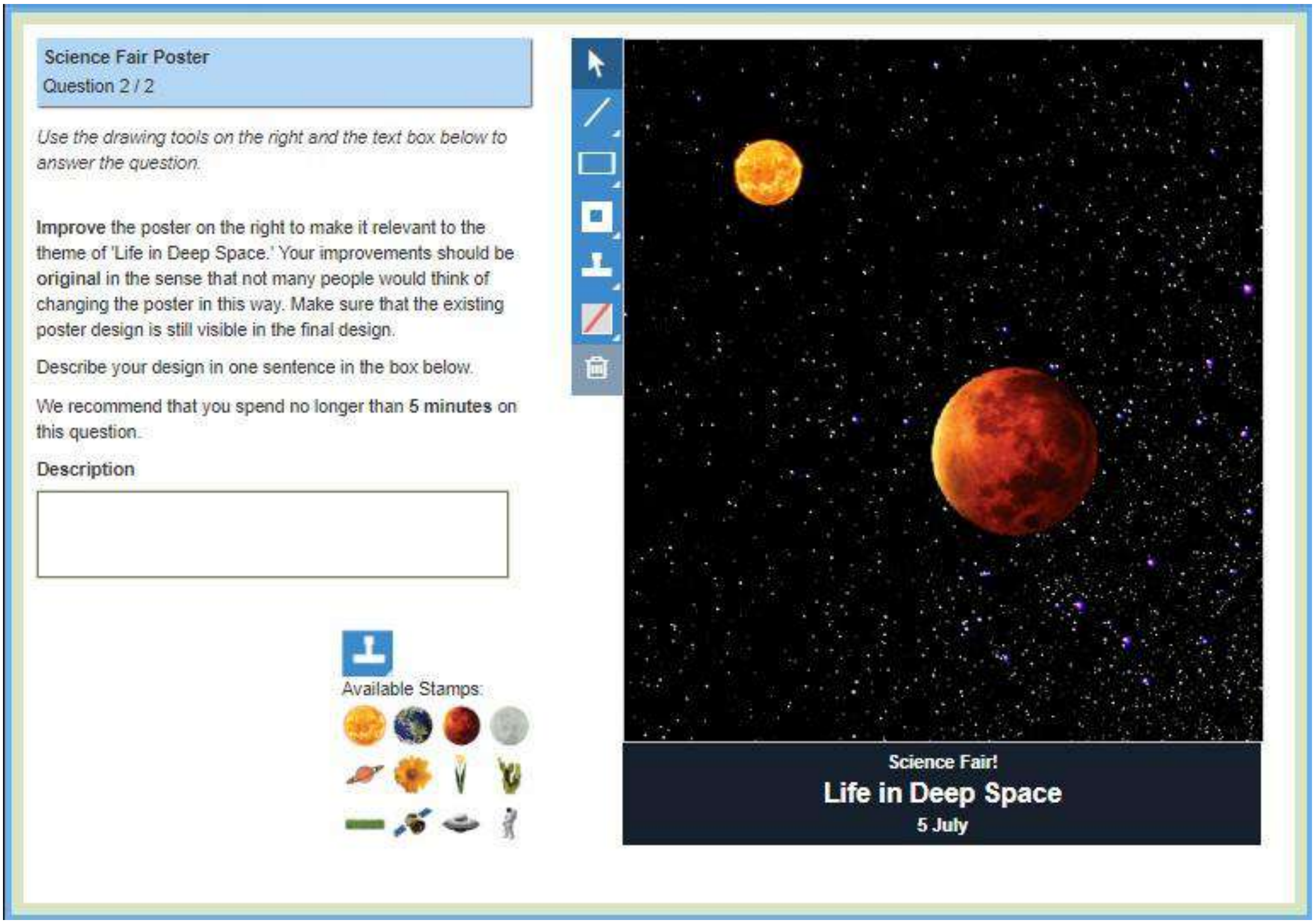
Unit T200: Science Fair Poster

Science Fair Poster: Released item #1 (DT200Q01)



Unit Name – Item #	Science Fair Poster – DT200Q01
Domain context	Visual expression
Ideation process	Generate creative ideas
Item format	Constructed response - human scored
Coding criteria	The coding guide defines conventional themes for all items corresponding to the “generate creative ideas” ideation process. There are two conventional themes for this item: • **Conventional Theme 1:** The Earth is the most dominant component used to represent life in space; • **Conventional Theme 2:** Components that convey exploration of space (such as astronaut(s), spacecraft, vehicles, or constructed satellites) are the most dominant representation of life in space. Appropriate responses (on task and on topic) corresponding to a conventional theme were awarded partial credit unless combined with an innovative approach or implementation. Appropriate responses corresponding to an original theme (i.e. not one of the conventional themes) were awarded full credit.
Proficiency levels	6 (full credit) 1 (partial credit)

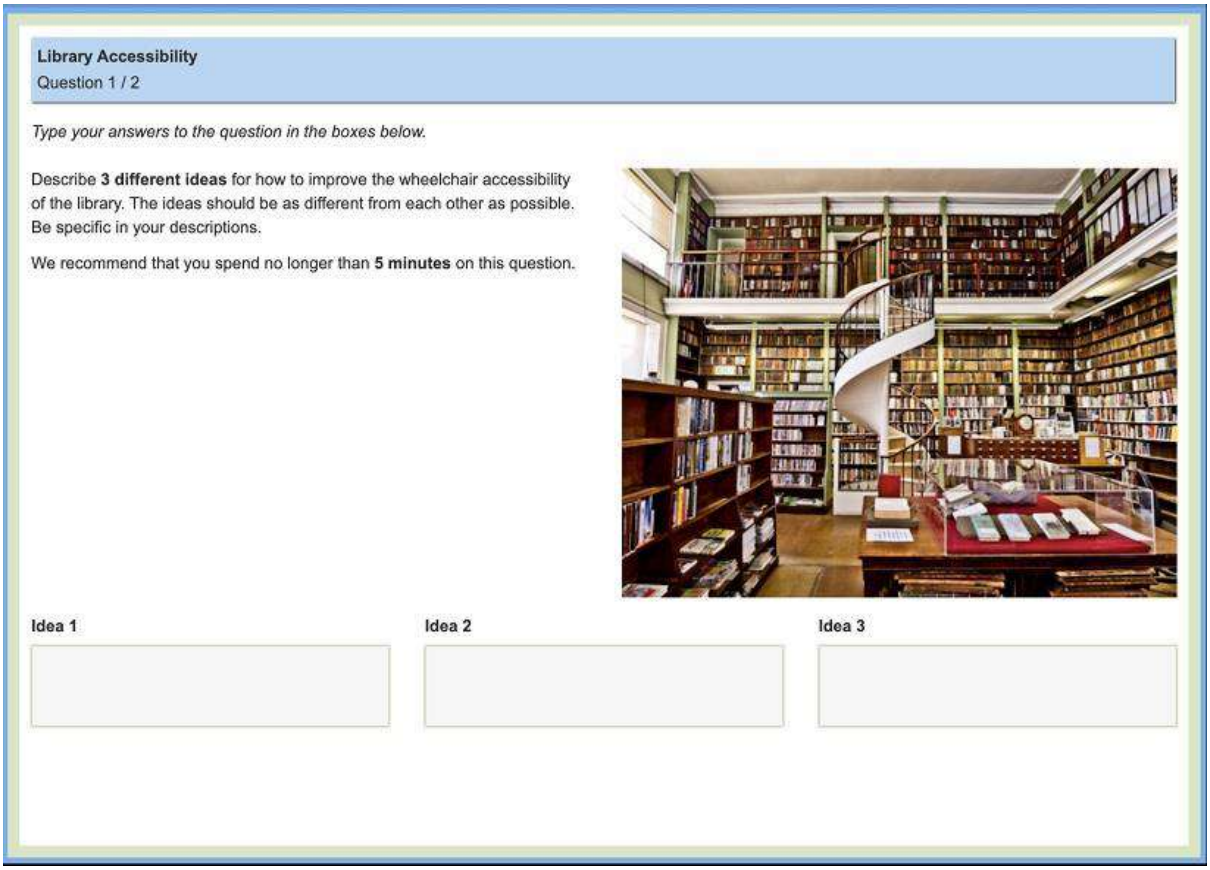
Science Fair Poster: Released item #2 (DT200Q02)



Unit Name – Item #	Science Fair Poster – DT200Q02
Domain context	Visual expression
Ideation process	Evaluate and improve ideas
Item format	Constructed response - human scored
Coding criteria	The coding guide defines conventional themes for all items corresponding to the "evaluate and improve ideas" ideation process. There are three conventional themes for this item: • **Conventional Theme 1:** The Earth is added to the poster to represent life in deep space; • **Conventional Theme 2:** Plants or flora are added to the poster to represent life in deep space; • **Conventional Theme 3:** Components that convey exploration of space (such as astronaut(s), spacecraft, vehicles, or constructed satellites) are added to the poster to represent life in space. Appropriate responses (on task and on topic) corresponding to a conventional theme were awarded partial credit unless combined with an innovative approach or implementation. Appropriate responses corresponding to an original theme (i.e. not one of the conventional themes) were awarded full credit.
Proficiency levels	6 (full credit) 1 (partial credit)

Unit T200: Library Accessibility

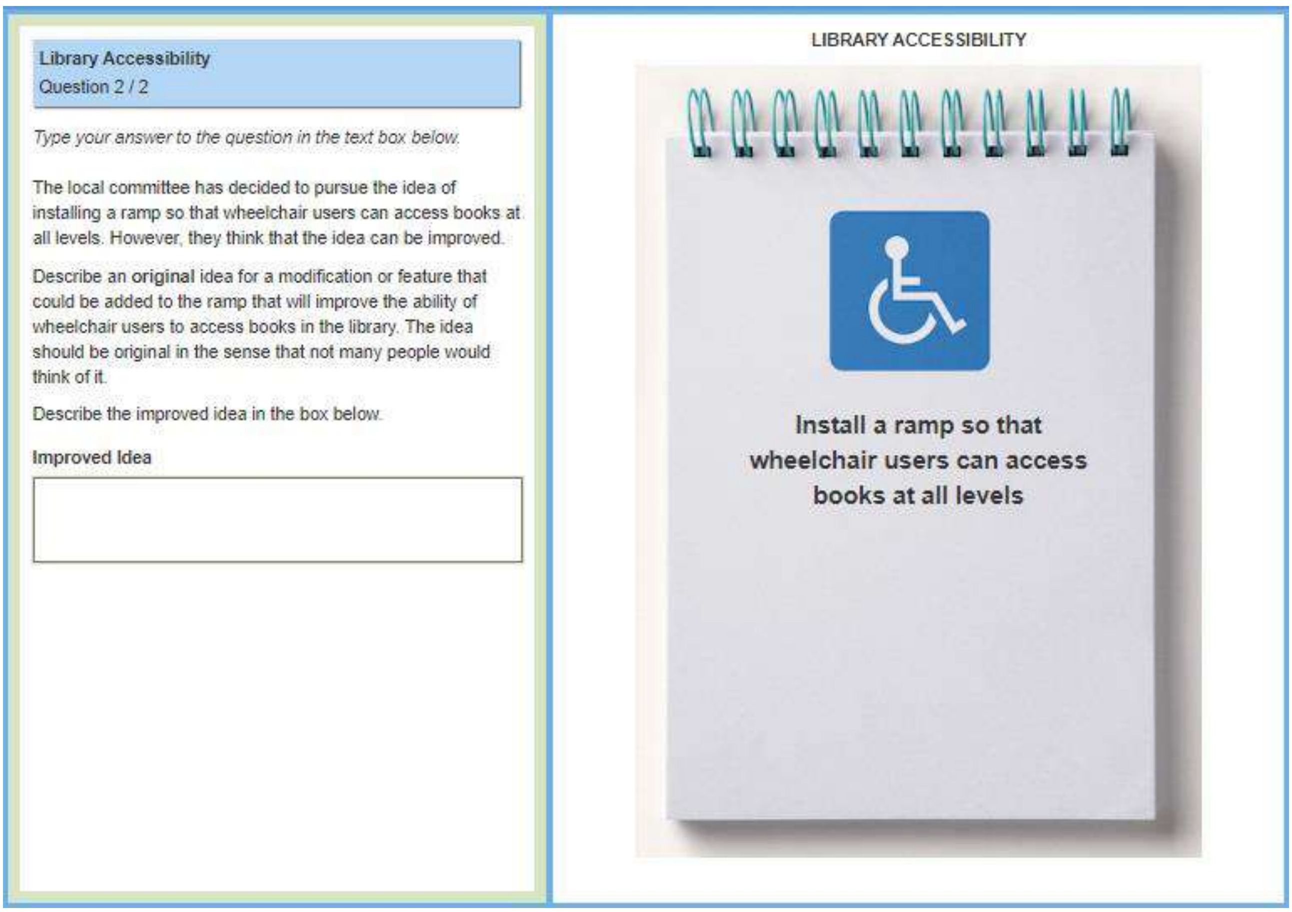
Library Accessibility: Released item #1 (DT500Q01)



Unit Name – Item #	Library Accessibility – DT500Q01
Domain context	Social problem solving
Ideation process	Generate diverse ideas
Item format	Constructed response - human scored
Coding criteria	In social problem-solving tasks, ideas can be different in **two** ways: • based on **underlying focus** – solutions in a response belong to different categories or to different sub-categories (such as, but not limited to, the list below); OR • based on **method of implementation** – the response introduces specifically different modes of implementing the same or similar solutions (such as by including distinct tools, strategies, people involved, etc.). Example categories and sub-categories for this item include the following: • **Category 1** – Physical modifications to the library ○ **Sub-category 1-1:** Adding ramps; ○ **Sub-category 1-2:** Modifying the staircase; ○ **Sub-category 1-3:** Adding an elevator; ○ **Sub-category 1-4:** Having only one floor; ○ **Sub-category 1-5:** Having lower shelves; ○ **Sub-category 1-6:** Having a special section for wheelchair users. • **Category 2** – Providing human assistance to wheelchair users (e.g. staff or volunteers deliver library materials or bring customers to the materials) ○ **Sub-category 2-1:** Hiring staff or adding volunteers to retrieve library materials for customers, and/or to deliver materials to customers (this excludes solutions unrelated to increasing access to the building, such as buying books online from retailers); ○ **Sub-category 2-2:** Hiring staff or adding volunteers to aid with taking customers to the materials.

	• **Category 3** – Providing technological assistance mechanisms (e.g. to aid with retrieving materials, guiding customers, or requesting deliveries) ○ **Sub-category 3-1:** To aid with retrieving out-of-reach materials for customers; ○ **Sub-category 3-2:** To aid with taking customers to the materials; ○ **Sub-category 3-3:** To request delivery of or access to library materials (this excludes solutions unrelated to increasing access to the library's building or the use of general solutions, such as "use e-readers").
Proficiency levels	4 (full credit) 2 (partial credit)

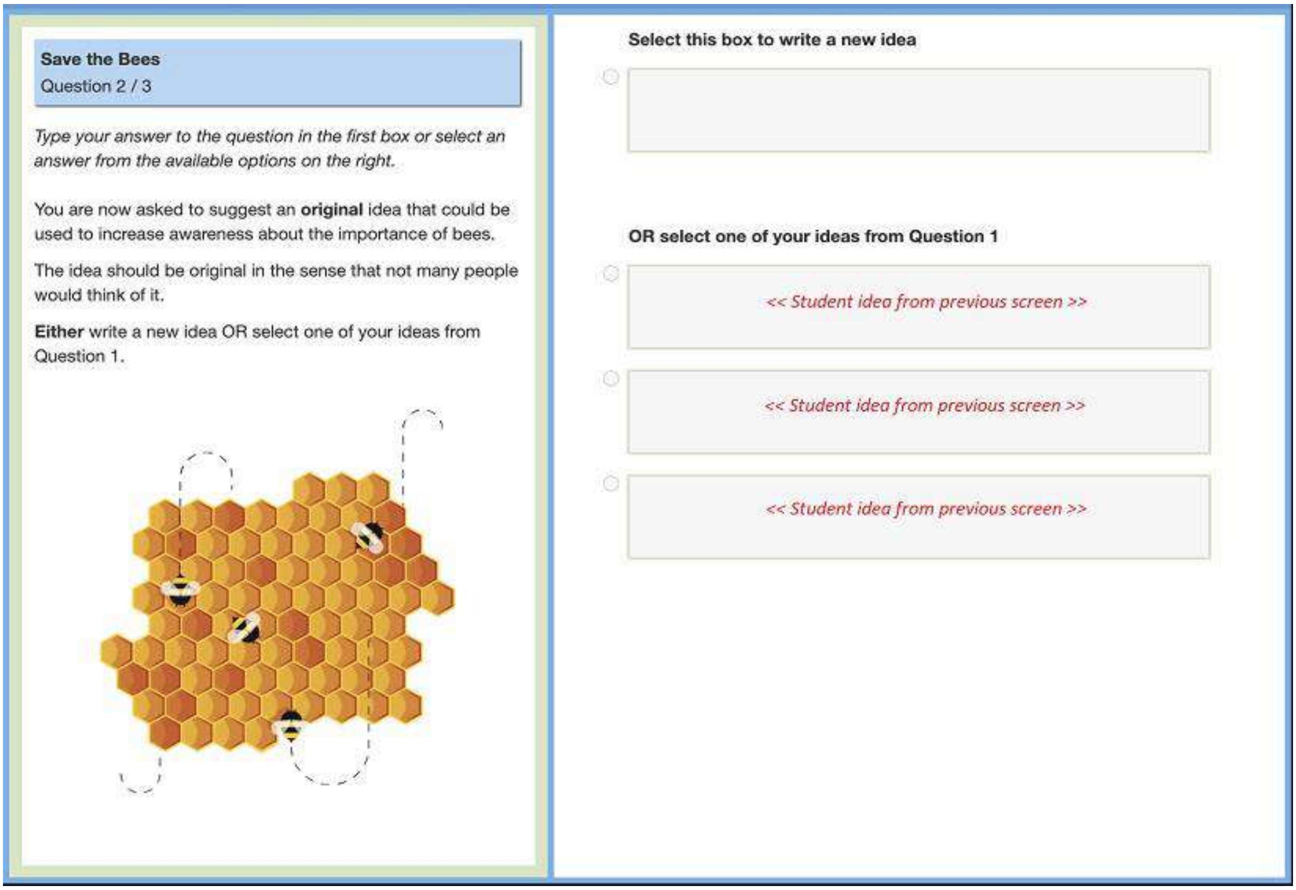
Library Accessibility – Released item #2 (DT500Q02)



Unit Name – Item #	**Library Accessibility – DT500Q02**
Domain context	Social problem solving
Ideation process	Evaluate and improve ideas
Item format	Constructed response - human scored
Coding criteria	The coding guide defines conventional themes for all items corresponding to the "evaluate and improve ideas" ideation process. There are two conventional themes for this item: • **Conventional Theme 1**: Automate the floor of the ramp to move customers in wheelchairs using a conveyor belt; • **Conventional Theme 2:** Automate the ramp in ways to move customers in wheelchairs (push and/or pull devices, ramps that move to different locations, etc.). Appropriate responses (on task and on topic) corresponding to a conventional theme were awarded partial credit unless combined with an innovative approach or implementation. Appropriate responses corresponding to an original theme (i.e. not one of the conventional themes) were awarded full credit.
Proficiency levels	6 (full credit) 5 (partial credit)

Unit T400: Save the Bees

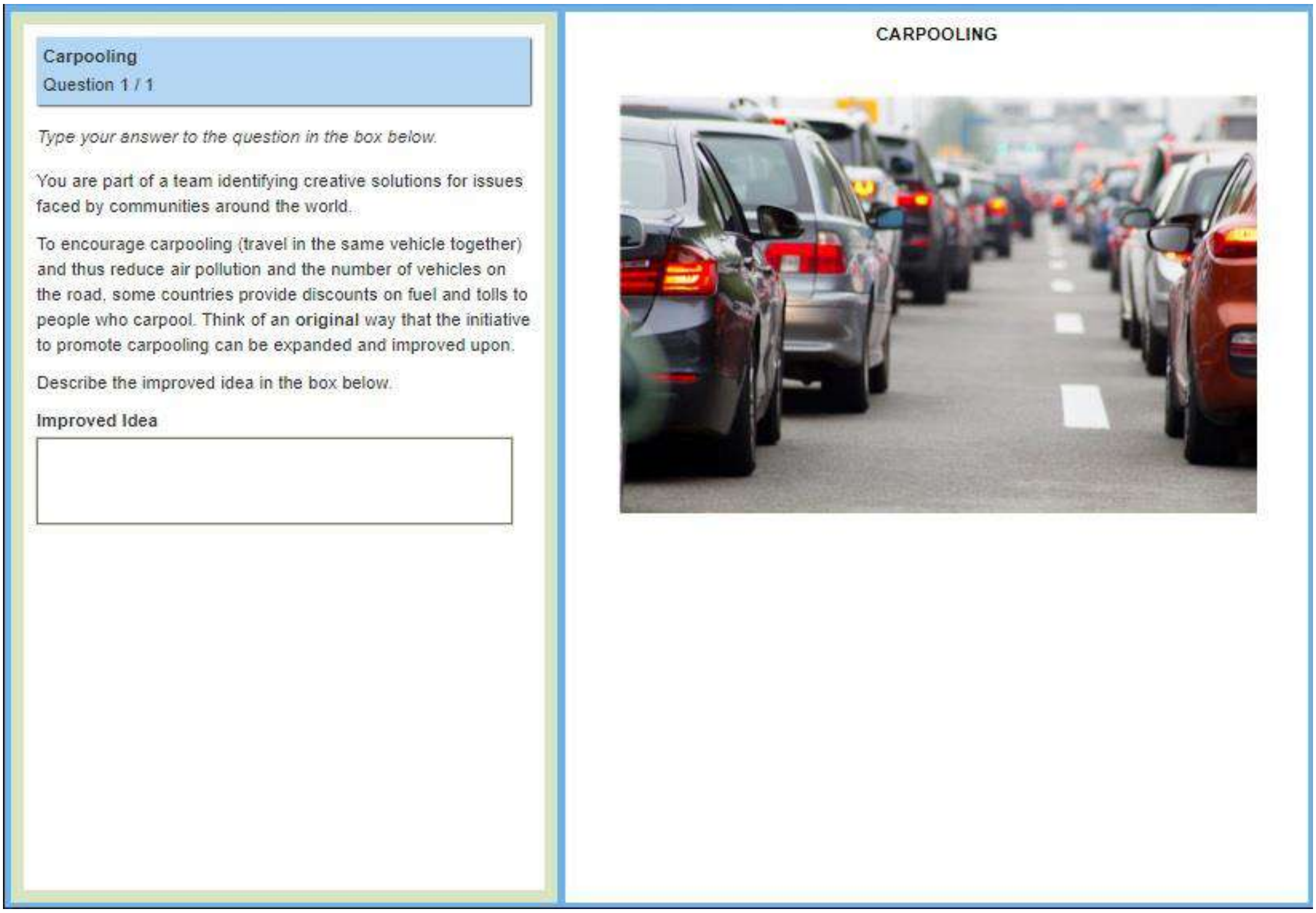
Save the Bees: Released item #1 (DT400Q02)



Unit Name – Item #	Save the Bees – DT400Q02
Domain context	Social problem solving
Ideation process	Generate creative ideas
Item format	Multiple choice based on previously constructed response, or constructed response - human scored
Coding criteria	The coding guide defines conventional themes for all items corresponding to the “generate creative ideas” ideation process. There are three conventional themes for this item: • **Conventional Theme 1:** Methods or content that club members may use to verbally communicate the importance of bees (this theme applies to solutions in which someone explains, tells, shares, etc.); • **Conventional Theme 2:** Create and/or present informative visuals (e.g. videos, posters or flyers); • **Conventional Theme 3:** Enable interaction with or the observation of live bees. Appropriate responses (on task and on topic) corresponding to a conventional theme were awarded partial credit unless combined with an innovative approach or implementation. Appropriate responses corresponding to an original theme (i.e. not one of the conventional themes) were awarded full credit.
Proficiency levels	5 (full credit) 4 (partial credit)

Unit T630: Carpooling

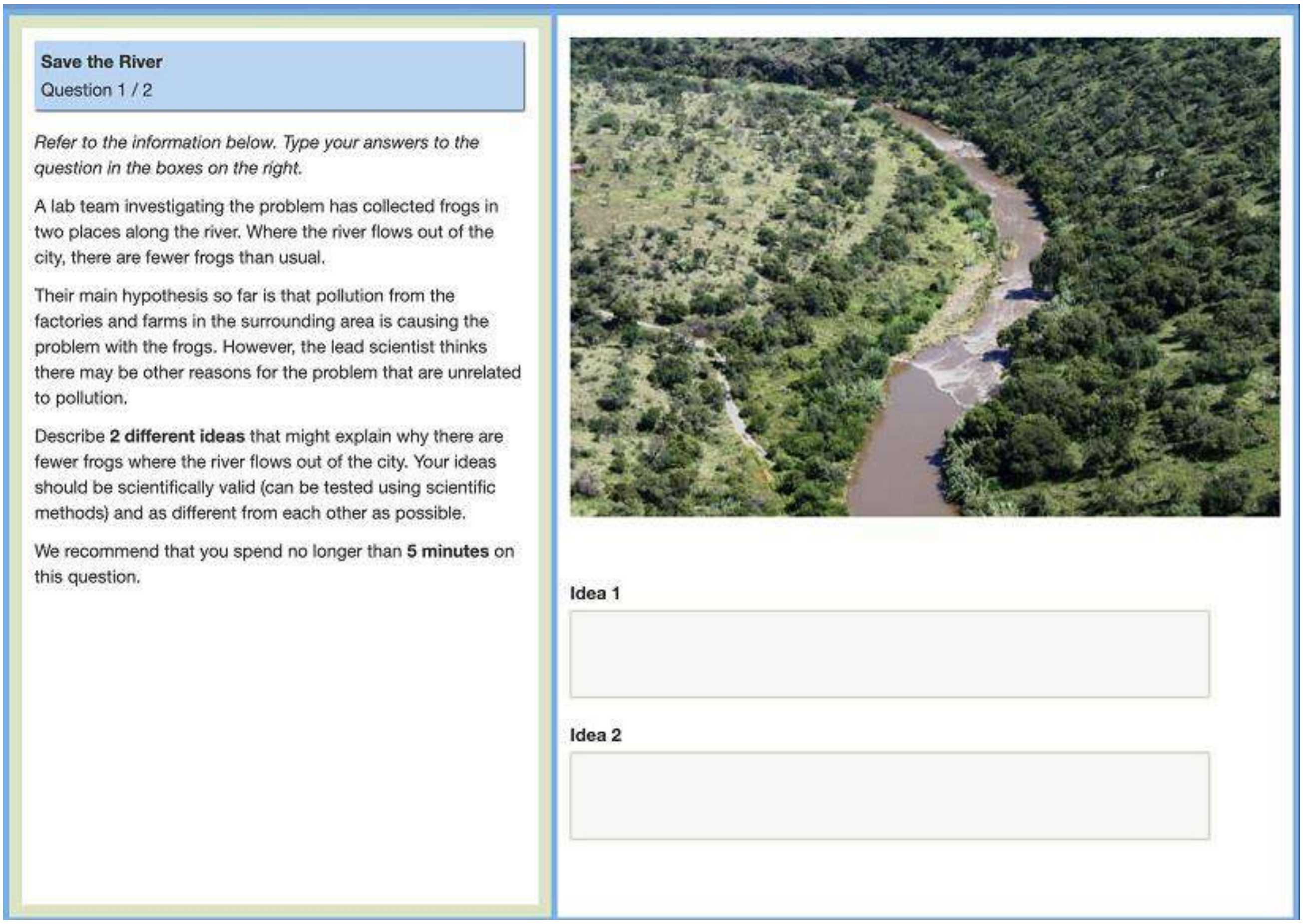
Carpooling: Released item #1 (DT630Q01)



Unit Name – Item #	Carpooling – DT630Q01
Domain context	Social problem solving
Ideation process	Evaluate and improve ideas
Item format	Constructed response - human scored
Coding criteria	The coding guide defines conventional themes for all items corresponding to the "Evaluate and Improve Ideas" ideation process. There is only one conventional theme for this item: • **Conventional Theme 1:** Establish additional financial incentives (e.g. rewards in the form of currency, OR discounts for services or items other than discounts on fuel and tolls); Appropriate responses (on task and on topic) corresponding to the conventional theme were awarded partial credit unless combined with an innovative approach or implementation. Appropriate responses corresponding to an original theme (i.e. not one of the conventional themes) were awarded full credit.
Proficiency levels	5 (full credit) 4 (partial credit)

Unit T690: Save the River

Save the River: Released item #1 (DT690Q01)



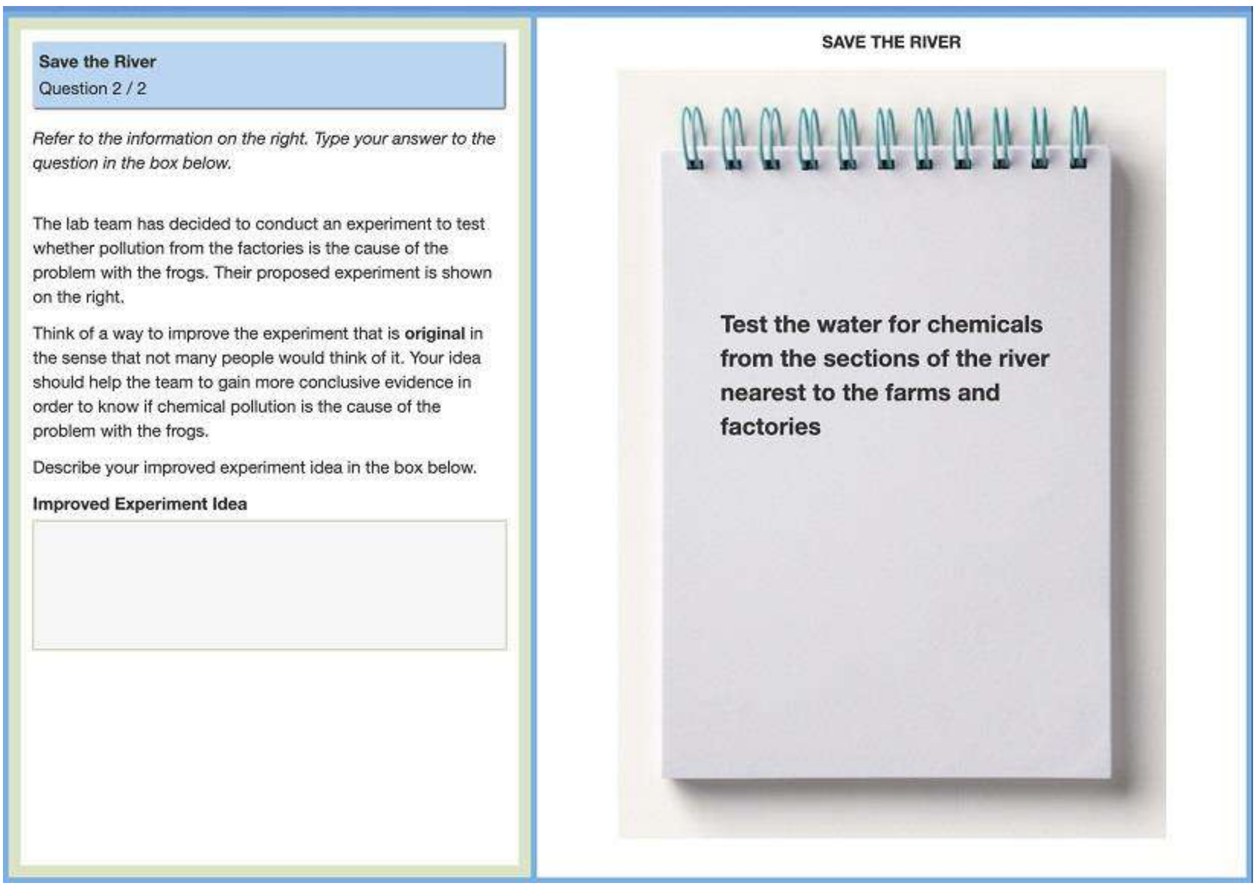
Unit Name – Item #	**Save the River – DT690Q01**
Domain context	Scientific problem solving
Ideation process	Generate diverse ideas
Item format	Constructed response - human scored

Coding criteria	In scientific problem solving, appropriate hypotheses can be different in **two** ways:
	• based on **underlying focus** – hypotheses in a response belong to different categories (or sub-categories) of reasons why the frog population has decreased (such as, but not limited to**,** the list in the table below); OR
	• based on **method of implementation** – hypotheses suggest specifically different effects to explain how the frog population has decreased due to the same underlying cause (for instance, the reason why there are fewer frogs could be the same, but the decrease may have happened because of either increased mortality or increased migration).
	Example categories and sub-categories for this item include the following:
	• **Category 1:** Changes to the water habitat
	  ○ **Sub-category 1-1:** Changes in water level;
	  ○ **Sub-category 1-2:** Changes in water temperature.
	• **Category 2:** Changes in surrounding fauna (non-human)
	  ○ **Sub-category 2-1:** New/additional predators;
	  ○ **Sub-category 2-2:** New/additional competitors for food.
	• **Category 3**: Changes to the local flora (e.g. a new invasive plant species, or absence of important flora)
	  ○ **Sub-category 3-1:** Changes to food availability;
	  ○ **Sub-category 3-2:** Changes in climate affecting local flora;
	  ○ **Sub-category 3-3:** Human interventions affecting local flora.

	• **Category 4:** Changes to the frogs themselves (e.g. infection, disease or mutation)
	  ○ **Sub-category 4-1:** Infection or disease;
	  ○ **Sub-category 4-2:** Mutation.
	• **Category 5:** Changes to the behaviour or activities of humans in the area (e.g. noise, ground vibrations, or humans capturing frogs)
	  ○ **Sub-category 5-1:** Change in noise;
	  ○ **Sub-category 5-2:** Excess ground vibrations;
	  ○ **Sub-category 5-3**: Capturing or removing frogs from the river.

Proficiency level	5 (full credit)

Save the River: Released item #2 (DT690Q02)



Unit Name – Item #	**Save the River – DT690Q02**
Domain context	Scientific problem solving
Ideation process	Evaluate and improve ideas
Item format	Constructed response - human scored
Coding criteria	The coding guide defines conventional themes for all items corresponding to the "evaluate and improve ideas" ideation process. There are three conventional themes for this item: • **Conventional Theme 1**: Test the water using a specific method to determine the presence of chemicals or pollution; • **Conventional Theme 2**: Test the frogs for the presence of chemicals in or on their bodies; • **Conventional Theme 3**: Introduce a control to the experiment so that results from affected samples can be compared to results where the pollution from factories and farms are not a variable (e.g. a control group of frogs unaffected by pollution from the farms and factories, or a control sample of unpolluted water unaffected by the farms and factories).
Proficiency levels	6 (full credit) 4 (partial credit)

Annex D. The development and implementation of PISA: A collaborative effort

PISA is a collaborative effort, bringing together experts from the participating countries, steered jointly by their governments based on shared, policy-driven interests.

A PISA Governing Board, on which each country is represented, determines the policy priorities for PISA, in the context of OECD objectives, and oversees adherence to these priorities during the implementation of the programme. This includes setting priorities for the development of indicators, for establishing the assessment instruments and for reporting the results.

Experts from participating countries also serve on working groups that are charged with linking policy objectives with the best internationally available technical expertise. By participating in these expert groups, countries ensure that the instruments are internationally valid and take into account the cultural and educational contexts in OECD Member and Partner countries and economies, that the assessment materials have strong measurement properties, and that the instruments place emphasis on authenticity and educational validity.

Through National Project Managers, participating countries and economies implement PISA at the national level subject to the agreed administration procedures. National Project Managers play a vital role in ensuring that the implementation of the survey is of high quality, and verify and evaluate the survey results, analyses, reports and publications.

The design and implementation of the surveys, within the framework established by the PISA Governing Board, is the responsibility of external contractors. For PISA 2022, the overall management of contractors and implementation was carried out Educational Testing Service (ETS) in the United States as the Core A contractor. Tasks under Core A also included the instrument development, development of the computer platform, survey operations and meetings, scaling, analysis and data products. These tasks were implemented in co-operation with the following subcontractors: i) the University of Luxembourg for support with test development, ii) the *Unité d'analyse des systèmes et des pratiques d'enseignement* (aSPe) at the University of Liège in Belgium for test development and coding training for open-constructed items, iii) the International Association for Evaluation of Educational Achievement (IEA) in the Netherlands for the data management software, iv) Westat in the United States for survey operations, and v) HallStat SPRL in Belgium for translation referee.

The remaining tasks related to the implementation of PISA 2022 were implemented through additional contractors – Cores B1, B2, B3, C, D and E to D. The Research Triangle Institute (RTI) in the United States facilitated the development of the mathematics assessment framework as the Core B1 contractor. ETS also facilitated the development of the background questionnaire frameworks as the Core B2 contractor. ACT/ACTNext in the United States Netherlands performed the test development for the innovative domain as the Core B3 contractor. Core C focused on sampling and was implemented by Westat in the United States in co-operation with the Australian Council for Educational Research (ACER). Core D was managed by cApStAn Linguistic Quality Control in Belgium for linguistic quality control in co-operation with BranTra in Belgium. Core E focused on country preparation and implementation support and was managed by the Australian Council for Educational Research (ACER) in Australia.

The OECD Secretariat has overall managerial responsibility for the programme, monitors its implementation daily, acts as the Secretariat for the PISA Governing Board, builds consensus among countries and serves as the interlocutor between the PISA Governing Board and the international Consortium charged with implementing the activities. The OECD Secretariat also produces the indicators and analyses and prepares the international reports and publications in co-operation with the PISA Consortium and in close consultation with Member and Partner countries and economies both at the policy level (PISA Governing Board) and at the level of implementation (National Project Managers).

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(*Former PGB representative who was involved in PISA 2022)

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United Kingdom: Ali Pareas, Keith Dryburgh, Lorna Bertrand*

United States: Peggy Carr

Observers (Partner economies)

Albania: Zamira Gjini

Argentina: Paula Viotti, Bárbara Briscioli*, María Angela Cortelezzi*, Elena Duro*

Azerbaijan: Elnur Aliyev, Narmina Huseynova*, Emin Amrullayev*

Brunei Darussalam: Shamsiah Zuraini Kanchanawati Tajuddin, Hj Azman Bin Ahmad*

Bulgaria: Neda Oscar Kristanova

Cambodia: Kreng Heng, Samith Put*

Chinese Taipei: Yuan-Chuan Cheng, Chung-Hsi Lin*, Tian-Ming Sheu*

Croatia: Marina Markuš Sandric, Ines Elezović*

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Guatemala: Marco Antonio Sáz Choxim, Luisa Fernanda Müller Durán*

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Indonesia: Anindito Aditomo, Totok Suprayitno*

Jamaica: Terry-Ann Thomas-Gayle

Jordan: Abdalla Yousef Awad Al-Ababneh

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Malta: Charles L. Mifsud

Republic of Moldova: Anatolie Topală

Mongolia: Oyunaa Purevdorj, Nyam-Ochir Tumur-Ochir*, Tumurkhuu Uuganbayar*

Montenegro: Miloš Trivic, Dragana Dmitrovic*

Morocco: Youssef El Azhari, Mohammed Sassi*

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Panama: Gina Garcés, Nadia De Leon*

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United Arab Emirates: Hessa Al Wahabi, Rabaa Alsumaiti*

Uruguay: Adriana Aristimuno, Andrés Peri*

Uzbekistan: Abduvali Abdumalikovich Ismailov, Radjiyev Ayubkhon Bakhtiyorkhonovich*

Viet Nam: Huynh Van Chuong, Le My Phong*, Sai Cong HONG*

PISA 2022 National Project Managers

(*Former PISA 2022 NPM)

OECD Members and PISA Associates

Australia: Lisa De Bortoli, Sue Thomson*

Austria: Birgit Lang, Bettina Toferer

Belgium: Inge De Meyer, Anne Matoul

Brazil: Clara Machado Da Silva Alarcão, Aline Mara Fernandes Muler, Katia Pedroza*, Wallace Nascimento Pinto Junior*

Canada: Vanja Elez, Kathryn O'Grady*, Tanya Scerbina*

Chile: Ema Lagos Campos

Colombia: Julie Paola Caro Osorio, Natalia González Gómez*

Costa Rica: Rudy Masís Siles, Giselle Cruz Maduro*

Czechia: Simona Boudova, Radek Blazek*

Denmark: Vibeke Tornhøj Christensen, Ása Hansen, Magnus Bjørn Sørensen*

Estonia: Gunda Tire

Finland: Arto Ahonen, Mari-Pauliina Vainikainen

France: Franck Salles, Irène Verlet*

Germany: Jennifer Diedrich-Rust, Doris Lewalter, Mirjam Weis, Kristina Reiss*

Greece: Chryssa Sofianopoulou

Hungary: Csaba Rózsa, Judit Szipocs-Krolopp, László Ostorics*

Iceland: Guðmundur Þorgrímsson

Ireland: Brenda Donohue

Israel: Georgette Hilu, Inbal Ron-Kaplan

Italy: Carlo Di Chiacchio, Laura Palmerio

Japan: Naoko Otsuka, Kentaro Sugiura*, Yu Kameoka*,

Korea: Seongkyeong Kim, Shinyoung Lee*, Inseon Choi*, Seongmin Cho*

Latvia: Rita Kiseļova

Lithuania: Rasa Jakubauske, Natalija Valaviciene*, Mindaugas Stundža*

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Netherlands: Joyce Gubbels, Martina Meelissen

New Zealand: Steven May, Emma Medina, Adam Jang-Jones*

Norway: Fredrik Jensen

Poland: Krzysztof Bulkowski, Joanna Kazmierczak

Portugal: Anabela Serrão

Slovak Republic: Júlia Miklovičová

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Sweden: Maria Axelsson

Switzerland: Andrea Erzinger

Thailand: Ekarin Achakunwisut

Türkiye: Umut Erkin Taş

United Kingdom: Grace Grima, David Thomas, Juliet Sizmur*

United States: Samantha Burg, Patrick Gonzales*

Observers (Partner economies)

Albania: Aurora Balliu, Rezana Vrapi*

Argentina: Maria Clara Radunsky, Paula Viotti*, Raul Volker*, Cecilia Beloqui*

Azerbaijan: Ulkar Zaidzada, Zinyat Amirova*, Leyla Abbasli*

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PISA 2022 Results (Volume III)

CREATIVE MINDS, CREATIVE SCHOOLS

The OECD Programme for International Student Assessment (PISA) examines what students around the world know and can do. This volume – Volume III, Creative Minds, Creative Schools – is one of five volumes presenting the results of the eighth round of the PISA assessment. For the first time, in 2022, PISA assessed students' capacity to engage in creative thinking in 64 countries and economies, defined as students' capacity to produce original and diverse ideas. This volume describes student performance in creative thinking in different contexts and how creative thinking performance and attitudes vary across and within countries and economies. It examines differences in performance by student characteristics, including gender and socio-economic status, as well as school-characteristics. The volume also offers an insight into school leader and teacher attitudes towards creative thinking, how opportunities for students to engage in creative thinking vary across schools, and how these factors are associated with student outcomes.

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