

CREATIVE MINDS IN ACTION

**Students' imagination and ideas in
storytelling, design and problem
solving tasks on the PISA test**



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1



Introduction

Why develop students' creativity?

Creativity lies at the heart of human progress and innovation (Puccio, 2017^[1]). Being able to generate, evaluate, and improve upon ideas is a key skill that has driven forward human culture and society, and will become more important in an ever-changing world. Indeed, creative thinking is consistently ranked amongst the most sought-after skill by employers (WEF, 2023^[2]) and, faced with a range of emerging challenges, organisations and societies alike require people to be adaptive and innovative (González-Pérez and Ramírez-Montoya, 2022^[3]; OECD, 2010^[4]).

Contrary to widespread beliefs, everyone has the potential to think creatively (Plucker, Beghetto and Dow, 2004^[5]). Creativity is not only about the arts but also demonstrated in thinking in new and original ways, in solving problems, and in achieving results in difficult situations (OECD, 2022^[6]). Creative thinking – the cognitive process that allows us to generate new ideas or solve problems in innovative ways – empowers individuals to overcome personal and professional obstacles (Szabo et al., 2020^[7]; Childs et al., 2022^[8]).

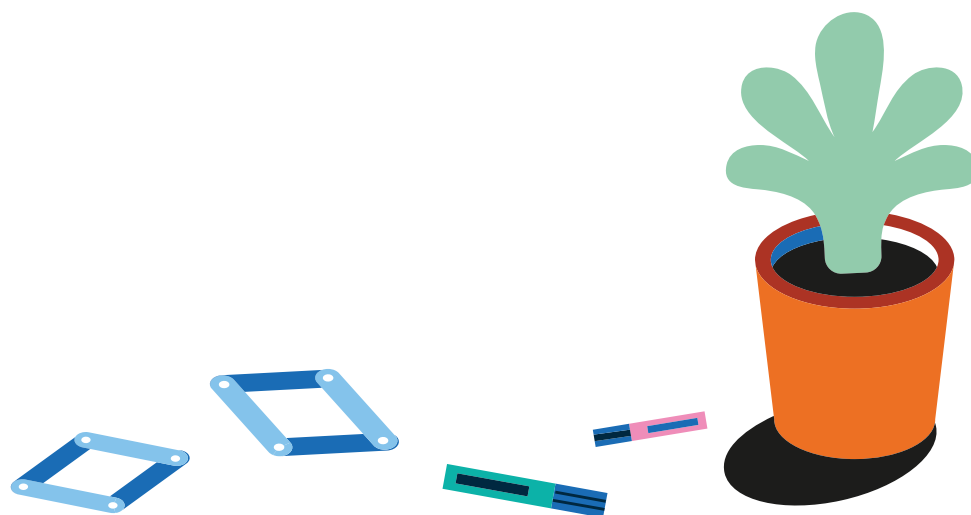
Creative thinking can and should be developed in education (Box 1). Research shows that teaching such skills in school enables students to transfer and apply them outside of educational settings, preparing them for life beyond the classroom (Szabo et al., 2020^[7]). Creative thinking can be nurtured through teaching methods that encourage exploration and discovery rather than relying on memorisation (OECD, 2023^[9]), but educators need support in recognising and promoting creativity in the classroom. With the right tools and approaches, schools can create environments where creativity thrives, preparing students for the challenges and opportunities of the future (Patston et al., 2021^[10]).

Recognising the importance of developing creativity in education, the Programme for International Student Assessment (PISA) included an assessment of creative thinking for the first time in its 2022 cycle (OECD, 2022^[6]). The results from the assessment were summarised in the *PISA 2022 Results (Volume III)* report, published in June 2024 (OECD, 2024^[11]).

Box 1. Why does creativity matter?

A fundamental role of education is to equip students with the competencies they need to succeed in life and society. Creative thinking is important to develop in education because it:

- Prepares students for the future: Students of today will face challenges and work in jobs that do not yet exist. Nurturing their creativity will help them develop the flexibility and problem-solving skills they will need to succeed.
- Helps students uncover their potential: Education plays a valuable role beyond preparing students for the labour market. Engaging students' creativity in education can help them to discover their individual talents and potential, furthering their personal development.
- Enhances learning: When students think creatively, they explore ideas in new and personal meaningful ways. This makes learning more engaging and effective, especially for students who may otherwise struggle with more traditional teaching methods.
- Supports all subject areas: Creativity is not limited to the visual arts but is also essential in subjects like science, technology and languages. It helps students to solve problems, think outside the box, engage their imagination and come up with original ideas in any field of study.



While that PISA report focused on comparing countries' performance on the test, as well as examining how creative thinking performance related to student and school factors, it did not focus on unpacking the different ways in which students around the world could think creatively nor on identifying the most creative responses. In this report, we take a deeper dive into the minds of students to unpack their creative potential and analyse the content of creative responses across countries and economies (see Box 2). In particular, we examine what kinds of creative ideas 15-year-old students around the world have and we explore how even the most underprivileged students are capable of thinking creatively.

Box 2. Identifying the most creative answers from the PISA data

In the PISA test, most responses to the items were awarded full credit, partial credit or no credit according to well-defined coding procedures (see Annex A1 of the PISA Results 2022 (Volume III) report) (OECD, 2024^[11]). In some cases, responses were awarded either full credit or no credit. The PISA scoring method focused on students' capacity to generate "sufficiently" original or different ideas, depending on the type of item, across a range of item contexts. While this scoring approach was developed to maximise cross-cultural comparability, it was not able to identify the most creative responses within each PISA participating country and economy. The PISA scoring approach also notably did not include any scoring criteria deemed more susceptible to subjective and cross-cultural rater bias, i.e. criteria related to the "value" of students' responses.

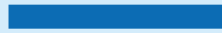
In this report, we identify some of the most creative responses from students in select countries and economies. To do this, the PISA Secretariat, in collaboration with researchers in 14 countries and economies that participated in the PISA creative thinking assessment, applied two alternative and more granular scoring approaches to a random sample of genuine student responses in the PISA test. These two alternative scoring approaches are described in detail in Annex 1, but can be summarised as follows:

- The Holistic Judgement method: Student responses were awarded a score of 1-7, considering all relevant elements of their response holistically to determine a final "creativity" score.
- The Criteria-Based method: Student responses were awarded separate scores for their appropriateness, originality, value, and (where appropriate) idea flexibility.

The OECD gratefully thanks researchers for their contributions to the rescoring effort (see Acknowledgements for a full list).



2



**What is creativity
and creative
thinking?**

Understanding creativity

Most people have an intuitive understanding of what creativity is, but how exactly it manifests in different contexts is a matter of debate. In general, creativity results from the interaction between a person, a process and its social environment to produce a discernible product (Plucker, Beghetto and Dow, 2004^[5]; Amabile, 1983^[12]).

Many theories of creativity acknowledge that both internal and external factors are important for reaching creative outcomes. Componential approaches emphasise the interaction between relevant skills and knowledge, cognitive processes, personality traits, motivation and the broader environment (Amabile and Pratt, 2016^[13]; Walia, 2019^[14]; Kaufman and Glăveanu, 2019^[15]). In other words, internal resources support an individual's creative potential, which may lead to creative outcomes in an enabling and recognising environment (Runco, 2003^[16]). While some of these internal resources may be more stable (e.g. personality traits), others are malleable by social and developmental influences (e.g. knowledge and skills, cognitive processes). In an educational context, the PISA creative thinking assessment framework identifies the internal and external factors that are important for enabling students to engage in creative work (OECD, 2023^[17]).

The literature on creativity generally distinguishes between “Big C” creativity and “little c” creativity. While the former refers to great works of art or technological and scientific breakthroughs, which are supported by significant expertise and a wider recognition of value from society, all people are capable of demonstrating “little c” creativity by engaging in creative thinking (Kaufman and Beghetto, 2009^[18]).

Creative thinking as the cognitive process supporting creative work

Creative thinking refers to the cognitive processes required to undertake creative work. Typically, research on the cognitive skills involved in creativity refers to both divergent and convergent thinking processes. Divergent thinking supports idea generation by enabling individuals to connect diverse pieces of information and adopt different points of view (Guilford, 1956^[19]; Reiter-Palmon, Forthmann and Barbot, 2019^[20]; Runco and Acar, 2012^[21]). Convergent thinking refers to the ability to apply logical and conventional reasoning to information (Zhang, Sjoerds and Hommel, 2020^[22]; Guilford, 1956^[19]), and it is crucial for problem-finding, identifying good ideas, and supporting idea generation through persistence (Nijstad et al., 2010^[23]; De Dreu, Baas and Nijstad, 2008^[24]). This process has also been referred to as convergent-integrative thinking, where several disparate ideas are brought together into a new synthesis (Lubart, Barbot and Besançon, 2019^[25]). Overall, both cognitive processes are essential in different stages of the creative process, and their relative importance may vary depending on the task at hand (Baer, 2016^[26]; Childs et al., 2022^[8]).

Creative thinking in PISA 2022

The PISA assessment focused on measuring creative thinking as it is a malleable individual capacity that can be developed through practice. The PISA 2022 assessment framework defines creative thinking as “the competence to engage productively in the generation, evaluation and improvement of ideas that can lead to original and effective solutions, advances in knowledge and powerful expressions of imagination” (OECD, 2023^[17]). The PISA test thus focuses on students’ capacity to generate and iterate upon ideas in different everyday contexts.

Understanding how creativity varies across subjects

Researchers in the field have long debated whether individuals are creative in everything they do or only in certain domains. The term ‘domain’ refers to a specific area of knowledge or practice. This domain-general vs. domain-specific debate naturally extends to creative thinking.

The first generation of creative thinking tests reflected a domain-general perspective – that a set of general and enduring attributes influence creative endeavours and that an individual’s capacity to be creative readily transfers across domains. Researchers now recognise that, to some extent, the internal resources that support creativity differ by domain and an individual’s capacity to produce creative work may thus differ across domain contexts (Baer, 2016^[26]; Miravete and Tricot, 2024^[27]; Baer, 2015^[28]). While agreement on the number of distinct domains of creativity remains an open question, researchers tend to agree that the capacity to engage creatively in the arts, on the one hand, and in mathematics and science on the other, draws upon a different set of internal resources, knowledge, skills, and attributes (Merseal et al., 2023^[29]; Evans and Jirout, 2023^[30]; van Broekhoven, Cropley and Seegers, 2020^[31]).

Domain specificity has important implications for education, both in terms of instruction and assessment. Different subject areas may emphasise diverse types of creative thinking and being able to think creatively may also depend on the extent to which students have acquired relevant knowledge, skills and experience in those areas. Given this, the PISA 2022 test measured students’ capacity to engage in creative thinking in four different domain contexts. Two contexts – written expression and visual expression – focused on students’ capacity to express their ideas creatively, whereas the other two contexts – social problem solving and scientific problem solving – focused on students’ capacity to apply creative thinking for a more functional purpose.





3



**Exploring creative
ideas in different
contexts**

Creative expression: communicating meaning and imagination to others

Expressing oneself through art and language is an inherent human experience, something all of us have done at some point in our lives (Pelowski, Leder and Tinio, 2017^[32]). Creative expression includes all forms of creative engagement where individuals communicate their thoughts, emotions, imagination and inner world to others. Being creative in expressive domains is deeply tied to imagination and storytelling (Zedelius, Mills and Schooler, 2018^[33]; Glaveanu et al., 2013^[34]). Both divergent and associative thinking processes support individuals to link different ideas with each other to create new ones, facilitating creativity in expressive tasks (Wang et al., 2023^[35]; Barbot et al., 2012^[36]).

One form of creative expression is through language. Language is inherently generative – meaning we use it to generate meaning and communicate ideas – which lends itself well to everyday expressions of creativity in both written and verbal forms (D'Souza, 2021^[37]). Both fictional and non-fictional writing for a variety of purposes can be creative, and learning how to express oneself creatively through language is important for helping students to develop effective and impactful communication skills that they will need throughout their lifetimes.

Good creative writing involves conveying information and ideas in imaginative or original ways that are clearly understood by others, including the rules of logic within the universe the author has created (D'Souza, 2021^[37]; Kandemirci et al., 2025^[38]). Empirical studies have found that both the density and conceptual distance of ideas in narrative writing influence the creative impact of written outputs (Runco et al., 2017^[39]; Johnson et al., 2022^[40]). Creative writing is also shaped by a wide set of literary elements such as characterisation, atmosphere, language, dialogue, setting, image and plot (Vaezi and Rezaei, 2018^[41]), as well as vocabulary use, although the latter needs to be balanced with achieving clarity and ease of interpretation (Taylor and Barbot, 2024^[42]; Kandemirci et al., 2025^[38]).

Visual expression involves exploring, experimenting with, communicating and embodying ideas using a range of media, materials and processes in addition to or instead of language. The visual arts enable learners to express themselves and process their experiences and emotions. As adolescents and adults, creative visual expression has arguably become more important in recent years with the ubiquity of desktop publishing and digital design software. Creativity in visual expression tasks may be viewed through intentionality, colour, form, composition and technique (Lindström, 2006^[43]), where the combination of these factors contribute to an overall aesthetic appeal (Mutter and Hübner, 2024^[44]; Stojilovic, 2017^[45]). In some contexts, such as product design, aesthetic considerations may also need to be balanced with other important criteria such as usefulness or functionality (Han, Forbes and Schaefer, 2021^[46]).



Fostering creative expression through education and practice

What students do and create in classrooms is important for developing their everyday or “little c” creative thinking skills (Kaufman and Beghetto, 2009^[18]). However, coming up with creative ideas in school requires time and space, as well as a supportive and collaborative classroom environment. Teachers can employ the following practices to foster students’ creative thinking in imaginative domains:

- **Exposure to creative work.** Being exposed to creative works can support students in their own creative endeavours. For example, students who read more tend to produce better written and more creative texts (Broekkamp, Janssen and Van den Bergh, 2009^[47]; Graham et al., 2017^[48]). Viewing art, including those of peers, allows students to gain inspiration on both form and technique as well as an appreciation of the overall creative process (Ishiguro and Okada, 2020^[49]; Millard and Marsh, 2001^[50]). Discussing visual arts in a classroom can strengthen students’ capacity to draw meaning from art, which has also been linked to more original writing in children (Barbot et al., 2013^[51]; Moeller et al., 2013^[52]).
- **Modelling peers, experts and teachers.** Students can especially improve their creative outputs when observing, understanding and modelling the creative process of others. For example, watching advanced students narrate the process of creating collages or poetry has been shown to help students improve their own creative works (Groenendijk et al., 2011^[53]). Experts understand the creative process and can provide unique insights into their creative strategies (Myhill, Cremin and Oliver, 2023^[54]; Hall and Thomson, 2017^[55]). When teachers practice writing and visual art themselves, they also gain a deeper understanding of the creative process and are thus able to adapt their pedagogy accordingly to convey creative strategies (Cremin et al., 2019^[56]; Sawyer, 2017^[57]). However, modelling should be adapted to students’ proficiency, as already advanced students might benefit more from it (Groenendijk et al., 2013^[58]).
- **Flexible and open-ended activities.** Allowing students to co-construct their learning gives them the opportunity to express themselves freely. Students learn to self-regulate by setting their own goals, defining their own aesthetic criteria for tasks, and persisting through failures or roadblocks (Sawyer, 2019^[59]; Greene, Freed and Sawyer, 2018^[60]). Practices like freewriting can promote individual expression without imposed time frames or structures, strengthening learners’ ownership, enjoyment and view of themselves as creators (Myhill, Cremin and Oliver, 2023^[54]). However, teachers remain crucial in providing guidance and feedback to students during such activities – especially for students who need more scaffolding or support.
- **Collaboration.** Establishing classrooms as “communities of practice” has also been shown to be beneficial for both writing and arts education (Myhill, Cremin and Oliver, 2023^[54]; Sawyer, 2017^[57]). Such communities of practice can foster ownership and can remove pressure from individuals who feel a need to always be correct. However, even when classrooms establish a judgement-free environment, some students may continue to feel pressure from comparison and competition (Cremin et al., 2019^[56]), meaning that teachers may need to reframe comparisons as sources of inspiration rather than signalling inferiority (Burleson, Leach and Harrington, 2005^[61]).
- **Opportunities to practice!** Practice really does make perfect. Students who practice elements of creative writing produce more creative works, strengthening their elaboration, verbal and vocabulary skills (Wang, 2012^[62]; Eser and Ayaz, 2021^[63]). In visual arts, repetition is also important for supporting students to learn various techniques and tools (Pelowski, Leder and Tinio, 2017^[32]). Project-based learning is a common approach that encourages students to get involved in creative work (Samaniego et al., 2024^[64]).

The challenge for teachers is to balance developing students' knowledge and skills that support domain readiness with supporting the underlying processes that support creative thinking (Sawyer, 2017^[57]). For example, while in narrative writing elements like voice, style and intent are considered more important for producing creative work, teachers tend to focus on more technical elements like grammar and spelling, which may lead students to prioritise avoiding errors rather than encouraging them to express their creativity (D'Souza, 2021^[37]).



Written expression in PISA 2022: What creative ideas do students have?

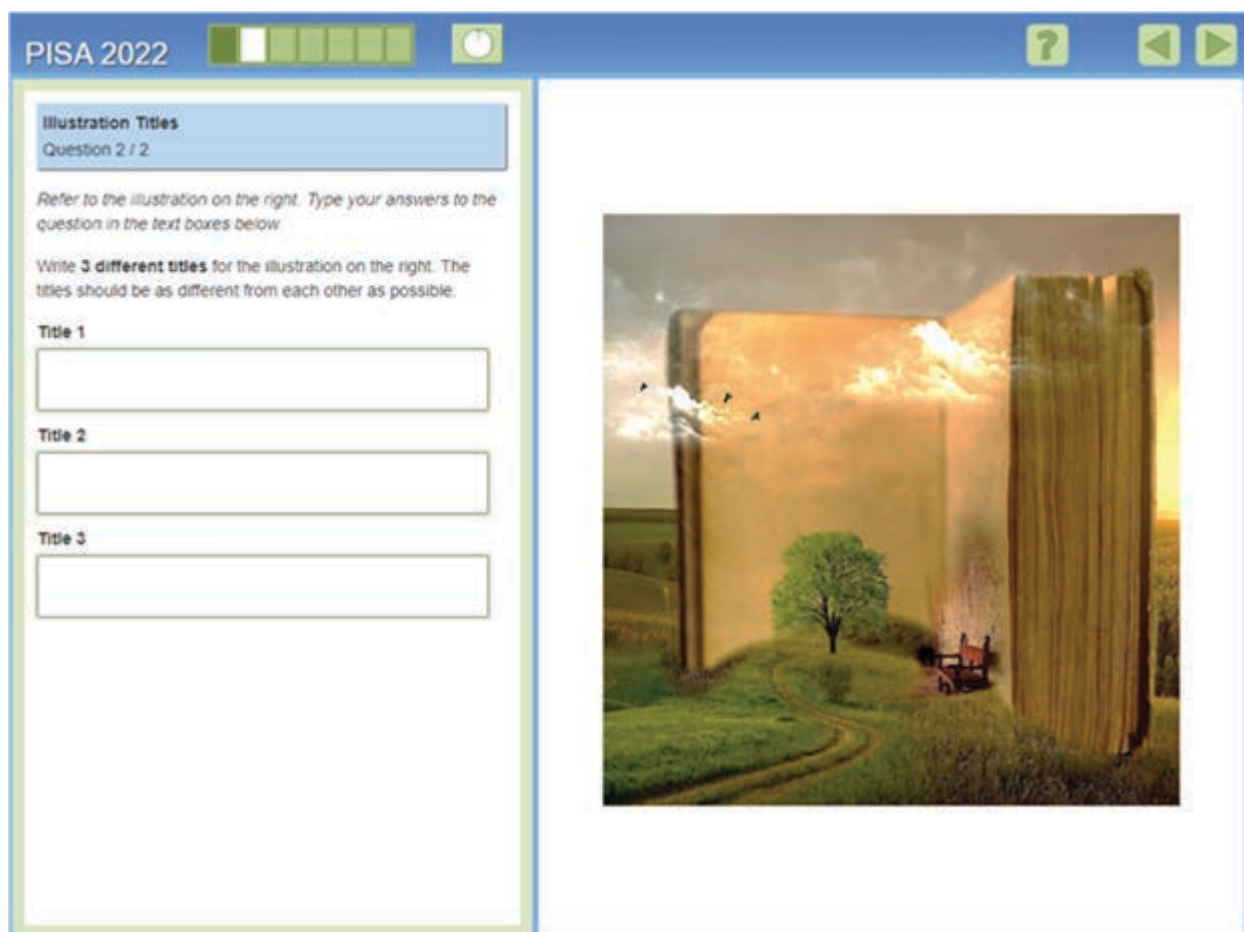
In the PISA 2022 creative thinking test, students were asked to express their imagination in a written format, responding to different stimuli. In general, students demonstrated a relative strength in creative expression tasks compared to other tasks on the PISA test (OECD, 2024_[11]). Overall, on average across the OECD, students were able to suggest original and diverse ideas for nearly half of all written expression tasks that they encountered.

But what kind of ideas were students around the world able to produce in these types of task, and which ideas were the most creative in different countries?

Example item 1. Illustration Titles

For the task Illustration Titles, students provided creative titles for an abstract illustration showing a book in a countryside landscape (Figure 1). Students were instructed to think of three original ideas that were as different as possible. Box 3 shows some of the most creative responses from students across select countries for this task.

Figure 1. Illustration Titles



PISA 2022

Illustration Titles
Question 2 / 2

Refer to the illustration on the right. Type your answers to the question in the text boxes below.

Write **3 different titles** for the illustration on the right. The titles should be as different from each other as possible.

Title 1

Title 2

Title 3

The illustration on the right shows a large, open book standing upright in a countryside landscape. The book's pages are visible, and the landscape features a winding path, a tree, and a small cart or carriage in the distance. The sky is filled with clouds, and the overall scene is surreal and imaginative.

Box 3. A selection of most creative responses across countries for the Illustration Titles item.

- **Promenade entre les pages** // *Strolling through the pages* (Belgium)
- **Colhemos o conhecimento** // *Harvesting knowledge* (Brazil)
- **momentos que no quedaron escritos** // *Moments that were never written* (Chile)
- **Pasar de pagina implica olvidar** // *Turning the page means forgetting* (Colombia)
- **Laissez-vous aller vers le chemin de la lecture...** // *Let yourself be drawn along the path of reading...* (France)
- **Λογοτεχνία: η άλλη πατρίδα του αναγνώστη** // *Literature: the reader's other home* (Greece)
- **Die Blätter altern aber nicht die Schrift** // *The leaves age but not the writing* (Germany)
- **A corner in someone else's eyes** (Hong Kong)
- **L'orizzonte non è un posto ma un punto di vista** // *The horizon is not a place but a point of view* (Italy)
- **현실의 기로에서 책은 답을 내어준다** // *At the crossroads of reality, the book gives the answer* (Korea)
- **O sagrado jardim dos leitores** // *The sacred garden of readers* (Portugal)
- **يُنْفِن لَهْ جِبْ يِقْبَن مِلْعَب** // *Through knowledge we endure, through ignorance we perish* (Saudi Arabia)
- **Kaj se skriva za platnicami človeštva** // *What lies behind the covers of humanity* (Slovenia)
- **يَقَاو رَادَج مِلْعَلَا** // *Knowledge is a protective shield* (Saudi Arabia)

Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.



What were common themes or features across creative responses?

Imagination was the key component that turned a generic title idea into a creative one. Yet – clearly – there is no single way to be creative in writing: how students expressed their imagination varied significantly across different countries and linguistic groups. What was shared amongst many creative answers was their ability to engage the reader in the world of the authors' imagination. Students used intrigue, adventure, humour, contemplation and more to create an emotional impact and convey their inner world to readers.

Students employed a variety of narrative and stylistic choices in their creative title ideas. The most common approach students adopted was to focus on one or more explicit elements within the stimulus picture and to add a unique characteristic or relationship to describe the element(s). Titles like “Le livre des souhaits” [*The book of wishes*], “A cadeira da morte” [*The chair of death*], “Die Bank der Fantasie” [*The bench of fantasy*], or “A trail in the Mystic Book” all reference explicit elements in the picture and allude to an intriguing property of those elements or some kind of adventure or journey. Some even reference the beginning of a story directly, like “Moments that were never written” or “En aquella página...” [*On that page...*].

Other creative answers relied on students' abstraction skills. Instead of referring to explicit elements in the picture, some students were able to connect the image to broader themes. For example, many students associated the book to topics like imagination, fiction, fairytales, writing or knowledge. Similarly, others connected the natural landscape to ideas of environmentalism, peace, solitude, or life in general, or connected the path to a broader sense of journeying. Taking a step further, students often suggested creative title ideas with a proverbial meaning. Often, these proverbs offered some wisdom, like “L'orizzonte non è un posto ma un punto di vista” [*The horizon is not a place but a point of view*], “يَنْفَن لَهْ جَبْ يَقْبَن مْلَعَبْ” [*Through knowledge we endure, through ignorance we perish*], and 大自然是我們最好的老師 [*Nature is our best teacher*], or connected the blank pages of the book to some deeper meaning, for example “Turning the page means forgetting” or «Que se cache t'il dans les pages que nous avons pas ouvertes» [*What is hidden in the pages that we have not opened*].

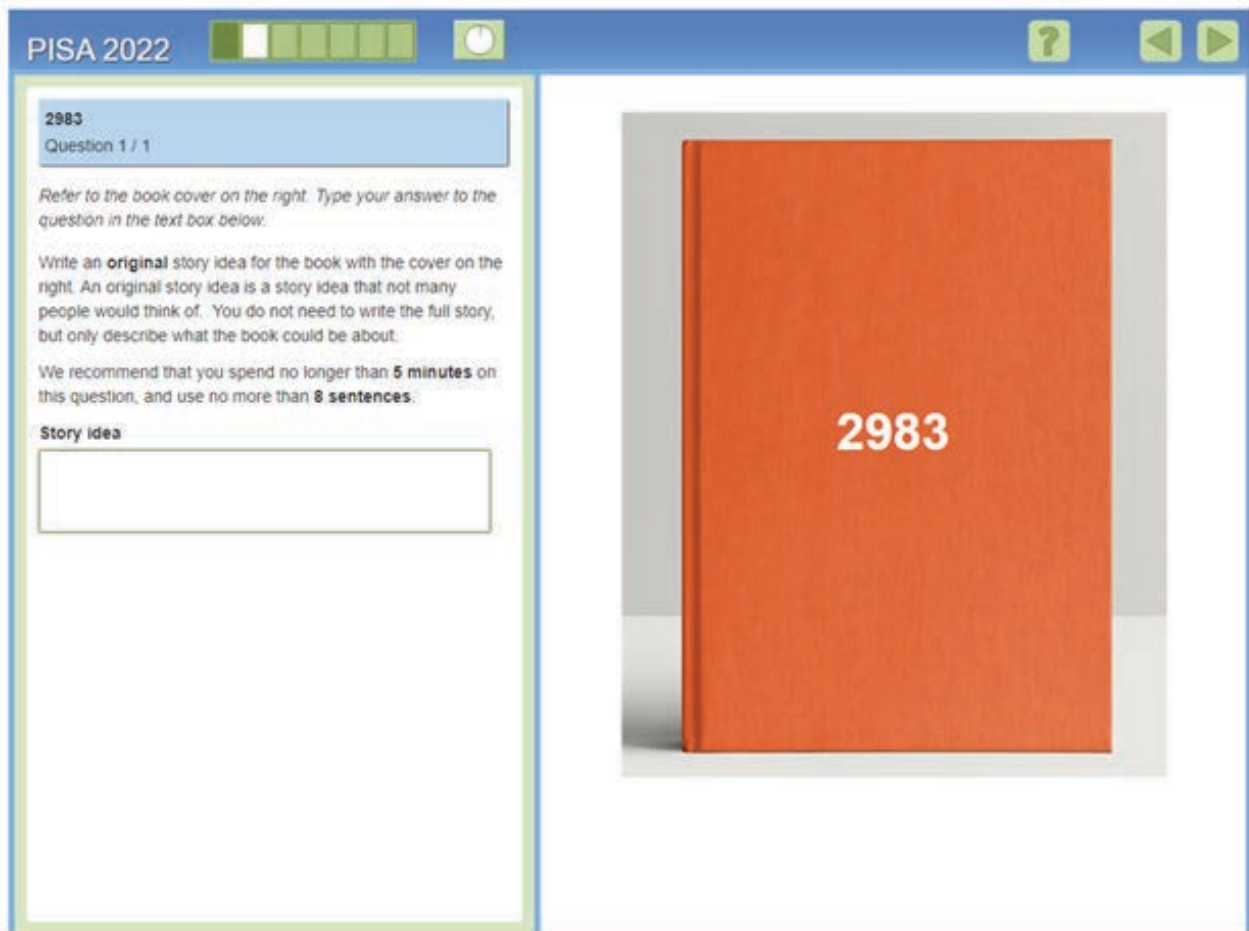
Some creative responses also used wordplay or humour to good effect. For example, in Spanish and Portuguese, some students exploited the double-meaning of “hojas” or “folhas”, meaning both leaves and pages (e.g. “Las hojas del paraíso” [*The leaves/pages of paradise*], and “nas folhas da Liberdade” [*In the leaves/pages of freedom*]). Some students also created rhymes or melodic phrases as titles (e.g. “cultura e natura” [*Culture and nature*]).

In terms of syntax and style, most students suggested title ideas in the form of noun-phrases, combining a singular noun with descriptive adjectives or prepositions (“어린꼬마의 추억” [*The memories of a little kid*]), or answered with full clauses (e.g. “Cada página num livro é para lá de mil palavras” [*Each page in a book is more than a thousand words*]). Achieving an impactful creative response in a only few words was rarer, yet nonetheless effective in a few cases (e.g. “Nature Gaché” [*Spoilt Nature*] or “Vida Novelística” [*A novelistic life*]). Only a few students suggested title ideas in the form of questions (“ماي خيال؟” [*Fantasy world?*]) or commands (“Sedi in zadihaj” [*Sit and breathe*]). Given significant differences exist between languages, some might allow students to condense more significant double-meaning and detail in fewer words than others. Some cross-cultural differences were also observed in terms of response length: title ideas that were deemed highly creative were often lengthy, proverbial statements, particularly in France and to some extent in Belgium and Portugal – although notably, all responses in French (not only those deemed creative) tended to be longer than in other country-language contexts; in contrast, creative responses in Greek, Chinese, Spanish and Arabic tended to include a larger number of shorter responses.

Example item 2. 2983

In another written expression task in the PISA test, called 2983, students were asked to think of story idea for a book whose cover displays only the number 2983 (Figure 2). Students were asked to briefly describe what the story could be about, and to focus on making their story idea as original as possible. Box 4 shows some of the most creative responses from students across select countries for this task.

Figure 2. 2983



PISA 2022

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

2983

Box 4. A selection of most creative responses across countries for the 2983 item.

- **Toutes les 2983 minutes, Monsieur Dheure oublie tout. Sa memoire recommence a zero [...]** // *Every 2983 minutes, Mr Dheure* [Mr Time] forgets everything. His memory resets to zero [...]* (Belgium)
- **No livro, teríamos como local principal um corredor com diversas salas, salas aparentemente infinitas [...]** Em cada porta, teríamos um número, ao qual remeteria alguma memória sua. Então, nosso personagem passaria por uma aventura pelas suas próprias lembranças, tentando entender como e o porque chegou nesse corredor [...] // *In the book, the main location would be a corridor with several rooms, seemingly infinite rooms [...] each door, we would have a number, which would refer to some memory of his. Our character would then go on an adventure through his own memories, trying to understand how and why he arrived in this corridor [...]* (Brazil)
- **In dem Buch geht es um einen Jungen, der in einer Welt lebt, in der alle Kinder in einem Bergwerk arbeiten und erst zu ihrem 18 Geburtstag heraus dürfen. Die Kinder bekommen alle eine Nummer und keinen Namen. Die Nummer des Jungens ist 2983. Die Kinder denken alle, das das Leben welches sie führen normal ist. Doch 2983 ist anderer Meinung und versucht mit seiner besten Freundin auszubrechen... Doch was sie an der Oberfläche erwartet hätten sie nicht gedacht.** // *The book is about a boy who lives in a world where all children work in a mine and are only allowed out on their 18th birthday. The children are all given a number and no name. The boy's number is 2983. The children all think that the life they lead is normal. But 2983 disagrees and tries to escape with his best friend... But they didn't expect what awaited them on the surface.* (Germany)
- **九加二的和跟八加三的和相同,而八和二的差跟九和三的差相同,这是一本关于命运的书,看似许多毫无关系的数字当中却包含许多巧合,就像每人的人生一样,总会遇到许多与自己看似无关的人,最后却发现他们为自己带来的意义远远超乎想象...** // *The sum of nine plus two is the same as the sum of eight plus three, and the difference between eight and two is the same as the difference between nine and three. This is a book about destiny. It seems that there are many coincidences among many seemingly unrelated numbers, just as in everyone's life, there are always many people who seem unrelated to you, but in the end, you realise that they have brought you meaning far beyond your imagination...* (Hong Kong)
- **Un hombre cae accidentalmente en un glitch llegando a un lugar de pasillos infinitos, para poder salir tiene que encontrar la salida pasando un total de 2983 niveles de abajo hacia arriba [...]** Este seria un diario de la persona documentando cada cosa que encontro en cada nivel, desde el nivel uno hasta el nivel 2983. // *A man accidentally falls into a glitch and arrives in a place of infinite corridors, in order to get out he has to find the exit by passing a total of 2983 levels from bottom to top [...]* This would be a diary of the person documenting every single thing they encountered in each level, from level one to level 2983. (Chile)

* The name Mr Dheure can be interpreted as a play on words in French (original language), best translated as Mr Time.

- **Il a fallut 2 ans de préparation, 9 mois et 8 jours pour tout mettre en place et précisément 3 secondes pour exécuter la vengeance [...] Mei ne voulait qu'une chose : vengeance. Mais il fallait que le meurtre soit absolument parfait, intraçable jusu'à elle. Cette fois ci, personne ne va l'arrêter. Elle va assassiner le président.** // *It took 2 years of preparation, 9 months and 8 days to set everything up and precisely 3 seconds to carry out the revenge [...] Mei wanted only one thing: revenge. But the murder had to be absolutely perfect, untraceable to her. This time, no one is going to stop her. She is going to assassinate the president.* (France)
- **2983. The number of people this simple book has killed. The book has a strange glow to it that is visible at night. The book almost calls out to you, longing for you to just take a peek at what it has to offer [...] and, thats exactly what would happen, the reader of the book would seem to simply dissapear, leaving the book on the ground, this time with one extra number on the cover.** (Canada)
- **Η Ελīs μια νεαρή γυναίκα έχει θυσιάσει την ζωή της για να μείνει για πάντα νέα. Μια συμφωνία που δεν έπρεπε να δεχτεί ποτέ. Χαρακωμένο στο χέρι της είναι η ημερομηνία στην οποία θυσίασε την ψυχή της για την αθανασία, 2 Σεπτεμβρίου 1783. Άραγε είναι ηδονή ή οδυνηρό να χρειαστεί να ζησεις για παντοτε.** // *Ellis a young woman has sacrificed her life to stay young forever. A deal she should never have taken. Engraved on her hand is the date on which she sacrificed her soul for immortality, September 2, 1783. I wonder if it's a pleasure or a pain to have to ask for forever.* (Greece)
- **2983. Potrebbe sembrare un semplice banalissimo numero, ma dietro c'è una storia ben più complessa. [...] Abbiamo un 2, che sembra quasi un L e un 3, che assomiglia alla E. Vediamo poi l'8 e un 9. [...] Ma esattamente per cosa stanno? Beh, le due lettere sono le iniziali di due ragazze scomparse, mentre 8 e 9 sta per gli anni che avevano quando sono sparite. Il libro parla quindi di queste due bambine scomparse nel nulla che non verranno più ritrovate, o meglio sì, ma senza vita.** // *2983. It might seem like a simple, very banal number, but there's a much more complex story behind it [...] We have a 2, which almost looks like an L, and a 3, which looks like an E. Then we see an 8 and a 9. [...] But what exactly do they stand for? Well, the two letters are the initials of two missing girls, while 8 and 9 stand for the ages they were when they disappeared. So the book is about these two little girls who vanished into thin air and were never found again, or rather they were, but lifeless.* (Italy)
- **Este es un libro que contiene solo 2983 palabras. No hay una biografía del autor, no hay una editorial, no hay una edición, no hay un índice, solo 2983 palabras. Parece una historia común y corriente con la extraña constancia en la que aparece el número 2983. Se sitúa en el año 2983. ¿Cómo se hará una historia compleja y completa en solo 2983 palabras?** // *This is a book that contains only 2983 words. There is no biography of the author, there is no publisher, there is no edition, there is no index, just 2983 words. It seems like an ordinary story with the strange consistency in which the number 2983 appears. It is set in the year 2983. How can a complex and complete story be told in just 2983 words?* (Colombia)

- **numa ilha no meio do atlântico, viviam exatamente 2983 pessoas. Corria por lá a lenda de que naquela ilha só poderiam estar 2983 pessoas, sem tirar nem por, por isso sempre que chegava alguém sabiam que alguém iria partir, sempre que nascia alguém sabiam que alguém iria morrer, e vice-versa. Foi então que um dia chegou à ilha um náufrago. Todos os habitantes acharam aquilo um preságio da morte de alguém, mas estranhamente ninguém morre por várias semanas. Os habitantes, que acharam que era um sinal de que a maldição estaria quebrada, fizeram uma grandefesta para celebrar e o aclamar líder. Mas acontece que, na manhã seguinte, morreram todos exceto o náufrago, que na verdade era responsável pela sua morte, uma vez que tinha como missão conquistar aquela ilha e repovoá-la [...]** // *On an island in the middle of the Atlantic, there lived exactly 2983 people. There was a legend that there could only be 2983 people on that island, so whenever someone arrived, they knew that someone would leave, whenever someone was born, they knew that someone would die, and vice versa. Then one day a castaway arrived on the island. All the inhabitants thought it was an omen of someone's death, but strangely no one dies for several weeks. The inhabitants, who thought it was a sign that the curse would be broken, threw a big party to celebrate and acclaimed him leader. But the next morning, everyone died except the castaway, who was actually responsible for his death, since his mission was to conquer the island and repopulate it [...]* (Portugal)
- **socialni eksperiment v katerem so ljudje prepričani da jih po celem svetu sodeluje 2983. znanstveniki ki so se za ta eksperiment odločili jih za velikim steklom opazujejo in na njih delajo razne poskuse (jim zastrupljajo hrano, spuščajo pline, umejujejo čas za spanje) da bi videli posledice. v eksperimentu v resnici sodeluje samo ena oseba, vsi ostali so halucinacija te osebe zaradi eksperimentov** // *a social experiment in which people are convinced that 2983 people around the world are taking part. the scientists who decided to do this experiment observe them behind a big glass and do various experiments on them (poisoning their food, releasing gases, limiting their sleeping time) in order to see the consequences. only one person is actually taking part in the experiment, all the others are hallucinations of that person because of the experiments* (Slovenia)

Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.

What were common themes or features across creative responses?

In general, many responses to this item associated the number 2983 to a year and described stories focused on what life will be like in the future. In many stories, themes of war, conflict, life and death, and power struggles between groups were central to the story context. A common narrative explored the dangers of concentrated power and efforts to save the world in a dystopian future, potentially reflecting broader contemporary anxieties about authority, governance, and the future of humanity.

Other students similarly depicted a dystopian future but where 2983 became a symbol of the controlling system, rather than the year itself. For example, one creative story idea from a student in Germany imagined that children were assigned numbers instead of names, and one boy, known as number 2983, embarks on a journey to escape this forced labour. In Chile and Slovenia, in particular, existential anxiety was a common theme across responses, and in Brazil and Colombia, story ideas explored themes of survival, tragedy, violence, and inequality, focusing on the resilience of individuals and communities under extreme circumstances.

What sets apart the most creative answers across countries from the rest, in general, was their emotional depth and ability to connect to the human experience. For instance, the story of a man who forgets everything every 2983 minutes conveyed a sense of sadness and anxiety and reminds us of the passage of time and fleeting nature of memory. A similar idea from a student in another

country described a main character who navigates endless corridors of doors that represent different memories, each of which is key to understanding their past and present. Other creative ideas suggested introspective stories that might lead a reader to interrogate fundamental questions about the human experience. For example, one creative story idea from a student in Greece described a young woman who sacrifices her soul for immortality on the date 2/9/1783 and questions the virtue of that sacrifice; whereas another student from France imagined a woman who dreamed of the number 2983 every night, and the story follows her existential journey to find meaning in life.

In other cases, students used the number 2983 to represent something mysterious or intriguing, creating intricate plots where the protagonist had to find some hidden truths. For example, an Italian student converted the digits in the number into letters, connecting them to the initials of two missing girls and suggesting a story that investigates the mystery surrounding their disappearance. Another creative story idea from a student in Canada turned the number 2983 on the book cover into a sinister clue, with the book “disappearing” people and each time leaving an extra number on the cover.

Finally, some of the most creative stories across countries introduced futuristic or science fiction elements. For example, one student in Korea described how the protagonist discovers a parallel world, E-2983, where time operates differently. In another example, a character was trapped in a glitch and must survive 2983 levels of strange and dangerous environments. In these types of stories, themes of life on other planets, artificial intelligence, digital control, and ethical dilemmas in an increasingly automated world were frequently observed.



Socio-economic status and performance in creative thinking in written tasks

Many groundbreaking artists, writers, scientists and inventors throughout history have come from humble beginnings, and every child – regardless of the economic and social status of their family – has the potential to excel in creative thinking. However, unequal access to basic literacies or opportunities to develop creative thinking skills can hinder the development of students' creative potential, much like unequal opportunities exacerbate divides in other areas. Data from the PISA 2022 assessment showed that student socio-economic status is positively associated with creative thinking performance, as it is with performance in mathematics, reading and science (albeit to a weaker degree), and that advantaged students consistently outperformed their disadvantaged peers in creative thinking tasks.

While the PISA data revealed significant performance gaps between advantaged and disadvantaged students in creative thinking, these reduced dramatically (though remained moderate) after accounting for students' reading and mathematics performance. When looking at the performance of students in particular tasks, the report also found that the difference in success (i.e. achieving full credit) between disadvantaged and advantaged students was greater in tasks requiring extended written answers compared to those requiring shorter written responses or visual designs. Using the rescored data from this project, we further investigated these findings by identifying creative responses from disadvantaged students across all countries and economies within our rescored sample (Box 5). The examples show that even amongst the most disadvantaged students, creative ideas can still be found – but we also observed that many more disadvantaged students successfully suggested creative responses to the Illustration Titles item (requiring short texts, sometimes only a few words) compared to the 2983 item (requiring more elaborated responses).

Box 5. Creative ideas can come from all places (I): written tasks

For both written items included in the rescoring project – Illustration Titles and 2983 – it was possible to identify creative responses from amongst the most disadvantaged students in our pooled sample (i.e. students in the lowest decile of the PISA socio-economic index). Some of these are highlighted below. Slightly more students within the lowest PISA socio-economic index decile provided responses judged to be relatively creative with respect to other responses in their country for the Illustration Titles item, possibly given responses with only a few words were acceptable compared to 2983 where students were required to elaborate more extended responses. Notably, several students were even able to suggest more than one creative idea in the Illustration Titles item.

Creative ideas from disadvantaged students for the item *Illustration Titles*

- 人類離去之後 // *After humans left* and 過去與現在 // *Past and present* (Same student, Hong Kong)
- لاخي لالامع ؟ // *Fantasy world?* and > ركفت و رظنا // *Look and think >* (Same student, Saudi Arabia)
- **El arbol de los milagros** // *The tree of miracles* (Colombia)
- **La panchinna che assiste a tanti amori sbocciati** // *The bench that witnesses so many blossoming loves* (Italy)
- **Um mundo em letras** // *A world of letters* and **As viagens de uma imaginação** // *The journeys of an imagination* (Same student, Brazil)

Creative ideas from disadvantaged students for the item 2983

Creative responses amongst the most disadvantaged students for item 2983 were spread across a more diverse range of countries, but they all shared a common characteristic – that they were relatively lengthy:

- **La historia trata de como un grupo de amigos en el año 2983, tratan de recuperar los colores menos el naranja, que es el unico color que sigue existiendo, pero, iran descubriendo porque los demas colores desaparecieron** // *The story is about how a group of friends in the year 2983 try to get back all the colours except orange which is the only colour that still exists, but they will discover why the other colours have disappeared* (Colombia)
- **Ein alter Mann kann in den verschiedenen Zeiten schauen, ob Zukunft oder Vergangenheit. Eines Tages sieht er die Zahl 2983 vor sich und warnt seinen Enkel, dass er im Jahre 2983 rot sehen würde und plötzlich starb er nach diesem Satz. Um heraus zu finden, was der alte Mann meine, gehen seine Enkel in seinem alten Haus um nach hinweisen zu suchen, doch es erwartet sie etwas wovon sie n iemals gedacht hätten.** // *An old man can see into different times, either future or past. One day, he sees the number 2983 and warns his grandson that he will see red in the year 2983. After saying this, he suddenly dies. To find out what the old man means, his grandchildren go to his old house to look for clues, but something awaits them that they never would have imagined.* (Germany)
- **A minha vizinha desapareceu misteriosamente em 1983 [...] Ela era louca, pelo que ouvi, mas não tinha nenhuma razão para ela desaparecer naquele dia. A casa tem estado vazia desde o dia 2 de setembro de 1983, mas há 9 noites que vejo as luzes da casa acesas pela janela. Há 8 noites comecei a ver uma sombra a mexer-se pela casa, há 3 noites comeceia ouvir uma voz a pedir ajuda. Mas há 2 noites tudo parou.** // *My neighbour mysteriously disappeared in 1983 [...] She was crazy, from what I heard, but there was no reason for her to disappear that day. The house has been empty since September 2, 1983, but for the last 9 nights I have seen the house lights on through the window. 8 nights ago I started seeing a shadow moving around the house, 3 nights ago I started hearing a voice asking for help. But 2 nights ago everything stopped.* (Portugal)
- **Knjiga bi pripovedovala o eni deklici in enem dečku, ki bi našla stroj, skozi kateraga sta po nesreči potovala nazaj v čas. Zato bi morala potovati v 9 različnih krajev, ki so v različnih časih. V vsakem iz med njih bi morala morala reševati 8 ugank ali izzivov. Za vrnitev domov bi imela le 3 mesece, če ne bi ostala zaprta v času.** // *The book would tell the story of a girl and a boy who find a machine that accidentally allows them to travel back in time. They would have to travel to 9 different places in different times. In each of them, they would have to solve 8 puzzles or challenges. They would only have 3 months to return home if they were not to get stuck in time.* (Slovenia)
- **Δωμάτιο 2983. Ενας μυστηριος θανατος μιας νεαρης ηθοποιου στο αποκορυφωμα της καριερας της εχει στοιχειωσει το δωματιο του ξενοδοχειου Tranquility στην Μπρατισλαβα οπου ουτε οι εργαζομενοι γνωριζουν τι προκαλεσε τον θανατο της. Κανεις δεν εχει επισκεφτει τον δωματιο απο την θανατο της, 7 χρονια μετα ενας ντεντεκτιβ αποφασιζει να λυσηει το μυστηριο. Δολοφονια? Ακαριαιος θανατος? Αυτοκτονια? [...]** // *Room 2983. A mysterious death of a young actress at the peak of her career has haunted the room of the Tranquility Hotel in Bratislava where not even the employees know what caused her death. No one has visited the room since her death, 7 years later a detective decides to solve the mystery. Murder? Instant death? Suicide? [...]* (Greece)

Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.

These initial observations around response length and the relative success of disadvantaged students in different types of items from the rescored sample support similar findings from the PISA Results (Volume III) report, namely that disadvantaged students may struggle to fully express their creative potential in tasks requiring more complex responses. Efforts aimed at improving students' writing skills could help reduce this gap, with some national initiatives targeting promoting creative thinking skills in writing amongst disadvantaged student populations (see Box 6).

Box 6. Berättarministeriet: Empowering creative potential in writing through storytelling

Berättarministeriet ("Ministry of Storytelling"), founded in 2011, is a non-profit initiative focused on fostering creativity and confidence in writing among disadvantaged children in Sweden.

The programme offers practical support for teachers in socio-economically disadvantaged primary schools through providing pedagogical resources and free, engaging school programs designed to inspire students. These programs emphasise the power of storytelling and writing, providing students with the opportunity to develop their creative skills. The program facilitates teachers to lead interdisciplinary learning activities in their classrooms, based on the Swedish curriculum, and connects children to writing mentors and adults beyond their families and teachers. Since its creation, the program has reached over 89,000 students and supported more than 7,000 teachers.

Recently, Berättarministeriet conducted a survey of nearly 200 teachers in 125 schools across Sweden to understand how and the extent to which they used creativity in their classrooms. Notably, most teachers reported to a high or very high degree that they believed integrating creative elements into their teaching can help them to meet the needs of different student groups, as well as to strengthen student motivation and enhance their students' knowledge and language skills (Berättarministeriet, n.d.^[65]). In subsequent qualitative interviews, teachers also emphasised that using creative methods like storytelling, games and project-based learning activities was particularly beneficial for the language development of students learning Swedish as a second language, as these activities encourage communication and interaction in a fun, active and enjoyable way.

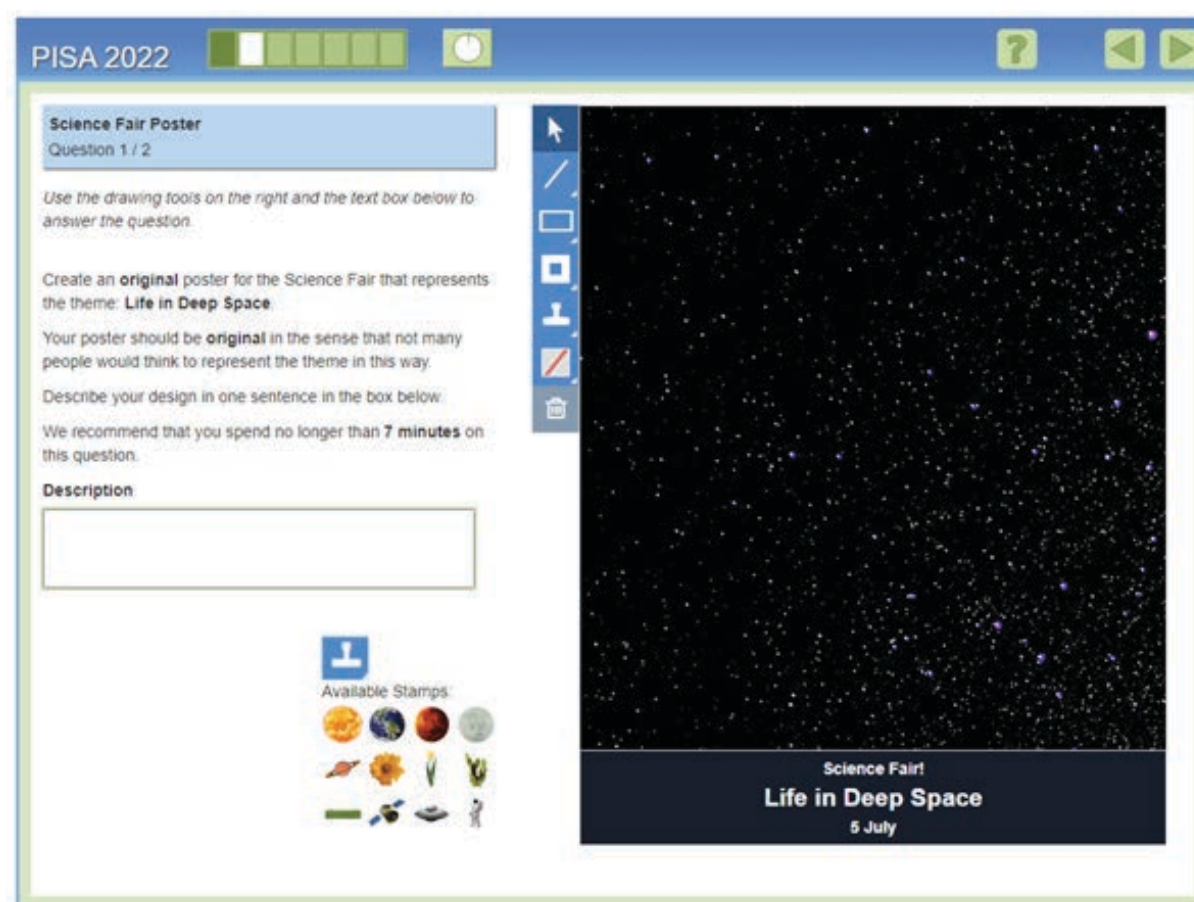
Visual expression in PISA 2022: what creative designs can students make?

The PISA 2022 creative thinking test also asked students to express their imagination in visual design tasks. In general, students found it much harder to produce creative responses in the visual expression tasks than other types of tasks in the PISA test – though factors like ICT literacy, unfamiliarity with such design tasks in a testing situation, and the overall PISA approach to scoring the visual tasks likely contributed to this finding (OECD, 2024^[11]). Despite this, some students in each country and economy were still able to produce varied and sometimes intricate creative designs.

Example item 3. Science Fair Poster

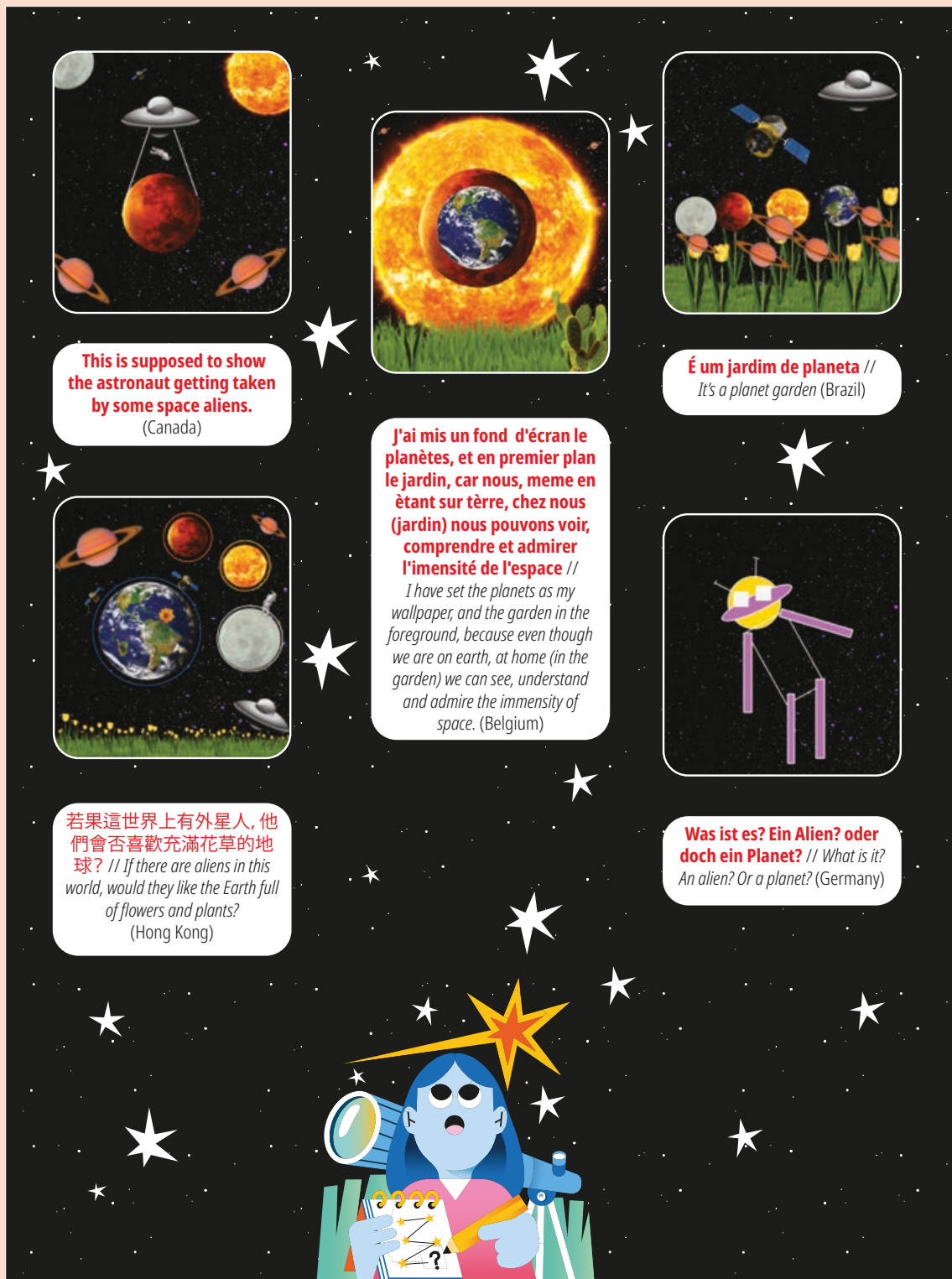
In the item Science Fair Poster, students were asked to create an original poster for a school science fair that focused on the theme of “Life in Deep Space” (Figure 3). The digital tool provided to students allowed them to drag and drop a selection of stamps and shapes in the workspace, as well as manipulate colours of shapes and lines. Students were also allowed to provide a brief description of their posters to help judges interpret the meaning behind their designs.

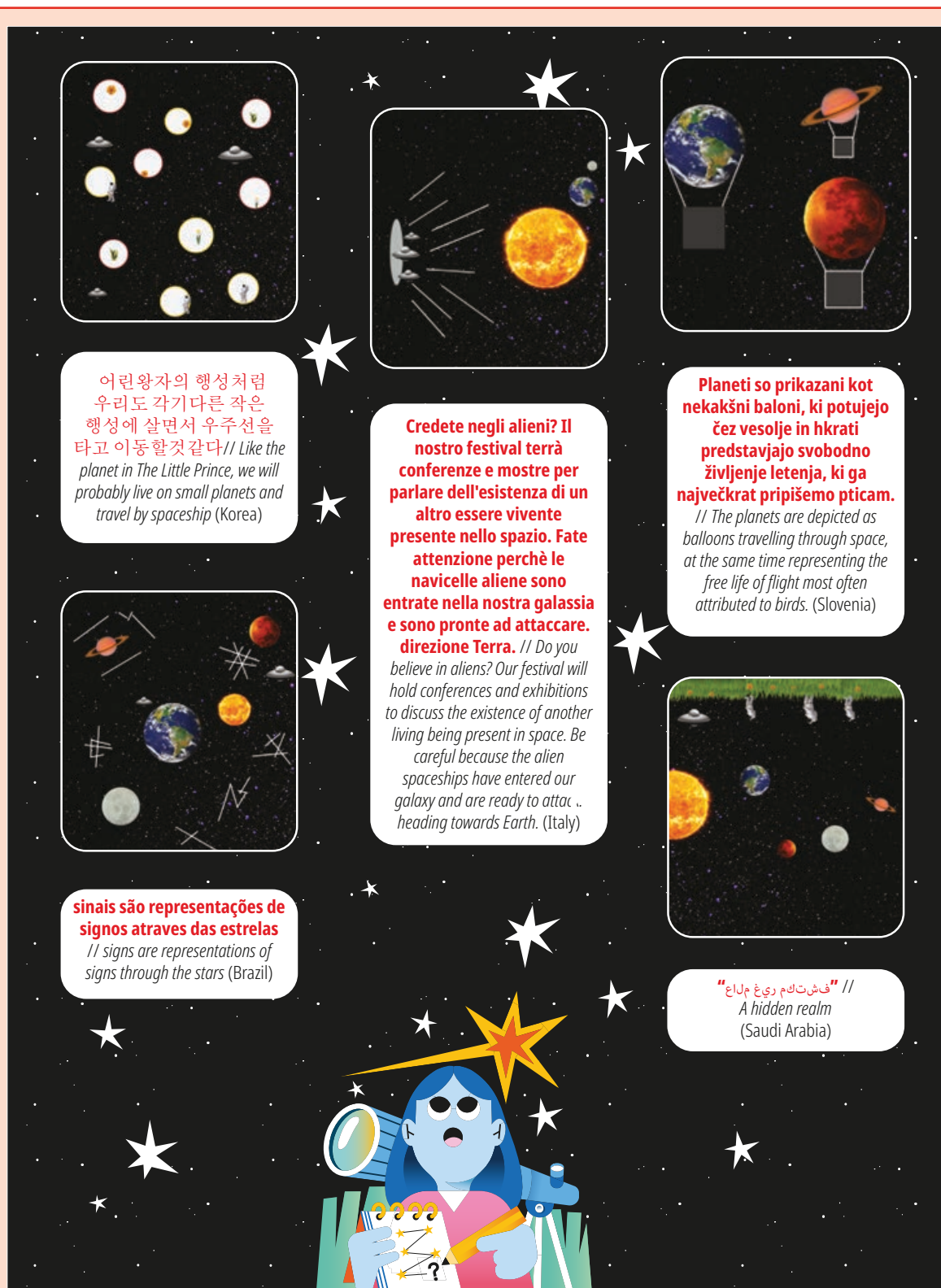
Figure 3. Science Fair Poster



Box 7 shows some of the creative designs produced by students across countries for this item.

Box 7. A selection of most creative responses across countries for the Science Fair Poster item





Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.

What were common themes or features across creative responses?

In this task, students were given a simple graphic design tool that allowed them to use pre-defined stamps from a given library and manipulate shapes and lines. They were not able to free draw, meaning that all students were somewhat constrained by the design environment in their designs. Nonetheless, students across countries were able to express their imagination creatively, overcoming the boundaries of the tool to interpret the theme in novel or unexpected ways or by creating interesting, aesthetic compositions.

Most designs judged as being creative across countries went beyond simply arranging a selection of the pre-defined stamps in a conventional “space-scape” scene. A few highly creative answers created depth in composition by overlapping planets, changing the relative size of elements, or moving stamps partially outside the frame. A large share of creative responses also combined multiple stamps and shapes, for example, overlaying planets and flower elements or combining them with lines and shapes to create new objects or “custom” stamps.

Students also chose to interpret the theme of “Life in Deep Space” in various ways, including both implicit and explicit references to life forms. Most students tended to include at least one of the pre-defined stamps showing human (i.e. an astronaut) or alien (i.e. an unidentified flying object, UFO) life forms present in space, or exploring and/or colonising other planets. Some designs also made a connection to the environment, with creative answers bringing forth ideas about ecology or even ecological collapse on Earth and the need for humanity to search for habitat elsewhere. Other highly creative answers made more implicit connections to the theme of “Life in Deep Space”, for example depicting “star signs” or astronauts at a space dance.



Creative problem solving: finding innovative ways to tackle open-ended problems

In addition to supporting individuals to express their ideas imaginatively, creative thinking supports our capacity to come up with new ideas, think deeply about challenges, and work together to find solutions to problems. Cultivating a sense of curiosity is important for encouraging the types of exploratory and information-seeking behaviours that support problem solving in general (Evans and Jirout, 2023^[30]). However, not all problems require creative thinking: creative problem solving is a distinct class of problem solving characterised by novelty, unconventionality, persistence, and ill-defined problems (Newell, Shaw and Simon, 1962^[66]). Creative thinking is necessary particularly when individuals are challenged with open, non-routine problems, those outside of their realm of knowledge, or where the techniques with which they are familiar do not work (Nickerson, 1999^[67]; Schoevers et al., 2022^[68]). As such, developing creative thinking is important for helping students to deal with complex, real-world challenges (Cremin and Chappell, 2021^[69]).

Young people use creative thinking every day to solve personal, interpersonal, and social problems. These “problems” might range from resolving a scheduling conflict to finding ways to improve sustainable living in their wider school or local communities. Creative thinking in this domain requires understanding the problem not just from a technical but also a social perspective, addressing the needs of others and finding innovative, functional and meaningful solutions for the parties involved (Brown and Wyatt, 2010^[70]). Cultivating empathy, sensitivity and a prosocial orientation – the tendency to act in way that is beneficial to others – can strengthen creative thinking in problem contexts with a social nature (Paek et al., 2025^[71]; Hu and Adey, 2002^[72]).

Creativity in problem-solving does not just involve solving problems but also formulating them in a way that leads to innovative approaches (Bulut Ates and Aktamis, 2024^[73]). Scientific creativity, for example, is seen as a process that not only involves the discovery of new ideas but the formulation and understanding of a theory. Creative thinking in science, technology, engineering and mathematical (STEM) contexts can manifest in various way: in the conception of new ideas that contribute to advancing scientific knowledge; in the conception of experiments to probe hypotheses; in the development and creation of new products and inventions; or in the novel implementation of methods, plans and blueprints (Ling and Mahmud, 2023^[74]; Othman, Iksan and Yasin, 2022^[75]).

Knowledge clearly plays an important role in problem solving. For example, studies have found that students who are good at science are more likely to solve scientific problems creatively (AlAli, 2024^[76]; van Broekhoven, Cropley and Seegers, 2020^[31]). The PISA 2022 results also show that students who achieve at least a baseline level of proficiency in mathematics, reading, and science are better equipped to excel in creative thinking, as this foundational knowledge enables the generation of appropriate, original or different ideas (OECD, 2024^[11]). While relevant knowledge and skills provide individuals with effective tools and techniques for generating innovative solutions (Baer, 1998^[77]), it can also be limiting by priming individuals to focus on conventional approaches. Creative problem solving can be encouraged by combining expertise with an openness to new perspectives (Plucker and Zabelina, 2009^[78]; Milgram and Livne, 2004^[79]).

Fostering creative problem-solving through education and practice

Developing students' creative problem-solving skills not only enhances their academic performance but also equips them with the ability to solve complex challenges across various subjects and contexts (Almulla, 2023^[80]). Integrating the learning of content knowledge with opportunities for creative thinking, by encouraging curiosity and exploration, can nurture students' creative problem-solving. Interdisciplinary learning and exposure to different fields can also promote creative problem solving as it encourages students to bridge ideas from different contexts (Baranova and Valeev, 2015^[81]).

Various student-centred pedagogical approaches focus on facilitating interdisciplinary learning to encourage and support students to think creatively. For example, Design Thinking (DT) promotes interdisciplinary thinking: teachers ask students to analyse a problem and provide them with tools for experimenting with ideas to find relevant, out-of-the-box solutions (Guaman-Quintanilla et al., 2022^[82]; Velu, 2022^[83]; Mardiah, Irwanto and Afrizal, 2023^[84]). This type of project-based approach enhances students' ability to solve problems creatively, through collaboration and empathy, instead of emphasising traditionally "academic" skills. Similarly, Project-Based Learning (PBL) approaches that use multidisciplinary and practice-based projects to address real-life issues can support students to learn to solve problems and collaborate with others more creatively and effectively (Smith et al., 2022^[85]; Jia, Jalaludin and Rasul, 2023^[86]).

Another widely recognised strategy is Inquiry-Based Learning (IBL), which promotes similar student-led activities where teachers guide student learning through an active inquiry process (Kousloglou et al., 2023^[87]; Almulla, 2023^[80]). In IBL lessons, pupils carry out investigations and participate in facilitated discussions while working with precise and concrete problems (Correia and Harrison, 2020^[88]). IBL has the potential to transform students from passive consumers into active adaptors in novel contexts. This type of pedagogical approach has been found to positively influence students' curiosity and continued interest in the pursuit of knowledge throughout their lives (Wale and Bishaw, 2020^[89]). Some countries have implemented national initiatives to encourage project- and inquiry-based learning activities to promote creative thinking in STEM contexts (see Box 8).

Box 8. Science Blast – inquiry and project-based learning in STEM in Ireland

In Ireland, the Science Blast initiative aims to promote students' design, creativity and innovation skills across a range of STEM contexts. The program encourages students to think, create, design, explore and learn new skills by partnering primary school classrooms with local organisations and asking them to investigate a question that the class are curious about. Previous topics have included "What makes our fingerprints unique?", "How do worms move?", and "Can a computer replace a teacher?", as well as environmentally oriented topics like "How to increase biodiversity in school grounds?" or "What can children do to reduce pollution?". These investigations encourage students to engage with real-world problems, and at the end of the process, the class presents their findings to a STEM judge who provides students with constructive feedback.

The Science Blast project offers 3rd-6th grade teachers with the opportunity to enhance their students' STEM, oral and literacy skills through open-ended and interdisciplinary investigation activities. The initiative provides structured lesson plans to teachers, based on a six-step investigative framework, helping them to guide students through selecting a question, planning, investigating, and reflecting on their findings. Teachers can also access various pedagogical resources focused on techniques for fostering students' problem-solving through the exercise.

Source: <https://www.esbscienceblast.com/about/>

Social problem-solving in PISA 2022: what solutions can students think of?

In the PISA 2022 creative thinking test, students were asked to come up with ideas to tackle real-world problems affecting different groups in society, their local community, or society at large. Overall, on average across the OECD, students were able to successfully come up with original and diverse ideas for nearly 40% of all social problem-solving tasks that they encountered. However, when the relative difficulty of the tasks was taken into account, students actually showed a moderate relative weakness in applying creative thinking to social problem-solving contexts compared to other tasks, on average across the OECD (OECD, 2024_[11]).

What kind of social problems were students asked to think about creatively on the PISA test, and what were some of their most innovative ideas?

Example item 4: Save the Bees

In the Save the Bees unit, students are told that the “Save the Bees” club at their school are trying to increase awareness about the important role that bees occupy in local ecosystems. In the first item of the unit, students were asked to suggest three different ideas for how the club could raise awareness about the importance of bees in their school. In this second item (Figure 4), students were asked to suggest one original solution for achieving this goal. Students were able to provide a completely new idea or choose one of the ideas they came up with in the previous item. Box 9 shows a selection of creative responses from students across countries for this item.

Figure 4. Save the Bees

PISA 2022

Save the Bees
Question 2 / 3

Type your answer to the question in the first box or select an answer from the available options on the right.

You are now asked to suggest an **original** idea that could be used to increase awareness about the importance of bees.

The idea should be original in the sense that not many people would think of it.

Either write a new idea **OR** select one of your ideas from Question 1.

Select this box to write a new idea

OR select one of your ideas from Question 1

The illustration shows a cluster of yellow hexagons representing a honeycomb. A bee is positioned in the center, with dashed lines indicating its flight path around the honeycomb.

Box 9. A selection of most creative responses across countries for the Save the Bees item

- رثك افرعتي لجلال هذه لالخالو زئافلا وه عيانه لل لصي نم لوأو لحن لثم بالطلال حبصي ضرألا لىلع عوبطم نوكت عبل
[...] // [...] a game that is printed on the floor. Students become like bees and the first one to reach the end is the winner and during this journey they learn more about bees. (Saudi Arabia)
- **Creare un videogioco a tema api [...] in cui il giocatore deve far crescere ed evolvere il suo alveare, e difenderlo dalle minacce degli umani cattivi.** // Create a video game on the subject of bees [...] in which the player has to make his hive grow and evolve, and defend it from the threats of evil humans. (Italy)
- **创建一个VR的场 [...] VR场景一开始是一片绿色的公园和繁忙的街道(有蜜蜂的世界) 下一个场景就变成一个种植植物的大棚,外面卻尘土飞扬 (这是没蜜蜂的世界)** // Create a VR scene [...] The VR scene starts with a green park and busy streets (a world with bees). The next scene becomes a greenhouse with plants growing, but it is dusty outside (a world without bees). (Hong Kong)
- **lahko bi naredili spletno platformo, ki bi s pomočjo banerjev/pasiv ljudi, ki redno uporabljajo družabna omrežja, kar je vecina, ozavešali o pomembnostih čebel. na dnevni bazi bi bili deljeni zanimivi podatki o čebelah. da bi ljudi se dodatno motivirali, bi lahko naredili nagradno igro za katero predpogoj je reševanje kviza o čebelah [...].** // an online platform could be created to make people who regularly use social networking sites, which is most of them, aware of the importance of bees by means of banners/passives. interesting information about bees would be shared on a daily basis. To motivate people further, we could make a prize game for which the prerequisite is to solve a quiz about bees [...] (Slovenia)
- [...] **Γι αυτό θα πρέπει να σχεδιαστεί ένα πρόγραμμα το οποίο δείχνει τις καθημερινές ρουτίνες των μελισσών με κάποια ειδική κάμερα η οποία θα δείχνει ζωντανά την ρουτίνα των μελισσών** // [...] a program should be designed that shows the daily routines of the bees with a special camera that will show the bees' routines live. (Greece)
- **Le club pourrait faire une expérience [...] Il faudrait deux terrain de fleurs différent. Dans l'un les abeilles pourrait butiner dans l'autre on leurs en empêcherait. A la fin de l'expérience, au printemps, seule les fleurs butinées auront fleuris. Les élèves se rendront alors comptent de l'importance des abeilles et l'impact qu'elles ont sur la nature** // The club could conduct an experiment [...] Two different flowerbeds would be needed. In one, the bees could gather pollen; in the other, they would be prevented from doing so. At the end of the experiment, in spring, only the flowers that had been pollinated would have blossomed. (France)
- **Faire faire au gens le travail des abeilles de manière ludique, c'est-à-dire leur faire fabriquer du miel, ou aider à la fécondation de plantes, comme un jeu pour les aider à comprendre leur importance et leur travail; Comme une simulation ou ils seraient l'abeille.** // Get people to do the work of bees in a fun way, i.e. get them to make honey or help with the fertilisation of plants, as a game to help them understand their importance and their work; like a simulation where they are the bee. (Belgium)
- **Realizar una especie de panal en grande, de modo que la gente pueda sacar de cada hexagono del panal distintos beneficios de la abejas en la naturaleza, en la salud y en todas las áreas posibles** // To make a kind of big honeycomb, so that people can draw from each hexagon of the honeycomb different benefits of bees in nature, in health and in all possible areas. (Chile)
- **hacer un panal tamaño persona, para ver lo que hacen las abejas y estas serian personas disfrazadas** // Make a person-sized honeycomb, to see what bees do and these would be people in disguise. (Colombia)

- **fazer um comercial para dizer o quanto elas são importantes** // *A play organised for all the schools in the town about bees and their importance.* (Brazil)
- **Use VR to make a simulation of what the world would look like without bees...** (Canada)
- **꿀벌의 이로운 점과 중요성, 현재 꿀벌에게 일어나고 있는 일등을 가사로 하는 노래를 만들어 사람들이 한번쯤 들으므로써 꿀벌에 관심을 가질 수 있게 한다** // *By making people interested in bees by listening to songs with lyrics about the benefits and importance of bees and what is happening to bees now.* (Korea)
- **realizar um espetáculo [...] em que pessoas voluntárias se vestiam não só de abelhas mas também de insetos e representariam todas as atividades que estes conseguem realizar, sendo uma forma engraçada e diferente de mostrar às pessoas como estes pequenos animais são importantes. Podendo elaborar cartazes com a informação sobre o local e a hora do espetáculo.** // *Hold a show [...] in which volunteers dress up not only as bees but also as insects and represent all the activities they can perform, as a funny and different way of showing people how important these little animals are. You could make posters with information about the place and time of the show.* (Portugal)
- **Hacer una JORNADA DE POLINIZACION en donde los estudiantes conozcan los beneficios de las abejas, la importancia que poseen. Además se les entregaría una flor nativa que pueden sembrar en algún lugar en donde puedan ser polinizadas o incluso pueden elegir una área de su comunidad para sembrar dichas flores** // *Hold a POLLINATION DAY where students learn about the benefits of bees and their importance. They would also be given a native flower to plant somewhere where it can be pollinated or they could even choose an area in their community to plant these flowers.* (Colombia)
- **A school play or concert where the main topic is to save the bees or the money raised goes to save the bees** (Canada)
- **man könnte einen Verkaufstand vor die Schule stellen in dem man Blumen und Obst verkauft. Die Blumen und das Obst sind allerdings aus Plastik und nicht echt. Trotzdem tut man so als wären dies die Produkte der Zukunft, um zu verdeutlichen was wegfällt, wenn es keine Bienen mehr gibt.** // *You could set up a stall selling flowers and fruit in front of the school. The flowers and fruit are made of plastic, not real ones. Nevertheless, you act as if these were the products of the future to illustrate what will be lost if there are no more bees.* (Germany)

Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.

What were common themes or features across creative responses?

Students in many countries were able to come up with creative awareness-raising initiatives, proposing ways to make learning about the importance of bees fun, interactive and practical (rather than simply disseminating the information). One common theme amongst creative ideas was proposing interactive and experiential games or activities where people play the role of bees. For example, a student in Saudi Arabia suggested creating a game where people race like bees to the end of a beehive design, learning about bees along the way. Similarly, a student in another country suggested creating a fun simulation where people help make honey or pollinate flowers.

Numerous students also used art and performance as tools for engaging audiences with the message. For instance, one idea was to create a giant life-sized honeycomb where students could observe what bees do (where the bees would be performers in disguise). Other students also suggested organising bee-themed shows or performances where people demonstrate the importance of bees in our societies in a fun and entertaining way. Organizing more typical campaigns or events like “Bee Days”, including performances, games and activities, was another popular approach amongst students.

Some students turned to technology to help spread the message amongst their peers. Creative responses across several countries proposed creating some kind of virtual reality (VR) experience, where individuals can look around and experience a world both with and without bees and observe the consequences. Other students suggested creating gamified online applications and/or combining information about bees with social media.

Finally, some creative responses proposed experiments that students could conduct to them to engage directly with the problem and observe, over time, the effect of bees on our ecosystems. For example, by showing the difference between two flowerbeds — one pollinated by bees and one without. A similar idea but more personally relevant idea from a student in Colombia was to have a “Pollination Day,” where students plant flowers in their own communities that bees can pollinate, learning in the process how the whole ecosystem depends on bees.

Example item 5: Food Waste

In the Food Waste unit, students were presented with the problem scenario that supermarkets across the world waste tons of unsold fresh food every day. Students were asked to suggest three different ways that supermarkets could reduce the amount of fresh food that they throw away at the end of the day (Figure 5). Box 10 shows a selection of creative responses from students across countries for this item.

Figure 5. Food Waste

PISA 2022

Type your answers to the question in the boxes below.

You are part of a team identifying creative solutions for issues faced by communities around the world.

Supermarkets across the world waste tons of unsold fresh food every day.

Describe **3 different ways** to reduce the amount of fresh food that supermarkets throw away at the end of the day. The ideas should be as different from each other as possible. Be specific in your descriptions.

We recommend that you spent no longer than **5 minutes** on this question.



Three empty text boxes for student responses.

Box 10. Most creative responses across countries for the Food Waste item.

- **Hacer un convenio con un restaurante para usar estos alimentos [...] // They could make an agreement with a restaurant to use this food [...]** (Colombia)
- **Para impedir a concentração de desperdício em determinados supermercados específicos, seria ideal otimizar tanto as rotas de distribuição, permitindo que o máximo da comida produzida seja distribuída em supermercados variados, como otimizar a conservação de alimentos, como por exemplo em refrigeração // To prevent the concentration of waste in certain specific supermarkets, it would be ideal to optimise both distribution routes, allowing as much of the food produced as possible to be distributed to a variety of supermarkets, and to optimise food preservation, such as refrigeration** (Portugal)
- **Campanhas de publicidade [...] a comerem de forma mais saudável e investirem ena compra de alimentos frescos ao invés de alimentos industrializados também reduziria a quantidade jogada fora e ajudaria na saúde geral populacional. // Advertising campaigns [...] to eat more healthily and invest in buying fresh food instead of industrialised food would also reduce the amount thrown away and help the general health of the population.** (Brazil)
- **Congeler les produits et les revendre coupé ou cuisiné [...] // Freezing products and reselling them cut or cooked [...]** (France)
- **Ocupar los alimentos para nuevas cosas y vender eso, como jugo de frutas // Use the food for new things and sell that, such as fruit juice** (Colombia)
- **30 minutes before closing time, the supermarkets could host a competition [...] about who can make the most delicious meal using the fresh food [...] Whoever wins can get free produce and shopping coupons for future shopping sprees in the nearest mall.** (Hong Kong)
- **create un app per comunicare agli interessati che il cibo sta per essere buttato e che per chi vuole è disponibilik ad un prezzo molto più basso e conveniente del normale // create an app to let interested parties know that the food is about to be thrown away and that it is available to anyone who wants it at a much lower and more affordable price than normal** (Italy)
- **مهيمر نم الدب ونوعيب بي و تاتابنللا ديفي دامس يلا هلوحث اهيف ماعطل امدنن عثيحب ةلا عنص // Making a machine so that when you put food in it, it turns it into fertiliser that benefits plants and they sell it instead of throwing it away.]** (Saudi Arabia)
- **changer le fonctionnements des supers marches pour un super marché en ligne ou les gens commandes quelques jours a lavances leurs courses pour que les super marché ne stockent que les produits qui von etre achetés. // Changing the way supermarkets operate and creating an online supermarket where people can order their shopping a few days in advance so that the supermarkets only stock the products that will be bought.** (Belgium)
- **[...] create bundles where a popular food is bundled with an unpopular food at a slight discount [...]** (Hong Kong)
- **Create cooking blogs run by the supermarket and use the unsold food to promote it.** (Canada)
- **Τα νωπά λαχανικά θα μπορούσαν να χρησιμοποιήθουν για διάφορες έρευνες σε διάφορους τομείς πχ. για διεξαγωγή DNA // Fresh vegetables could be used for research in specific areas, e.g. for DNA research.** (Greece)
- **버려진 신선한 채소들로 사람들에게 경각심을 일깨우는 조형물을 만든다 // We make sculptures that raise awareness among people with discarded fresh vegetables.** (Korea)

- **Sadje in zelenjava bi lahko znotraj trgovine še zmeraj rasle v visokih gredah. S tem bi zagotovili še boljšo kakovost, manj zavržene hrane in kupci bi lahko bili prepričani da kupujejo sveže pridelano zelenjavo.** // *Fruit and vegetables could still grow in high beds inside the shop. This would ensure even better quality, less food is wasted and shoppers could be sure they are buying freshly grown vegetables.* (Slovenia)
- **le verdure avanzate potrebbero essere raccolte e tagliate a pezzi grandi, poi raccolte in sacchetti dove vengono chiuse con minore quantità possibile d'aria e possono essere rivenduti per fare minestre e zuppe.** // *leftover vegetables could be collected and cut into large pieces, then collected in bags where they are closed with the least possible amount of air and can be resold for making broths and soups.* (Italy)

Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.

What were common themes or features across creative responses?

Students suggested a range of approaches for tackling food waste by supermarkets, including (but not limited to) technological innovation, community redistribution, creating economic incentives, and ideas related to creative repurposing of waste products. In many instances, students' ideas did not only address food waste directly but also aimed to encourage a more conscious and responsible approach to food consumption or aimed to address other sustainability issues, highlighting that students often took an interdisciplinary problem-solving approach. For example, several students suggested repurposing waste material into new and otherwise valuable products that could be sold for profit like fertilizer, skincare products or juices, or freezing or creating processed food that could then be preserved and subsequently sold. A student in Greece also proposed a highly unconventional idea of donating waste products for research purposes rather than profit.

Many students across different countries proposed ways to ensure surplus food is not wasted but instead shared with others. This highlights the social nature of the problem and how students aimed to propose solutions that meet the needs of others while addressing a collective problem. Creative responses sharing this general theme often went beyond suggesting that food waste be donated to those from disadvantaged backgrounds or to charities: for example, students from both Chile and Colombia suggested creating partnerships between supermarkets and local restaurants to use unsold food in their dishes, or a student in Hong Kong suggested donating wasted food to hospitals or nursing homes. Many disadvantaged students also proposed ideas relating to these broader themes (see Box 11).

Economic strategies were also a prominent theme amongst responses in general, with students frequently suggesting sales models that could help reduce food waste. While many such strategies are commonplace across countries, some students were able to add a novel or innovative twist to their solutions. For example, a student from Hong Kong recommended creating discounted bundles of popular food items paired with less popular ones that are susceptible to being wasted, thus ensuring that less desirable products are still sold to consumers rather than discarded completely.

Many students also highlighted the potential for technology to promote responsible consumption and efficient food distribution, aligning with the idea that technology can drive systemic change in solving complex problems. Students across various countries proposed using digital platforms to help redistribute or sell food nearing its expiration date at a reduced price. For example, a creative response from a student in Italy suggested creating an app that informs people when food is about to be thrown out, allowing them to purchase it at a lower price at that point in time. In Belgium, one student proposed changing how supermarkets operate entirely by making them all be online, where consumers pre-order their food and thus supply can match demand and reduce the likelihood of overstocking and waste.

Box 11. Creative ideas can come from all places (II): Creativity can flourish in adversity

In some cases, adversity might unlock problem-solving skills. The “hidden talents” theory suggests that some abilities may actually be enhanced by adversity (Ellis et al., 2023^[90]), especially those that help youth to meet real-world challenges in adverse environments, and research has found that children facing difficult circumstances often develop enhanced cognitive abilities as adaptive responses (Young et al., 2022^[91]). For an item like Food Waste on the PISA test, that has a high ecological value, can disadvantaged students successfully come up with very creative solutions? We found many examples of responses to this item across several countries that were suggested by the most disadvantaged students in our PISA rescoring sample and that were judged to be highly creative in that student’s respective country:

- **Odvrženo hrano naj ne vržejo ljudje takoj v smeti, ampak imajo zabojnike, prijazne okolju in hrani, ki jih lahko nato naprej dajo humanitarnim akcijam, ki lahko to odnesejo ljudem v stiski.** // *People should not throw their food waste straight into the rubbish but have environmentally and food-friendly containers that they can then pass on to humanitarian campaigns that can take it to people in need.* (Slovenia)
- **نوعرزيو اهنم روذبال نوذخاي** // *They extract the seeds from it and cultivate them.* (Saudi Arabia)
- **Potrebbe essere utilizzato come rifiuto organico per produrre energia elettrica.** // *It could be used as organic waste to produce electricity.* (Italy)
- **[...] un supermercato potrebbe fare delle indagini statistiche in cui vede mediamente quanta insalata vende o quanti pomodori e cercare di prendere la giusta quantità di pomodori e insalta senza averne in abbondanza** // *[...] a supermarket could carry out statistical surveys to see how many salads or tomatoes it sells on average and try to buy the right quantity of tomatoes and lettuce without having too much of either* (Italy)
- **Fiscalizar a cada cadena de supermercado y vigilar para que no boten alimentos en buen estado.** // *Inspect every supermarket chain and make sure they don't throw out food that is still good.* (Chile)
- **捐给老人院或医院，让有需要的人吸取足够营养** // *Donate to a nursing home or hospital so that people in need can get enough nutrients.* (Hong Kong)
- **拿去风干做成农场饲料** // *Air-dried to make farm feed* (Hong Kong)
- **هزاتمم هكاو ل ددحم موي صي صخت** // *Allocate a specific day for [selling] excellent fruits* (Saudi Arabia)
- **ةديفم ءايشا يف اهم ادخت ساو ةع فانل ايريت كب ل نم ةداف سال** // *Benefit from the beneficial bacteria and use them in things* (Saudi Arabia)

Amongst the creative responses suggested by disadvantaged students across countries, variations on a few common themes consistently emerged. These included reducing the amount of food wasted by ensuring it was given to others (e.g. the poor or needy, or supermarket employees themselves), turning the waste food into fertiliser, using the waste product to raise livestock, or strategies for limiting supermarket purchases in the first place to prevent waste from overproduction and overstocking.

Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.

Scientific problem-solving in PISA 2022: can students combine scientific knowledge with creative thinking?

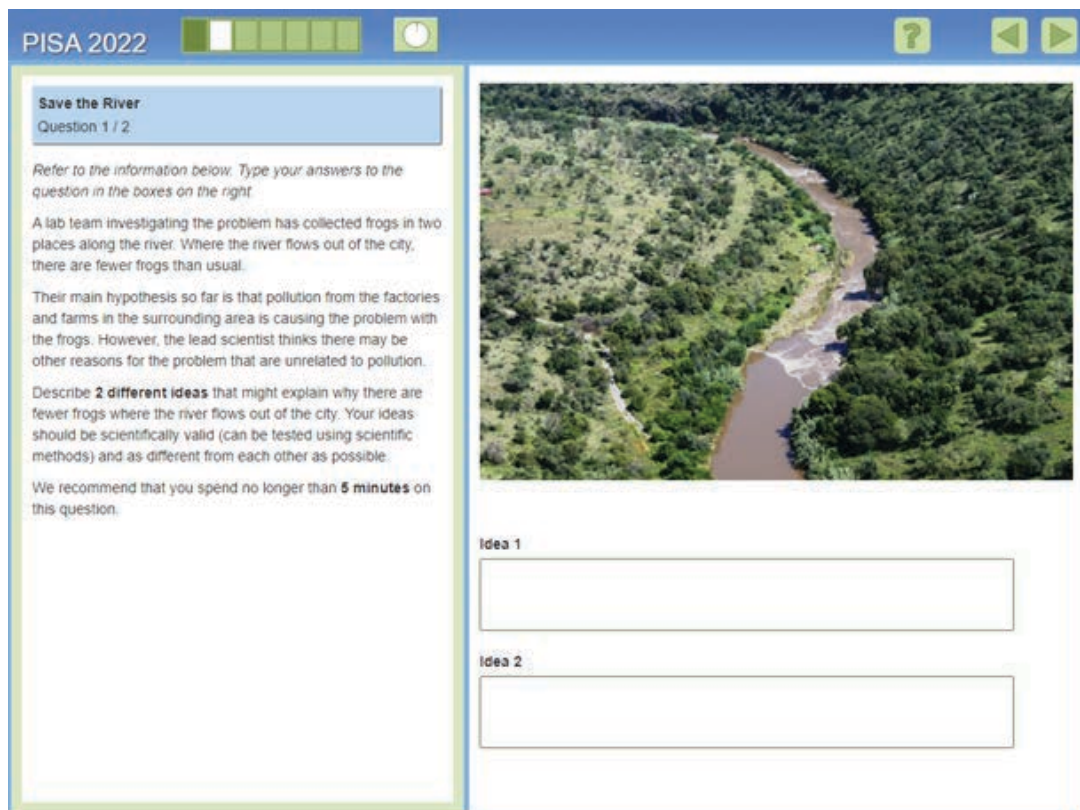
In the PISA 2022 creative thinking test, some items were also situated in scientific or engineering contexts, requiring students to propose new techniques to solve problems or to formulate hypotheses that could be tested to explain a given phenomenon. In general, the scientific problem-solving items were amongst the most difficult items on the test, but even after accounting for this students on average across the OECD demonstrated a small relative weakness in applying creative thinking to scientific problem-solving contexts compared to other types of tasks (OECD, 2024^[11]).

What kind of scientific contexts were students asked to apply creative thinking to, and what were some of their ideas?

Example item 6: Save the River

The unit “Save the River” consisted of two items, and in the first item of the unit, students were asked to provide two different, testable ideas that might explain a declining frog population in one part of a river flowing out of a city (Figure 6). Students were explicitly asked to think of causes other than pollution from local farms and factories, to encourage students to think of alternative hypotheses. Box 12 shows a selection of creative responses from students across countries for this item.

Figure 6. Save the River



PISA 2022

Save the River
Question 1 / 2

Refer to the information below. Type your answers to the question in the boxes on the right.

A lab team investigating the problem has collected frogs in two places along the river. Where the river flows out of the city, there are fewer frogs than usual.

Their main hypothesis so far is that pollution from the factories and farms in the surrounding area is causing the problem with the frogs. However, the lead scientist thinks there may be other reasons for the problem that are unrelated to pollution.

Describe **2 different ideas** that might explain why there are fewer frogs where the river flows out of the city. Your ideas should be scientifically valid (can be tested using scientific methods) and as different from each other as possible.

We recommend that you spend no longer than **5 minutes** on this question.

Idea 1

Idea 2

Box 12. Most creative responses across countries for the Save the River item

- **Il y a un barrage qui a été fait au milieu de la rivière par des enfants qui voulaient juste s’amuser. Celui ci retient donc toutes les grenouilles [...]** // *There is a dam in the middle of the river that was built by children who were just having fun. It is trapping all the frogs [...]* (Belgium)
- **Tal vez se deba a una sequía actual o próxima, dónde el nivel del río baja y muchas ranas tienden a migrar a lugares con más agua, o a morir a causa de la sequía.** // *Perhaps it is due to a current or upcoming drought, where the river level drops and many frogs tend to migrate to places with more water, or to die because of the drought.* (Colombia)
- **Uma das causas do problema podem ser protozoários que atacam anfíbios. Em girinos esses protozoários o impedem de comer, e em sapos adultos o impedem de respirar [...]** // *One of the causes of the problem could be protozoa that attack amphibians. In tadpoles these protozoa prevent them from eating, and in adult frogs they prevent them from breathing [...]* (Brazil)
- **A mudança da cor do rio, devida à poluição, provocou uma sensação de estagnação nas rãs, fazendo com que estas, não reconhecendo o seu habitat habitual, se deslocassem para um local onde a água se encontrasse da cor normal.** // *The change in the colour of the river due to pollution has caused the frogs to feel stagnant and, not recognising their usual habitat, to move to a place where the water is a normal colour.* (Portugal)
- **There is a disease spreading throughout the frogs in the river, and the frog population has decreased [...].** (Canada)
- **Que puede haber una nueva especie en el rio en especifico en esa parte y que es un depredador que su principal alimento sea las ranas [...].** // *That there may be a new species in the river specifically in that part and that it is a predator whose main food is frogs [...]* (Chile)
- **مهدد علة لى ال ايدوت ايريت ك ب دوج و و تاسرت فم ةئيب دوج و** // *The presence of a predator environment or the presence of bacteria that leads to a decrease in their number.* (Saudi Arabia)
- **[...] si la raison de ce manques de grenouilles n’était pas en rapport avec la pollution : ces petits batraciens sont parfois chassés et tués, pour en faire des cuisses de grenouilles... Pour vérifier cela, nous pouvons demander aux restaurants locaux quels sont leurs fournisseurs et demander à ces derniers d’où viennent leurs grenouilles.** // *[...] what if the reason for this lack of frogs has nothing to do with pollution: these little amphibians are sometimes hunted and killed to make frog legs... To verify this, we can ask local restaurants who their suppliers are and ask the suppliers where their frogs come from.* (France)
- **有一种新型细菌控制青蛙的生育功能并使其致命,这细菌只感染两栖类和爬虫类** // *A new type of bacterium controls the reproductive function of frogs and makes them deadly. This bacterium only infects amphibians and reptiles.* (Hong Kong)
- **Es gibt mehr Vögel in der Stadt, da die Stadt im Süden liegt, und die Zugvögel eingetroffen sind und die Frösche verjagen** // *There are more birds in the city because the city is in the south and the migratory birds have arrived and are chasing away the frogs.* (Germany)
- **possibile malattia genetica delle rane, [...] è possibile che con il passare degli anni rane di un determinato posto abbiano sviluppato un cambiamento genetico che le ha portate ad affrontare difficoltà fisiche al di sopra delle loro capacità** // *possible genetic disease of the frogs, [...] it is possible that over the years frogs from a certain place have developed a genetic change that has led them to face physical difficulties beyond their capacity* (Italy)

- 도시에서는 열 방출이 상대적으로 잘 안되기 때문에 그 열을 강이 받게 되고, 그로 인해 강의 온도가 높아져 개구리가 살 수 있는 수온이 아니게 되어 개구리가 점점 사라져 간다. // *In cities, heat is not released well, so the heat is taken up by the river, which increases the temperature of the river and makes it unsuitable for frogs to live in, causing frogs to gradually disappear.* (Korea)
- V mestu ni primernega prostora za zadrževanje in razmnoževanje, saj je struga večinoma umetna ali protipoplavno ograjena. // *There is no suitable space for staying and breeding in the city, as the riverbed is mostly artificial or flood proofed.* (Slovenia)

Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.

What were common themes or features across creative responses?

In this item, students demonstrated how scientific inquiry can be applied to complex ecological problems, integrating knowledge from fields of biology, chemistry, geography, ecology and environmental science to explore potential causes and solutions to the problem of a declining frog population. One recurring theme – despite the instruction in the prompt to think of alternate hypotheses – were ideas related to pollution and resulting environmental degradation. However, some students were still able to creatively connect potential explanations to pollution beyond more obvious ideas like leakage of toxic chemicals, for example changes in the river colour that have unsettled the frog population.

Another common theme amongst responses in general was the impact of urbanisation and resulting changes in the natural landscape due to the impact of humans. While most responses along these lines referenced more obvious human activities, such as increased noise or a general closer proximity to natural areas disturbing the frogs, some creative responses proposed “hidden” or unintended consequences as a potential cause of the issue. For example, a creative response from a student in Belgium suggested that a dam built by children may be preventing the frogs from leaving the river where it exits the town, connecting a seemingly harmless or innocent act (children building a dam) to the disruption of an ecosystem. Similarly, a student from Slovenia suggested that the artificial nature of urban riverbeds – designed for flood control for human development – might have unintended adverse effects for the frog population by removing suitable breeding spaces.

Common responses amongst students also suggested that new ecological pressures – whether from an invasive species or new predators – were responsible for pushing frogs out of their natural habitats. Numerous students also proposed that diseases or genetic mutations could be at the root of the decline in the frogs’ population. For example, a student from Hong Kong suggests that a bacterium controlling the reproductive function of frogs could be making them “deadly” to other frogs. Similarly, a student from Italy proposes that genetic changes over time could result in physical difficulties for frogs, potentially making them less fit to survive in their environment.

Example item 7: The Exhibit

This item had more of an engineering problem-solving focus, with students asked to propose design ideas for constructing a separating wall in an animal park exhibit that would allow squirrels to pass from one room to the other while preventing the rats from doing so (Figure 7). The item specified that while the squirrels and the rats had the same body size, squirrels are heavier, faster and more agile than rats. Box 13 shows a selection of creative responses from students across countries for this item.

Figure 7. The Exhibit

PISA 2022

Refer to the information on the right. Type your answers to the question in the boxes below.

Describe **3 different ideas** for a wall that allows the squirrels but not the rats, to pass from room to room. The ideas should be as different from each other as possible.

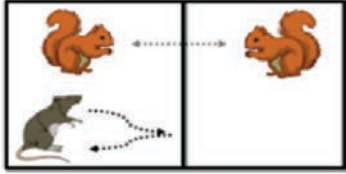
Clearly explain how each idea works, and be specific about the technique or tools you would use.

We recommend that you spent no longer than **5 minutes** on this question.

THE EXHIBIT

You are in charge of creating an exhibit for squirrels and rats for an animal park. The exhibit consists of two glass rooms separated by a single wall that runs floor to ceiling.

For feeding reasons, you need to design a separating wall that allows the squirrels to pass from room to room while preventing the rats from passing through. Squirrels and rats have the same body size but the squirrels are heavier than the rats. Squirrels are also faster and more agile than the rats.



Box 13. Most creative responses across countries for The Exhibit item.

- [...] να βάλουμε δύο δέντρα και από τις δύο πλευρές του τείχους για να μπορούν να σκλαραλώνουν οι σκίουροι και να πιδάνε από το ένα κλαδί στο άλλο [...]. // [...] put two trees on both sides of the wall so that the squirrels can perch and jump from one branch to the other [...]. (Greece)
- parete con ostacoli che richiedono un grado abilità motorie possedute solo dagli scoiattoli. possibilmente gli ostacoli sono posizioni ad un'altezza di oltre 3 metri da terra. [...] lo scoiattolo potrà arrivare alla sua destinazione, dove si posiziona una ricompensa per spronarlo. // A wall with obstacles that require a degree of motor skills possessed only by squirrels. the obstacles are preferably positioned at a height of over 3 metres from the ground [...] the squirrel will be able to reach its destination, where a reward is placed to encourage it. (Italy)
- Another system could be created in which a sliding door would open and close at a pace [...] Squirrels would be able to use this system because they are faster than rats and more agile. They would have enough agility and speed to pass through the doors before they close. (Canada)
- 弄一个一次只能进去一个动物的空间，下面有一块板子，板子只会在有一定重量时才会沉下去，沉下去后就会有一个洞可以让松鼠钻过去 而老鼠因为太轻不会令板子下沉，就不能看见那个洞了 // Make a space where only one animal can go in at a time. There is a board at the bottom that will only sink when there is a certain weight. After sinking, there will be a hole for the squirrel to go through. while the mouse, being too light to make the board sink, will not be able to see the hole. (Hong Kong)

- **Tehtnica, ki ima na eni strani utež, ki je težja od podgane, vendar lažja od veverice. Ko veverica stopi na drugo stran tehtnice se dvigne utež, kar dvigne tudi prehod na drugo stran stene(s pomočjo vrvice) [...]** // *A scale with a weight on one side that is heavier than a rat but lighter than a squirrel. When the squirrel steps on the other side of the scale, the weight is lifted, which also lifts the passage to the other side of the wall (with the help of a string) [...]* (Slovenia)
- **Eine hohe Wand aus Stahl, die nur mit einem Aufzug überwunden werden kann trennt die Teile. Der Lift fährt nur hoch, wenn das Gewicht des Eichhörnchens sich darauf befindet.** // *A high wall of steel, which can only be crossed with an elevator, separates the parts. The lift only goes up when the weight of the squirrel is on it.* (Germany)
- **هتفتل نوكت شي حب دي عب نم هعرسل راعشتسا زاهج وا قابو بل حتفت رعشل دجو اذاف رعشل راعشتسا زاهج عضو نكم مي ملعي دق اذه و ئطبناك اذا قلغت و باجنس عرس تناك اذا حوتفم يقبت اهيلي مداقل نئاكل هعرس سايق نم و حوتفم اهيلي قلغت اليكل حوتفم بابلا قيؤر دنع هعرسل وه و بستكم كولس بجانسل** // *A hair sensor can be placed, and if hair is found, the gate opens, or a speed sensor from afar so that the opening is open and from measuring the speed of the object coming to it, it remains open if it is the speed of a squirrel and closes if it is slower, and this may teach squirrels a learned behaviour, which is speed when they see the door open so as not to close on them.* (Saudi Arabia)
- **una pared que tenga una inteligencia artificial visual que permita reconocer ardillas y ratones con analisis de cámara** // *a wall with a visual artificial intelligence that can recognise mice and squirrels with camera analysis* (Chile)
- **Mettre en place une petite trappe s'ouvrant à l'aide d'un fil suspendu en haut de la boîte auquel sera accroché une noisette. L'écureuil, plus agile que le rat pourra sauter afin s'attraper la noisette, déclencher la trappe et traverser la cloison.** // *Set up a small trap that opens with the help of a thread suspended from the top of the box, to which a hazelnut will be attached. The squirrel, more agile than the rat, will be able to jump to catch the hazelnut, trigger the trap and cross the partition.* (Belgium)
- **montaria uma gangora dividida no meio com um estilo de portao dividindo os dois lados da gangora, de um lado ficaria um senso de movimento, toda vez que um bicho subisse na gangora do outro lado dela seria colocado um objeto com peso o suficiente para levantar o lado dos bichos...** // *I would set up a gangway split down the middle with a gate style door dividing the two sides of the gangway, on one side there would be a motion sensor, every time an animal climbed the gangway on the other side of the gangway an object would be placed with enough weight to lift the side of the animals...* (Brazil)
- **un sistema de resorte,unido a una pequeña plataforma donde podrán acceder tanto ratas comò ardillas, la plataforma impulsará con la fuerza suficiente para llegar al otro lado si un peso similar al de una ardilla promedio es el que esta en la plataforma** // *a spring system, attached to a small platform where both rats and squirrels can access, the platform will provide enough force to reach the other side if a weight similar to that of an average squirrel is on the platform.* (Colombia)
- **on peut utiliser un odeur ou forme que la souris craint Mais que l'ecureuil ne craint pas** // *you can use a smell or shape that the mouse fears but that the squirrel does not* (France)
- **uma porta automática poderia ser acionada a partir de um serviço exterior controlado por um humano, que através de camaras poderia distinguir rato de esquilo.** // *an automatic door could be triggered from an external service controlled by a human, who through cameras could distinguish rat from squirrel.* (Portugal)
- **속도감지 쳃바퀴, 일정수준이상의 속도로 쳃바퀴가 돌아가면 문이 열림.** // *Speed-sensing wheel, and when the wheel spins at a certain speed, the door opens.* (Korea)

Note: Student responses are shown as they were submitted in the PISA 2022 creative thinking test, including creative spelling and grammar. The notation [...] indicates where student responses have been shortened for brevity.

What were common themes or features across creative responses?

For this item, many students offered solution ideas that focused on exploiting the distinct physical traits of the animals – such as their differing agility, weight and speed – to create mechanisms that allowed only squirrels to pass through the separating wall. For instance, ideas often proposed some kind of opening system that operated too quickly for the rats or solutions that required squirrels to jump, climb or traverse across some kind of obstacles. Mechanisms based on weights were also recurring theme. In general, what differentiated creative responses from other more average responses corresponding to these ideas was students' ability to propose specific design ideas that were well-formulated, likely to be effective, and that had some kind of novel element to them.

Students in several countries also proposed technological solutions, such as biometric or AI-based sensors that would recognise and differentiate between the animals based on their physical characteristics (e.g. facial recognition) or behaviours (e.g. movement sensors).

Finally, some creative responses proposed strategies that relied on human intervention or external control. For example, a student in Portugal suggested that a door could be triggered by a human monitor using cameras to distinguish between the animals.



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Annex 1. PISA Rescoring project: Methods and data sample

The PISA rescoring project was coordinated between September 2024 and April 2025 by the OECD PISA Secretariat and involved 15 research teams scoring data from 16 national-language datasets (see Acknowledgements at the front of this report). Each research team was responsible for rescoring a sample of genuine student responses to the PISA 2022 creative thinking test from their respective national-language context. The project aimed to explore the rich data contained in raw student responses to the test across countries and economies as well as advance the practical application of scoring methods to open-ended creative tasks.

Items and data included in the study

Selected items

The following 7 items were administered as part of the PISA 2022 Creative Thinking assessment and rescored as part of the PISA rescoring project:

- Unit T200 – Science Fair Poster (Item 1) [Visual expression; Generate creative ideas]
- Unit T300 – Illustration Titles (Item 2) [Written expression; Generate diverse ideas]
- Unit T370 – 2983 (Item 1) [Written expression; Generate creative ideas]
- Unit T400 – Save the Bees (Item 2) [Social problem solving; Generate creative ideas]
- Unit T610 – Food Waste (Item 1) [Social problem solving; Generate diverse ideas]
- Unit T690 – Save the River (Item 1) [Scientific problem solving; Generate diverse ideas]
- Unit T700 – The Exhibit (Item 1) [Scientific problem solving; Generate diverse ideas]

These seven items represent diverse contexts (written expression, visual expression, social problem solving and scientific problem solving) and cognitive processes (generate diverse ideas, generate creative ideas), as described in the PISA 2022 Creative Thinking assessment framework (OECD, 2023^[17]) and as presented in this report.

Data

A random sub-sample of up to 1000 students in each national-language sample was selected for this study. Due to the rotated test design used in PISA, each national-language dataset included around 300-400 unique responses (or fewer, if the total national-language sample was fewer than 1000 students) per item selected for inclusion in the study.

Scoring methods used in the study

Each research team applied two scoring methods to the randomly sampled responses for all 7 of the items included in the study. These were:

1. Holistic Judgement Method
2. Criterion-Based Method

Holistic Judgement Method

Objective of the scoring method

The Holistic Judgement Method (HJM) required judges to attribute a score between 1 (least creative) and 7 (most creative) to student responses. Judges attributed scores according to their holistic judgement of the creative quality of the response, considering elements such as its appropriateness, novelty, value and usefulness together when defining a final “holistic” score. For generate diverse ideas items, the whole response was given a single score (i.e. all ideas considered together). A score of 0 was attributed to responses that were aberrant, missing or clearly inappropriate.

The main objective of this scoring method was to establish a relative ordering of the creative quality of responses and identify the most creative responses within each national-language context. Judges were instructed to approximate a normal distribution in their scores in this method and thus attributed scores with respect to within-country comparisons of the creative quality of responses.

A simple general rubric was provided to judges across countries to facilitate common interpretations of the HJM scoring model and to provide guidelines for the number of responses in score categories (i.e. to approximate a normal distribution).

Coding process

In each national-language item sample, a minimum of 100 responses were double coded (or, if the total number of responses was fewer than 100, the whole sample).

As a first step, judges were instructed to familiarise themselves with all responses in their national-language item sample to facilitate the relative ranking of responses and attribution of score codes. Then, two judges scored 100 responses and reviewed the inter-rater reliability metrics (see below), engaging in calibration when necessary. Once a sufficient level of inter-rater reliability was achieved between the two judges, one judge proceeded to score the entire national-language sample of responses for that item.

Inter-rater reliability metrics

For all HJM scored items, the following three inter-rater reliability metrics were used:

- Correlation coefficient (r) – $r > 0.75$.
- Mean score difference < 1
- Absolute value differences exceeding 1 score point < 20 .

Criterion-Based Method

Objective of the scoring method

The Criterion-Based Method (CBM) required judges to attribute separate scores to students’ ideas based on the following criteria:

- Appropriateness (0-2) – referring to the extent to which an idea respects the task instructions and constraints, is in the required format, and is relevant to the task content.
- Originality (0-3) – refers to the extent to which a response presents a relatively uncommon, unusual, different, imaginative or innovative idea.
- Value (0-3) – a refers to the extent to which a response is useful and impactful for its stated purpose.

For generate diverse ideas items, each idea within the student response was scored and given separate scores for appropriateness, originality and value. The whole response was then also attributed a score for flexibility (ranging from 0-1, or 0-2, depending on the number of ideas requested in a response), which referred to the extent to which the ideas were different from each other.

The main objective of this scoring method was to attribute separate scores for the multiple elements considered in a holistic evaluation and to identify cross-cultural differences in the relative weight attributed to different evaluation criteria when awarding holistic scores.

An item-specific coding guide was provided to research teams to facilitate a common understanding of each of the evaluation criteria as contextualised for each item.

Coding process

In each national-language item sample, a minimum of 100 responses were double coded (or, if the total number of responses was fewer than 100, the whole sample).

Judges completed the CBM scoring after the HJM scoring. First, the two judges scored the first 100 responses for appropriateness, followed by the rest of the criteria; if an idea received an appropriateness score of 0, it was not scored further for the remaining criteria.

After scoring the 100 responses according to each criteria, the two judges reviewed the inter-rater reliability metrics (see below), engaging in calibration when necessary. Once a sufficient level of inter-rater reliability was achieved between the two judges across the different criteria, one judge proceeded to score the entire national-language sample of responses for that item.

Inter-rater reliability metrics

For all CBM scored items, the following three inter-rater reliability metrics were used:

- Correlation coefficient (r) – $r > 0.75$.
- Mean score difference < 1
- Absolute value differences exceeding 1 score point < 20 (for criteria of originality and value) and absolute value differences equal to or exceeding 1 score point < 20 (for appropriateness and flexibility).

Judges

Criteria to be selected as a judge

Any judges participating in the study and responsible for scoring any responses to the PISA 2022 Creative Thinking items met the following criteria:

- Engaged in the broader field of creativity research;
- Fluent in the local culture (i.e. a native of the country or have lived in the national-language context for a significant period of time leading up to and including the year of the PISA 2022 administration).

Lead judges

Each research team was led by at least one experienced national lead researcher that acted as “lead judge” for the study in their national-language study. The lead researcher participated in anchor response training exercises coordinated by the OECD and were responsible for training other judges participating in their rescoring team, as well as implementing recalibration exercises if needed.

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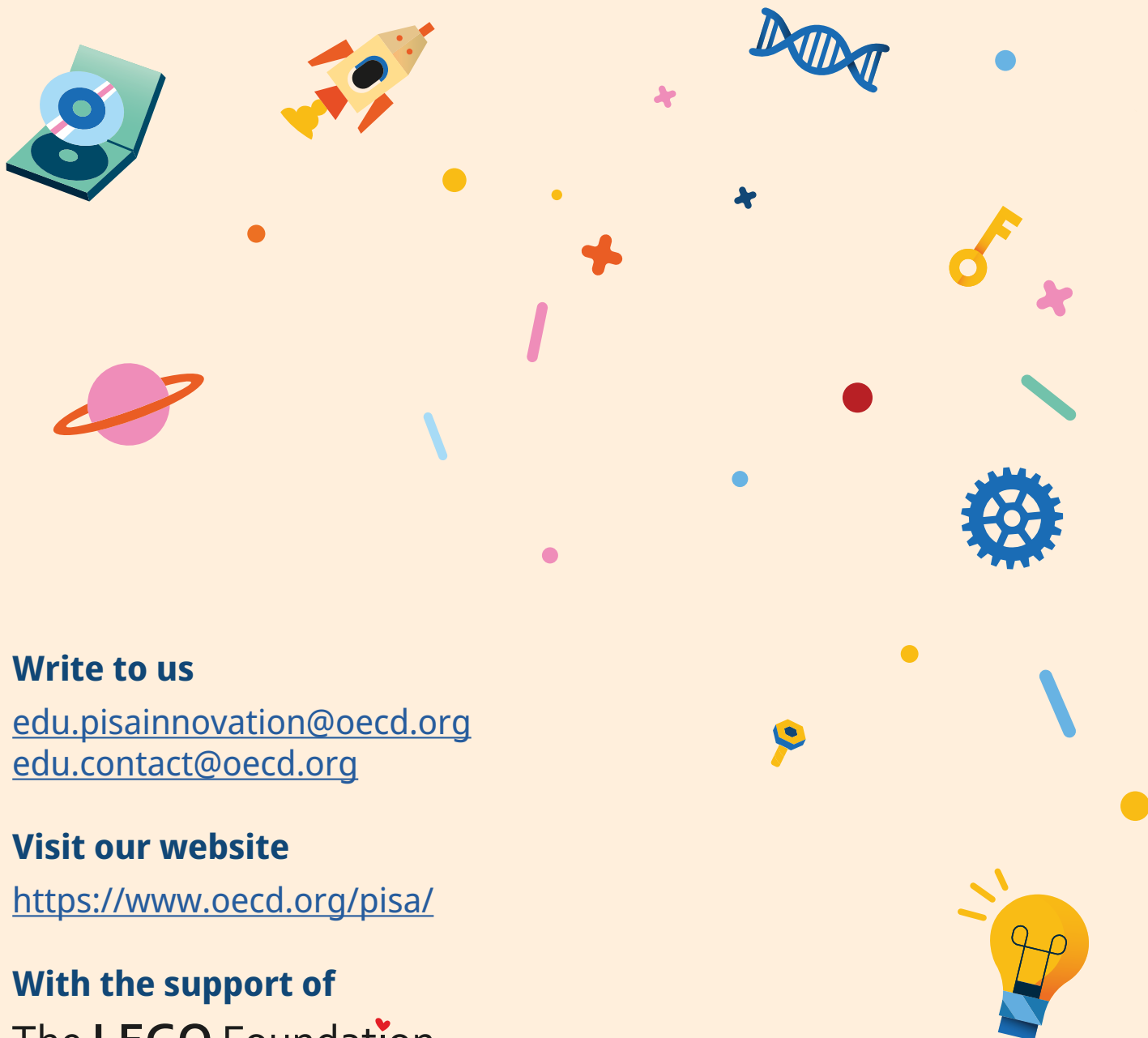
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