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# Creative thinking skills of Filipino learners in science: a PISA 2022 analysis

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**ABSTRACT**

The study aims to analyze the Programme for International Student Assessment (PISA) 2022 data of the selected creative thinking test and survey question on the perceptions related to Filipino learners creative thinking skills and their implications on the Philippine science K-12 curriculum. The study employed a descriptive quantitative design using secondary data with respondents from 3662 female and 3531 male learners. Based on the PISA 2022 eight-item questions, the findings showed that Filipino male learners are predominantly perceived as more confident than female learners in their creative thinking skills. However, based on the creative thinking assessment, both gender perceptions did not match their creative thinking skills scores, resulting in a low frequency of full credit, indicating a lack of full proficiency. The analysis of results revealed a mismatch between creative thinking items and Filipino learners' performance standards assigned to science curricula. The findings serve as a good reference for curriculum developers on how to review and recalibrate the Philippine science curriculum. Additionally, integrating ecopedagogical literacy into science education may offer a contextualized approach to fostering creative thinking skills among learners, ultimately improving learning outcomes for both genders.



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## 1. INTRODUCTION

Creative thinking plays a crucial role in advancing humankind, particularly in science, technology, philosophy, the arts, and the humanities, which rely on the progress of human culture and civilization [1]. Research demonstrates that teaching creative thinking has a lasting impact on students throughout their lifetimes [2]. The Programme for International Student Assessment (PISA) in 2022 incorporated creative thinking skills into their examinations, along with mathematics, science, and reading, in 64 countries, as reported by the Organisation for Economic Co-operation and Development (OECD) [3]. The cognitive processes necessary for creative thinking are explicitly emphasized in this subset of creativity [3]. PISA identifies creative thinking as the ability to create, assess, and enhance ideas that lead to unique and successful solutions, developments in understanding, and meaningful displays of creativity [3].

The PISA 2022 creative thinking assessment emphasizes the importance of incorporating instruction in learners' creative thinking skills. Studies have suggested that creative thinking significantly influences academic achievement [4]. Furthermore, other studies have examined instructional strategies to foster creative thinking, such as open-ended and collaborative (OE-C) learning, showing that OE-C learning is a practical approach for enhancing creative thinking skills [5]. Despite the advancements in the literature on creative thinking skills, there is an urgent need to develop effective strategies and approaches for teaching these skills at the basic education level [6]. Learning culture, particularly in science, often emphasizes understanding concepts and theories, leading to rote learning (i.e., banking education) rather than empowering students' creative thinking skills [7]. Teachers' lack of creativity and innovative teaching affects students' creative thinking skills and scientific literacy, limiting their potential [8]. Moreover, scholars have suggested that using ecopedagogies to teach science enhances students' critical thinking [9]–[11]. Nevertheless, the Philippines' 2018 ranking at the bottom of the PISA ranking prompted policymakers to improve the curriculum to improve scientific literacy, numeracy, and reading comprehension. Thus, this study aims to analyze the PISA 2022 data of the selected items of the creative thinking test and its implications on the Philippine science curriculum towards the inclusion of ecopedagogical literacies. This study specifically aimed to answer the following research question: i) how do Filipino learners perceive their creative thinking skills, and what is their confidence level in these skills, considering gender differences based on the PISA 2022 data? ii) how do perceptions of creative thinking skills match learners' performance on the selected creative thinking items, namely science fair poster, save the bees, save the river, and carpooling? and iii) how do creative thinking skills reflect on the performance standards of the Philippine science curriculum from grades 7-9?

Ecopedagogy is an educational concept that weaves ecological and environmental consciousness into instructional methods to nurture a profound relationship between students and the natural environment. This method highlights the importance of sustainability, ethical accountability, and fostering of critical and creative thinking. An essential component of ecopedagogy is integrating environmental education, which deepens students' comprehension of ecological challenges and their responsibility to tackle them [12], [13]. Ecopedagogy highlights the importance of experiential learning, which frequently incorporates hands-on activities that actively connect students to their surroundings. Studies have indicated a positive relationship between ecological understanding and creative thinking abilities, particularly regarding solutions to environmental challenges. One study indicated that students exhibiting greater ecological literacy also showed enhanced creative thinking abilities, especially in the context of environmental problem solving [14]. Despite this link, exploring creative thinking in environmental education remains a relatively overlooked field. Educators acknowledge the ability of environmental education to enhance creative thinking; however, empirical studies investigating this connection are scarce [12]. Moreover, employing various methods, including science, technology, engineering, arts, and mathematics (STEAM) education alongside the engagement, exploration, explanation, elaboration, extension, and evaluation (6E) instructional model, has improved students' creative thinking skills [15]. These findings highlight the need for additional investigation and innovation in teaching methods to enhance the effectiveness in the development of creative thinking.

In June 2024, PISA released the results of the creative thinking skills test, placing the Philippines second to last (mean score (MS), 14) on the list below the OECD average, alongside other Association of Southeast Asian Nations (ASEAN) countries, namely Malaysia (MS, 25), Brunei Darussalam (MS, 24), Thailand (MS, 21), and Indonesia (MS, 19). In contrast, Singapore ranked first and was perceived as the best in creative thinking skills, which was higher than the OECD average (MS, 41) [16]. Notably, the Philippines has consistently fared low compared with other ASEAN countries. In PISA 2018, the Philippines ranked last out of 78 countries [17]; in 2022, it ranked in the bottom six out of 81 countries in mathematics, science, and reading [18]. In addition, based on the report, also known as second congressional commission on education (EDCOM 2) [19], the Philippines is in a state of crisis owing to its miseducation, which has resulted in a failed system. To establish significant connections between international assessments and the Philippine education system, particularly within the basic science education curriculum, the theoretical foundation was examined. The Philippines is one of the countries that has fully implemented the K-12 curriculum, transitioning from a previous 10-year system to a K-12 basic education system. The "Enhanced basic education act" was enacted by legislators in 2013 [20]. In August 2016, the department of education (DepEd) issued an improved curriculum guide for scientific education. This curriculum emphasizes three critical domains: environmental, technological, and scientific literacy [21].

## 2. METHOD

The study employed descriptive quantitative data from secondary data from the OECD on creative thinking skills in PISA 2022 [22], [23]. The researchers obtained data by submitting an online request through the OECD website. Two datasets were downloaded: PISA 2022 student dataset and PISA 2022

creative thinking dataset. In this study, we analyzed the PISA 2022 Philippine data, specifically the regional presented in Table 1 and gender profiles.

Table 1. Regional profile of PISA 2022 takers from the Philippines

| Regions | Frequency (number of students) | Percentage (%) |
|---|---|---|
| Region 1 | 408 | 5.7 |
| Region 2 | 276 | 3.8 |
| Region 3 | 836 | 11.6 |
| Region 4A | 1074 | 14.9 |
| Region 4B | 271 | 3.8 |
| Region 5 | 456 | 6.3 |
| Region 6 | 597 | 8.3 |
| Region 7 | 546 | 7.6 |
| Region 8 | 406 | 5.6 |
| Region 9 | 270 | 3.8 |
| Region 10 | 354 | 4.9 |
| Region 11 | 364 | 5.1 |
| Region 12 | 244 | 3.4 |
| National Capital Region (NCR) | 750 | 10.4 |
| Cordillera Administrative Region (CAR) | 104 | 1.4 |
| Caraga Region | 237 | 3.3 |
| Total | 7193 | 100 |

We reviewed the August 2016 science curriculum from grades 7 to 9 based on the literature. One of the limitations of this study is that it only examined the junior high school science curriculum. In addition, based on the demographic profile presented in Table 2, most learners who participated in PISA 2022 belonged to grade 10 [24]. However, when presenting the findings, it is essential to note that the number of learners may sometimes be different from the total number of learners, which is 7193. This discrepancy can occur because of missing values, which is common in International Large-Scale Assessments (ILSA) such as PISA [25]. Furthermore, 3662 female and 3531 male learners participated in the PISA 2022 examination.

Table 2. Demographic profile of the PISA 2022 Filipino learners

| Year level | | Student (standardized) gender | | Total |
|---|---|---|---|---|
| | | Female | Male | |
| Student international grade (derived) | Grade 7 | 41 | 93 | 134 |
| | Grade 8 | 171 | 294 | 465 |
| | Grade 9 | 1238 | 1380 | 2618 |
| | Grade 10 | 2199 | 1760 | 3959 |
| | Grade 11 | 12 | 4 | 16 |
| | Grade 12 | 1 | 0 | 1 |
| Total | | 3662 | 3531 | 7193 |

The creative thinking skills test from PISA 2022 has nine themes: science fair poster, space comic, Illustration Title, 2983, save the bees, wheelchair accessible library, robot story, carpooling, and save the river [26]. The space comic theme appears in the science topic; however, the test focuses on writing a comic strip. Thus, only four themes were chosen based on the science education curriculum: science fair poster, save the bees, carpooling, and save the river. The creative thinking skills test was rated using standardized rubrics with three scoring options for reviewers: full credit, partial credit, and no credit. Full credit was provided when responses were both suitable and innovative. Partial credit is given exclusively for deemed appropriate responses, while no credit means not meeting the proficiency level set in the rubrics [27].

The PISA 2022 survey focuses on learners' perceptions and perceived confidence in their creative thinking skills. We selected eight items based on the themes selected for the creative thinking skills test. Table 3 presents the Likert-scale interpretation of the perceptions of creative thinking skills and confidence level items. In addition, we utilized frequency, means, and standard deviations for the descriptive statistics and desk review method of the Philippine science education curriculum [21]. We adhered to the ethical standards for using secondary data by properly citing the sources [24] and applied a certificate of exemption for ethics review. In addition, no identifiable data were collected for this study.

Table 3. Likert scale interpretation on creative thinking skills item

| Ranges | Description |
|---|---|
| 4.00-3.00 | Strongly agree/very confident |
| 2.99-2.00 | Agree/confident |
| 1.99-1.00 | Disagree/not very confident |
| 1.00-0.99 | Strongly disagree/not at all confident |

## 3. RESULTS AND DISCUSSION

In Table 4, the Filipino learners' perception of their creative thinking skills based on PISA 2022 data shows that the statement "I am very creative" resulted in a mean value of 2.64±0.695 (N=3138), which implies that learners agree on being creative, which ranges from 2.00 to 2.99. In terms of gender differences, males had a mean score of 2.62±.746, while females had a mean score of 2.66±.644, which revealed that female learners perceived themselves to be more creative than male learners. The statement "I enjoy solving complex problems" yielded a mean value of 2.61±0.727 (N=3087), (2.63±.752) for male learners as compared to female learners (2.60±.703) in solving complex problems. Furthermore, a mean value of 2.58±.826 (N=6282), which is interpreted as agree, male learners got 2.61±.823 while female learners got 2.55±.829, where male learners perceived that creativity could only be expressed through the arts. The majority of male learners perceived that they were very creative, could solve complex problems, and expressed themselves through the arts.

Table 4. Perceptions of Filipino male and female learners of their creative thinking skills

| Statements on perception | Mean | Standard deviation | Interpretation |
|---|---|---|---|
| I am very creative. | 2.64 | .695 | Agree |
| Male | 2.62 | .746 | Agree |
| Female | 2.66 | .644 | Agree |
| I enjoy solving complex problems. | 2.61 | .727 | Agree |
| Male | 2.63 | .752 | Agree |
| Female | 2.60 | .703 | Agree |
| Creativity can only be expressed through arts (e.g., music or writing) | 2.58 | .826 | Agree |
| Male | 2.61 | .823 | Agree |
| Female | 2.55 | .829 | Agree |

These findings highlight that learners' perceptions of creativity are essential for cultivating creative thinking skills. Similar studies conducted in the Philippine context showed that student teachers had a high perception of their creative styles [28]. Moreover, another study revealed that male students exhibited higher perceptions of creative thinking in terms of flexibility than did female students [29]. In contrast, female students exhibited slightly higher creative thinking scores than male students in a case study of undergraduate students in Jordan [30]. Meanwhile, research conducted in Indonesia found that female students in vocational high schools have superior mathematics and creative thinking abilities compared to their male counterparts [31].

Table 5 shows five selected statements on the confidence level of Filipino learners regarding their creative thinking skills. These statements are related to the selected themes on the creative thinking skills test. The mean score for statement 1, being creative, was 2.7±.803; expressing your ideas creatively has a mean score of 2.7±.787, while thinking of many good ideas for science experiments (2.64±0.786), then inventing new things (2.57±.801), and addressing social problems like pollution (2.62±0.809). These statements imply that learners are confident in their creative thinking skills, which range from 2.00 to 2.99. On the contrary, females have a higher confidence level as compared to males in being creative and expressing their ideas creatively. Conversely, male learners appeared to have high confidence in thinking of many good ideas for science experiments, inventing new ideas, and addressing social problems like pollution.

The findings revealed that the learners were confident in their creative thinking skills. Overall, males had higher confidence levels than females. Studies have revealed that self-confidence is directly linked to creative thinking skills [32], [33]. Students with high self-confidence can identify connections among topics and solve complex problems using innovative algorithms [33]. Students' confidence contributes to their academic success. As Sbaih [30] pointed out, academic success and creative thinking are positively correlated, with better accomplishments corresponding to more creative thinking. A study by Marzuki *et al.* [34] on mathematical creative thinking between genders in grade 10 students highlighted that male students demonstrated higher creative thinking skills than female students. However, both genders showed a positive correlation between mathematical creative thinking ability and mathematical learning achievement [34].

Table 5. Confidence level of male and female Filipino learners

| Statements | Mean | Standard deviation | Interpretation |
|---|---|---|---|
| 1. Being creative | 2.7 | .803 | Confident |
| Male | 2.66 | .828 | Confident |
| Female | 2.73 | .779 | Confident |
| 2. Expressing your ideas creatively. | 2.70 | .787 | Confident |
| Male | 2.68 | .768 | Confident |
| Female | 2.73 | .805 | Confident |
| 3. Thinking of many good ideas for science experiments. | 2.64 | .786 | Confident |
| Male | 2.67 | .805 | Confident |
| Female | 2.60 | .767 | Confident |
| 4. Inventing new things. | 2.57 | .801 | Confident |
| Male | 2.63 | .829 | Confident |
| Female | 2.51 | .769 | Confident |
| 5. Addressing social problems like pollution. | 2.62 | .809 | Confident |
| Male | 2.64 | .838 | Confident |
| Female | 2.59 | .769 | Confident |

Out of the 7 193 Filipino learners who took PISA 2022, as displayed in Table 6, performance on selected creative thinking items. The selected creative thinking skills themes were science fair poster item 1(Q1) (frequency (f)=76 or 7%) and item 2(Q2) (f=16 or 2%), save the river item 1(f=81 or 11%) and item 2(f=48 or 7%), save the bees item 1(Q1) (f=46 or 6%), item 2(Q2) (f=48 or 7%) and item 3(Q3) (f=82 or 11%), and one item (f=74 or 10%) for carpooling. This shows that most learners did not achieve the required proficiency and yielded no credit for responding to these eight items based on the four selected themes. However, a mismatch was observed in their confidence levels and positive perceptions of creativity, which resulted in poor performance on the creative thinking skill test.

Table 6. Filipino learners' performance on selected creative thinking skills items [26]

| Selected items | Frequency | | No credit |
|---|---|---|---|
| | Full credit | Partial credit | |
| Carpooling Q1 | 74 | 24 | 611 |
| Save the bees Q1 | 46 | 40 | 619 |
| Save the bees Q2 | 48 | 36 | 604 |
| Save the bees Q3 | 82 | 84 | 540 |
| Save the river Q1 | 81 | 0 | 633 |
| Save the river Q2 | 48 | 63 | 587 |
| Science fair poster Q1 | 76 | 434 | 77 |
| Science fair poster Q2 | 16 | 380 | 99 |

Notes: Q=quarter

The findings indicated that most Filipino learners were not proficient in the selected items. A report from the Department of Education Regional Office II revealed the low performance of Filipino learners in the 2018 National Achievement Test (NAT) for grades 6, 10, and 12 [35]. One of the assessment dimensions is 21st-century skills, which has three components: problem solving, information literacy, and critical thinking, based on the five recommended subjects. For grades 6 and 10 learners, critical thinking was the lowest component among the five subjects. This demonstrates that the local nationwide examination has similar results to the PISA 2022 creative thinking test.

Table 7 presents the selected creative thinking skills in four themes, namely, science fair poster, save the bees, save the river, and carpooling, with identified literacy such as technological, environmental, and scientific. These literacies are the end goals of the K-12 basic education science curriculum framework. Based on the science fair poster with two items, learners were tasked with creating visual compositions from a library of images and shapes, using a simple graphic tool. However, the task did not match or align with the performance task given to grade 7 learners based on the prescribed performance standards. Grade 7 learners were assigned to create a chart, poster, or multimedia presentation featuring common elements including their names, symbols, and uses. During the second quarter of grade 7 science, Filipino learners are tasked with conducting collaborative actions to preserve the ecosystem in the locality. In grades 8 and 9, the performance task was not observed in the prescribed performance standard.

The save the bees theme has two items, which include learners being asked to help the school club conduct an awareness-raising campaign focused on the ecological importance of bees. In grade 7, in the second quarter of science, the learners' task was to conduct collaborative action to preserve the ecosystem in the locality. This task did not match or align with the questions on the two items. Moreover, in quarters 1, 3,

and 4 of grade 7, and in all quarters of grades 8 and 9, the performance task was not observed in the prescribed performance standard. In the save the river theme, learners were asked to think creatively about a problem related to frogs in a local river. In the Philippines, students in grade 8 are required to demonstrate the behavior of water in various states, as part of the water cycle is not aligned and matched to the items. In grades 7 and 9 and in the other quarters of grade 8, the performance task was not observed according to the prescribed performance standard.

Table 7. PISA 2022 selected creative thinking skills and the junior high school science curriculum performance standard [21]

| Selected creative literacy items | Identified literacy in selected creative literacy items | Junior high school science curriculum performance standards |
|---|---|---|
| Science fair poster | Technological | Grade 7 (Q1): make a chart, poster, or multimedia presentation of common elements showing their names, symbols, and uses<br>Grade 7 (Q2-Q4): not observed<br>Grades 8 and 9 were not observed |
| Save the bees | Environmental | Grade 7 (Q2): conduct collaboration action to preserve the ecosystem in the locality<br>Grade 7 (Q1-Q3-4): not observed<br>Grades 8 and 9 were not observed |
| Save the river | Scientific | Grade 8 (Q3): present how water behaves in its different states within the water cycle<br>Grade 7-not observed<br>Grade 8 (Q1-2-4): not observed<br>Grade 9 not observed |
| Carpooling | Environmental | Grade 9 (Q3): participate in activities that reduce risks and lessen the effects of climate change<br>Grade 7: not observed<br>Grade 8: not observed<br>Grade 9 (Q1-2-4): not observed |

Notes: Q=quarter

The save the bees theme has two items, which include learners being asked to help the school club conduct an awareness-raising campaign focused on the ecological importance of bees. In grade 7, in the second quarter of science, the learners' task was to conduct collaborative action to preserve the ecosystem in the locality. This task did not match or align with the questions on the two items. Moreover, in quarters 1, 3, and 4 of grade 7, and in all quarters of grades 8 and 9, the performance task was not observed in the prescribed performance standard. In the save the river theme, learners were asked to think creatively about a problem related to frogs in a local river. In the Philippines, students in grade 8 are required to demonstrate the behavior of water in various states, as part of the water cycle is not aligned and matched to the items. In grades 7 and 9 and in the other quarters of grade 8, the performance task was not observed according to the prescribed performance standard.

Based on Table 7, the performance standard for quarter 3 of grade 9 science, learners are assigned to participate in activities that reduce risks and lessen the effects of climate change, which is matched and aligned but lacks the aspect of performance task and needs to introduce the economic aspect of climate change (e.g., financial incentives) to the item from the carpooling unit. In grades 7 and 8, and other quarters of grade 9, the performance task was not observed in the prescribed performance standard. Hence, the selected creative thinking skills items from the four themes of the PISA 2022 data appeared to be mismatched or not aligned with the Philippine science curriculum performance standards.

Research into scientific standards presents several challenges. One of these challenges is determining the criteria for determining the alignment. Another challenge is defining the alignment of the integrated standards [36]. Moreover, studies have revealed a misalignment between curriculum standards and learning resources (e.g., textbooks) in research conducted in China. The study found a greater focus on lower cognitive learning skills and an uneven distribution of core concepts and cognitive levels [37]. Another recent study on chemistry core competencies (CCCs) in the senior high school curriculum found a lack of alignment between CCCs and curriculum standards [38].

Creative thinking skills are essential for learners' development as they are positively correlated with academic achievement [6], [39]. These skills go beyond academic knowledge and help students solve problems and face future challenges [6], [40]. In addition, creative thinking skills also assist in conveying ideas, thinking critically from the beginning of learning, and realizing imagination [41], [42]. Likewise, skills are essential in subjects such as mathematics, enabling students to solve problems using various alternative solutions [43], [44]. Various effective learning models such as open inquiry, guided inquiry-based learning, and problem-based learning have been shown to improve creative thinking skills [39], [43], [45], [46]. The 5-I training program and

creative problem-solving (CPS) learning model have also been developed to effectively enhance students' creative thinking skills [41]. Creative thinking skills are vital for learners' development, as they extend beyond academic knowledge, facilitate problem solving, and prepare students for future challenges. Although various learning models and training programs have been developed to enhance these skills, there remains a need for effective strategies and approaches, especially at the basic education level.

The following limitations were identified and considered during data analysis. This study is confined to PISA 2022 perceptions and confidence levels in science, which are not the only ways to assess students' creative thinking skills, and PISA 2022 data only include the total number of gender profiles. All grades were inaccessible. This study predominantly emphasizes secondary data rather than the actual performance of students, which may result in inconsistencies when assessing creative thinking skills through pen-and-paper methods compared with performance-based approaches. This study exclusively examined eight-item questions, which we contend are inadequate or non-generalizable for assessing the influence of examinations on students' creative thinking abilities. Furthermore, the study is confined to monitoring and assessing competencies for potential alignment between PISA test items and Philippine science curriculum performance standards, resulting in a misalignment or mismatch between curriculum standards and learning resources. To address this gap, the researchers proposed a framework that presents the alignment between the creative thinking skills domain context of PISA 2022 and the K-12 basic education science curriculums.

### 3.1. Implications for practice and future research directions

The proposed framework shown in Figure 1 presents the alignment between the creative thinking skills domain context of PISA 2022 and the K-12 basic education science curriculum, where the MATATAG curriculum was drawn. It is better to explore science, technology, engineering, and mathematics (STEM), and ecopedagogical literacies to examine factors such as sociocultural, socio-political, and socio-economic contexts. These contextual factors support the argument of Claxton *et al.* [47] that fostering creative mentalities requires six habits: curiosity, resilience, experimentation, attentiveness, thoughtfulness, and environmental setting (i.e., physical and social). Nurturing creative thinking skills at an early age, or before formal schooling, encourages lifelong learning and holistic development to succeed both academically and socially.

Items from PISA 2022 were designed based on the domain context: written expression, visual expression, social problem solving, and scientific problem solving [3]. The Philippine science curriculum was designed based on the "Three domains of learning science: understanding and applying scientific knowledge in local settings and global context, the performance of scientific processes and skills, and developing and demonstrating scientific attitudes and values." Costa [48] suggested having a thought-full curriculum aligned with five themes: i) learning to think, ii) thinking to learn, iii) thinking together, iv) thinking about one's own thoughtfulness, and v) thinking big.

Curriculum alignment is necessary for improvement, considering three contextual factors. We argue that the DepEd might consider improving the Philippine science curriculum through the lens of ecopedagogical literacies [11], [49] and STEM. Ecopedagogical literacies serve as a fundamental element of the science curriculum, aligned with the Filipino core values of *Maka-Kalikasan* (pro-environment), *Maka-Tao* (pro-people), *Maka-Diyos* (pro-God), and *Maka-Bansa* (pro-nation) [50]. Practicing these values in the teaching process encourages learners to develop creative thinking, as ecopedagogies unleash their thinking skills (e.g., critical and creative).

The emphasis on glocalization focuses on a global perspective, with local solutions to address challenges in the Philippine educational system. ILSA, such as Southeast Asia primary learning metrics (SEA-PLM) [51] and the Programme for International Student Assessment (PISA) [3], demonstrate the need for improvement rather than reform. Moreover, educational improvement science (EIS) emphasizes evidence-based practice to improve the curriculum [52]. Likewise, with a focus on ecopedagogical literacies implemented from an early age to grade 12, the low results of creative thinking are a ripple effect of the problem from the onset of schooling. Scholars have proven that ecological literacy and creative thinking skills are positively correlated, suggesting that ecological knowledge can improve creative thinking abilities [14].

The researchers advocate for the enhancement of the pre-service teacher education curriculum to match the K-12 basic education science curriculum, thereby equipping future teachers with excellent instruction that emphasizes the development of students' creative thinking skills, which are essential. Similarly, in-service training programs should be developed to enhance teachers' abilities and cultivate the creative thinking capabilities of their students. Effective and suitable pedagogical methods are essential in the setting of the Global South. A longitudinal study on creative thinking skills from early grades to senior high school is necessary to identify the contextual elements that influence Filipino creative thinking abilities. The findings discussed in this section highlight the key insights and implications of the Philippine basic education science curriculum and provide a foundation for the synthesis of this study. In addition, the following section summarizes the results, outlining broader practical and theoretical applications for future studies.

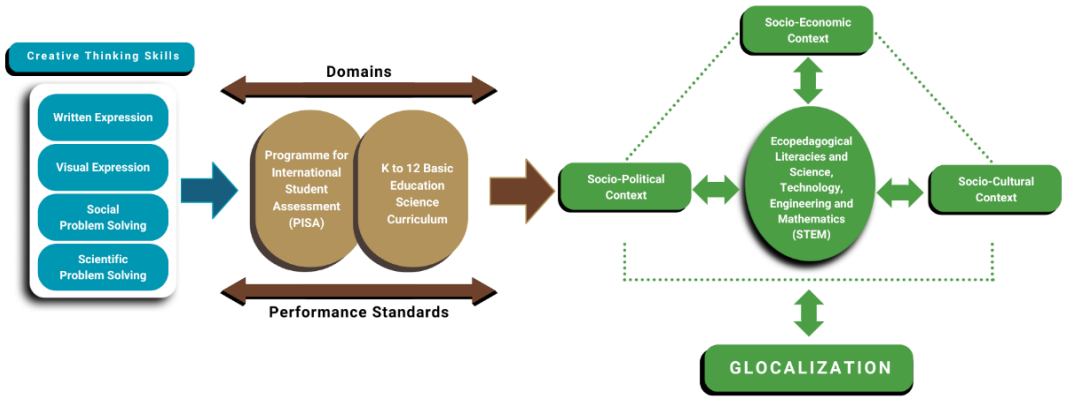


Figure 1. Proposed science curriculum framework to strengthen learners' creative thinking skills

## 4. CONCLUSION

This study analyzed PISA 2022 data of the selected creative thinking test items and the implications for the Philippine science K-12 curriculum. Recent findings have revealed that Filipino learners generally have a positive perception of their creative thinking skills. The findings showed that male learners excel in complex problem-solving, and believe creativity can be expressed through various forms, which contributes to academic success. Thus, recent observations suggest that performance standards are misaligned with the PISA creative thinking item test. The findings provide conclusive evidence that the proposed framework will help in the alignment between the creative thinking skills domain context of PISA and the K-12 basic education science curriculum. The proposed framework aims to integrate ecopedagogical literacy, which offers a balanced approach to identifying contextual factors that support the enhancement of creative thinking skills. The researchers recommend improving the pre-service teacher education curriculum program to align with the K-12 basic education science education curriculum to prepare future teachers on how to deliver quality education by focusing on students' creative thinking skills, which is vital. Likewise, in-service training programs should be designed to further capacitate teachers on how to unleash the creative thinking skills of their students. Relevant and appropriate teaching and learning delivery are imperative in the context of the Global South. Finally, a longitudinal study on creative thinking skills from early grades to senior high school is needed to determine the contextual factors affecting Filipino creative thinking skills.

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C : **C**onceptualization
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R : **R**esources
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O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## ETHICAL APPROVAL

The Philippine Normal University Research Ethics Committee granted the authors an exemption under the REC code 2024-224.

## DATA AVAILABILITY

Data are available on the OECD website.

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