THE ROLE OF ACADEMIC ACHIEVEMENTS, BELIEFS AND CONTEXTUAL FACTORS IN PREDICITING CREATIVE THINKING PROFICIENCY AMONG ADOLESCENTS IN NORTH MACEDONIA

Beti LAMEVA
National Examinations Centre, Skopje, Republic of North Macedonia
betilameva@dic.edu.mk

Zhaneta CHONTEVA
Bureau for Development of Education, Skopje, Republic of North Macedonia
zanetaconteva@bro.gov.mk

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ABSTRACT:

This research investigates the role of students' academic achievements in mathematics, science, and reading literacy, their beliefs and attitudes about their own creativity and demographic and contextual factors in predicting creative thinking proficiency among 15 years old students in the Republic of North Macedonia. Data for the research are based on the 2022 cycle of the Programme for International Students Assessment (PISA). Creative thinking is defined as the competence to engage productively in the generation, evaluation, and improvement of ideas that can result in original and effective solutions, advances in knowledge, and impactful expressions of imagination. It is operationalized through three ideation processes (generating diverse ideas, generating creative ideas, and evaluating and improving ideas) and four domains (written expression, visual expression, social problem solving, and scientific problem solving). The sample is consisted of 4,169 fifteen years old students that have complete data on all predictors. Results from the linear multiple regression analysis show that mathematics ($\beta = .25$), science ($\beta = .21$), and reading literacy ($\beta = .17$) are the strongest positive predictors of creative thinking, stressing the foundational role of academic skills. Demographic and contextual factors, including language of instruction, gender, educational track, and economic, social, and cultural status, also are significant predictors. But, attitudinal variables such as creative self-efficacy, curiosity, growth mindset on creativity, imagination and adventurousness and openness to art and reflection had minimal predictive power. These research findings show that strengthening creative thinking in North Macedonia requires raising foundational literacy skills, students must first be supported to reach the level of understanding that allows them to apply, extend, and transform their knowledge in new ways. They also highlight the need for educational policies and practices that integrate creativity-supportive instruction and cultivate growth-oriented mindsets in both teachers and students.

Keywords: *critical thinking, PISA 2022, creative self-efficacy, curiosity, growth mindset on creativity, imagination and adventurousness, openness to art and reflection.*

Introduction

PISA 2022 research cycle defines creative thinking as "the competence to engage productively in the generation, evaluation and improvement of ideas that can result in original and effective solutions, advances in knowledge and impactful expressions of imagination" (Organization for Economic Cooperation and Development [OECD], 2024, p.47). For measurement purposes in PISA 2022, the construct of creative thinking is consisted of three ideation processes: generating diverse ideas, generating creative ideas and evaluating and improving ideas. Given the age of PISA test takers and the amount of available testing time, tasks in the PISA 2022 creative thinking test were situated in four different domain contexts: written expression, visual expression, social problem solving and scientific problem solving (OECD, 2024, p.49).

The importance of developing creative thinking in education is recognized and reflected in national curricula worldwide. Nearly all PISA 2022 participating countries reported creativity as an intended student outcome in education. It is as well reflected in the national educational documents in the Republic of North Macedonia. Key areas of action, defined in the Concept for Primary Education, are mastering transversal skills such as critical thinking, entrepreneurship, creativity, and civic engagement through transdisciplinary, student-centered, and challenge-based approaches (Ministry of Education and Science [MES], 2021a). Additionally, creative thinking is regulated in the National Standards for students in primary education. National standards are based on the competence that students should develop and master by the end of primary education. In each domain of the standards competencies referring to development of creative thinking can be found (MES, 2021b). North Macedonia has identified creativity as a priority cross cutting theme or competency in its curricula, but there is no explicit reference to the development of creative skills within specific subject areas. There are no clear guidelines or learning progressions to guide educators on how to integrate opportunities for students to recognize and develop creative thinking across different curricular domains.

In PISA 2022 creative thinking is measured explicitly for the first time as a key competency for a rapidly changing world, so students' beliefs about their own creativity are part of the picture in understanding how it develops. A **growth mindset on creativity** is one of several positive attitudes and beliefs associated with better performance on creative thinking tasks. If students believe that their creativity cannot change much that may limit how much they engage in effortful creative-thinking work and may affect how educational systems encourage creativity (OECD, 2024).

Besides the mindset, research studies have identified an array of student beliefs and attitudes that relate to creative thinking proficiency. **Creative self-efficacy** describes an individual's beliefs about their capacity to successfully produce creative work, especially when faced with challenges (Beghetto & Karwowski, 2017). **Openness to art and experience** outlines an individual's receptivity to engage with novel ideas, imagination, and fantasy (Berzonsky & Sullivan, 1992). Its predictive value for creative achievement across domains is likely due to its inclusion of cognitive

(imagination), affective (curiosity), and behavioral aspects (adventurousness) (Chávez-Eakle, 2009). **Imagination and adventurousness** connect to the divergent thinking component of the creative thinking process (Guilford, 1956). Divergent thinking refers to the ability to think of original ideas, to make flexible connections between ideas or pieces of information, and to apply fluency of association and ideation (Cropley, 2006). **Curiosity** manifests in several attitudes towards creative thinking, and in particular in attitudes that relate to open-mindedness (e.g., openness to art and experience). Students with a high degree of curiosity show greater interest in novel ideas, love of learning, understanding, intellectual exploration, and an inquisitive mindset (Chávez-Eakle, 2009).This research aims to investigate how students' achievements in mathematics, science, and reading literacy together with their beliefs and attitudes about their own creativity, as well as with relevant demographic and contextual factors, jointly predict their creative thinking proficiency.

Research methodology

Sample

The research sample is consisted of 4,169 fifteen years old students, those with complete data on all predictor variables. The assessments were conducted in both Macedonian and Albanian language, thus 73% of the students present on the testing day were evaluated in Macedonian, while 27% were tested in Albanian language.

Instrument and Variables

The instrument used to measure students' creative thinking proficiency is PISA 2022 Creative Thinking Test (OECD, 2023). Students who participated in PISA 2022 assessment spent one hour completing creative thinking items, while the remaining hour of testing time was assigned to mathematics, reading, or scientific literacy tasks. In addition, students also responded to background questionnaires that gathered data on their economic, social, and cultural status as well as on their beliefs and attitudes toward creative thinking, following the international research protocol of PISA 2022.

The creative thinking test is consisted of 32 open ended items organized into units based on common stimuli. Each unit differed in the ideation process required, length, number of items, and domain context (OECD, 2023). Scores are reported on a bounded scale ranging from 0 to 60 score points, representing the total possible points available across all test items. A score of 60 points indicate the maximum performance across the entire test-item pool (OECD, 2024). Students' results reflect estimated scores, calculated as the sum of full and partial credit responses that a student would likely achieve if they completed all 32 items. Each task in the PISA Creative Thinking Test is open ended, allowing for multiple valid and original responses. Scoring is based on human judgment but it is supported with detailed coding rubrics and item specific scoring guides (OECD, 2024).

The main variable in this research is **creative thinking** proficiency operationalized as the students' scores on the PISA 2022 creative thinking scale (0–60 points). Higher scores indicate a greater ability to generate, evaluate, and refine original ideas within the contexts assessed by the PISA 2022 framework (OECD, 2024).

Reading literacy isindividual's capacity to understand, use, evaluate, reflect on, and engage with texts in order to achieve one's goals, develop one's knowledge and potential, and participate in society (OECD, 2024). It is assessed based on the total score obtained from the reading literacy test tasks in PISA 2022.

Mathematical literacy is defined as an individual's capacity to reason mathematically and to formulate, employ, and interpret mathematics to solve problems in a variety of real world contexts. It includes concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to know the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective 21st century citizens (OECD, 2024). It is assessed on the total score obtained from the mathematical literacy test tasks in PISA 2022.

Science literacy is defined as ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires the competencies to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically (OECD, 2024).It is assessed on the total score obtained from the science literacy test tasks in PISA 2022.

Index of Economic, Social, and Cultural Status (ESCS) is a composite score derived from three indicators related to family background: parents' highest education in years, parents' highest occupational status and home possessions. Based on the score three groups are created: low, medium and high ESCS (OECD, 2024).

Language of instruction, two categories of this variable are defined: Macedonian language of instruction and Albanian language of instruction.

Educational Track,three categories of this variable are defined: Gymnasium, Vocational education, and Art schools. The classification is based on the type of upper secondary programme in which the student was enrolled at the time of testing.

Gender is self-reported by students in the PISA student questionnaire andtwo categories of the variable are defined: Girls and Boys.

Creative thinking self-efficacy scale, this scale reflects students' self-perceived confidence in performing tasks that are reflective of creative thinking skills. Each of the 10 items included in this scale had four response options (OECD, 2024).

Curiosity scale reflects students' ratings of their agreement with statements about a range of behaviors indicative of curiosity. Each of the 10 items included in this scale had five response options (OECD, 2024).

Growth mindset on creativity scale reflects students' ratings of their agreement with a range of statements indicative of their mindset. Each of the four items included in this scale had four response options and were reverse-coded prior to scaling (OECD, 2024).

Imagination and adventurousness scale reflects students' ratings of their agreement with statements regarding their own views on their imagination and adventurousness. Each of the seven items included in this scale had four response options (OECD, 2024).

Openness to art and reflection scale reflects students' ratings of their agreement with statements regarding their own views on their openness to art and experience. Each of the five items included in this scale had four response options.

Statistical data analysis

Scale indicesare constructed by scaling multiple items with the generalized partial credit model (GPCM) (Muraki, 1992). The GPCM model describes the probability that a person will provide a certain type of response to a polytomous item, taking into account the person's trait level and the item's affectivity (or difficulty)Values of the index correspond to standardized Warm likelihood estimates (Warm, 1989).

Multiple regression analysis was utilized to predict students' creative thinking achievement using SPSS Statistics 21. Weights were applied to the student-level data, ensuring that the sample was representative of the broader population. Categorical predictors, including students' index of economic, social, and cultural status (ESCS), and the language of instruction and gender were dummy coded.

Results

Students in North Macedonia achieved low average score in creative thinking assessment (19 points), significantly below the OECD average of 33 points (OECD, 2024). The results of the multiple regression analysis are summarized in Table 1.

Table 1. Results from multiple regression analysis

Variable	B	SE B	β	t	p
(CONSTANT)	-22.85	1.30		-17.56	
Creative self-efficacy	0.26	0.21	0.02	1.25	>.05
Curiosity	0.21	0.23	0.02	0.92	>.05
Growth Mindset on Creativity	-0.03	0.17	0.00	-0.15	>.05
Imagination and Adventurousness	0.28	0.22	0.02	1.27	>.05
Openness to Art and Reflection	0.00	0.32	0.00	0.00	>.05

Variable	B	SE B	β	t	p
LA: Macedonian	6.04	0.55	0.21	10.94	< .001
Gender: Girls	1.37	0.43	0.05	3.21	< .001
ET: Vocational	-1.29	0.47	-0.05	-2.74	< .01
ET: Artistic	1.89	1.34	0.02	1.41	>.05
ESCS: Medium	-1.14	0.47	-0.04	-2.42	<.05
ESCS: Low	-2.48	0.59	-0.08	-4.18	< .001
Science Literacy	0.03	0.01	0.21	6.77	< .001
Reading Literacy	0.03	0.00	0.17	7.10	< .001
Mathematical Literacy	0.04	0.00	0.25	9.21	< .001

Note. Reference categories: Language of Assessment (LA) = Albanian, Gender = Boys, Educational Track (ET) = Gymnasium, Index of Economic, Social, and Cultural Status (ESCS) = High. B = unstandardized coefficient; SE B = standard error of B; β = standardized coefficient; t = t-statistic; p = significance.

From the presented results, we can see that the model is statistically significant and there is a substantial proportion of the variance in creative thinking, $R^2 = .58$, adjusted $R^2 = .58$, SE = .01, that can be explained by the predictors (approximately 58%).

Among the predictors, academic achievement in mathematics literacy ($\beta = .25$, $p < .001$), science literacy ($\beta = .21$, $p < .001$), and reading literacy ($\beta = .17$, $p < .001$) were the strongest positive contributors to creative thinking.

Students believes and attitudes toward their own creativity, including creative self-efficacy, curiosity, growth mindset on creativity, imagination and adventurousness, openness to art and reflection, showed small and non-significant effects (β ranging from 0.00 to 0.02, $p > .05$).

Demographic and contextual factors had mixed effects, we can see that girls scored higher than boys ($\beta = .05$, $p < .001$), students in vocational tracks scored lower than gymnasium students ($\beta = -.05$, $p < .01$), and lower socioeconomic status was associated with lower creative thinking scores ($\beta = -.04$ to $-.08$, $p < .05$). Language of assessment also had a significant effect, with Macedonian-language students scoring higher than Albanian-language students ($\beta = .21$, $p < .001$).

Discussion

Students' academic performance in the Republic of North Macedonia show consistently low results on international assessments (Mullis et al., 2023; von Davier et al., 2024; OECD, 2024). They are placed at the lowest proficiency levels, indicating that many of them have not yet reached even the basic knowledge and comprehension levels in reading, mathematics, and science. From the PISA 2022 Creative Thinking assessment, it is evident that students face difficulties not only with cognitive tasks that require arriving at a single correct answer, but also with open-ended tasks that have no pre-defined solution and require students to generate original ideas or propose creative solutions.

Results from the multiple regression analysis show that mathematical, reading, and science literacy are the strongest predictors of students' creative thinking proficiency. The positive coefficients for mathematical literacy (β = 0.25), reading literacy (β = 0.17), and science literacy (β = 0.21), all statistically significant at $p < .001$, indicate that students with higher core academic skills are more capable of generating, evaluating, and communicating original ideas. The attitudinal variables in this model did not show statistically significant effects. Creative self-efficacy, curiosity, imagination and adventurousness, and growth mindset about creativity all had very small effects (β values near zero), and none reached statistical significance. This indicates that students' beliefs do not translate into higher creative performance if they lack the basic academic and cognitive knowledge and skills needed to express those ideas. In the educational context of North Macedonia, where teaching tends to be reproductive and focused on correct answers, creative dispositions alone may not be enough to support creative behavio Demographic and contextual factors also play a significant role. Students who took the test in Macedonian language scored significantly higher compared to those tested in Albanian, suggesting possible differences in instructional quality or access to learning resources. Girls outperformed boys, which aligns with international patterns where girls often show stronger performance in tasks with written expression and elaboration. Differences between educational tracks are also evident: students in vocational education scored lower, while students in artistic tracks scored slightly higher, though not significantly. This refers to contrary emphasis on creative expression and problem-solving across curricular pathways. Additionally, socioeconomic status showed a clear effect; with students from low ESCS backgrounds scoring significantly lower, supporting the research evidence that opportunity and resource inequalities shape cognitive outcomes.

An important lesson learnt from the OECD creativity project is that a key condition for the successful implementation of activities with opportunities for creative thinking in education is to create a caring and non-threatening environment where students are willing to take the risk of sharing their personal ideas (OECD, 2024). This environment presupposes a series of teacher attitudes and beliefs, such as a positive attitude towards mistakes and a belief in the malleability of students' skills and knowledge. These further supports students to develop a growth mindset on creativity, which in turn helps students, persist longer in the creative process. In North Macedonia, the interplay between teachers' professional mindsets and students' learning mindsets presents both opportunity and challenge for advancing creative thinking and academic achievement. Results from the Teaching and Learning International Survey (**TALIS) 2024** cycle show that only about **half of teachers** believe that intelligence is malleable and can be developed over time, indicating that many educators still hold a**fixed mindset**regarding abilities (OECD, 2025). From the student side,**PISA 2022**results show that**65% of 15 years old in North Macedonia believe that their own creativity cannot change very much,** reflecting a similarly fixed mindset about creative ability. This alignment suggests that existing classroom environments may not be sufficiently supporting students in viewing creativity as a skill that can be learned and practiced. **Professional**

development that focuses on developing teacher strategies for nurturing students' belief in the trainability of creativity, for example, modeling creative thinking processes, valuing idea exploration, and providing low-risk opportunities for originality, could help shift classroom culture toward one that supports creative growth.

Policymakers in North Macedonia can support schools and teachers to reflect on and experiment with new practices in different ways. The first step needed in promoting the development of creative thinking consistently and effectively in education is ensuring that students have strong basic, foundational literacy skills, particularly reading with understanding. Without sufficient reading comprehension, students struggle to access, interpret and build upon new ideas, which are essential conditions for creative thought and problem solving. Beside literacy development, it is crucial for educators, curriculum developers and assessment designers to have a shared understanding of what creative thinking is, how students can develop creative thinking skills, and how their progress can be measured.

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