Educación XX1
ISSN: 1139-613X · e-ISSN: 2174-5374

Creative problem-finding and problem-solving in Primary Education. Influence of gender, grade and school

Búsqueda y resolución creativa de problemas en Educación Primaria. Influencia del género, curso y centro

Eva Izquierdo-Sanchis [1]
Yolanda Echegoyen-Sanz [1]
Antonio Martín-Ezpeleta [1*]

[1] University of Valencia, Spain
* Corresponding author. E-mail: anmarez@uv.es

How to reference this article:

Izquierdo-Sanchis, E., Echegoyen-Sanz, Y., & Martín-Ezpeleta, A. (2025). Creative problem-finding and problem-solving in Primary Education. Influence of gender, grade and school. *Educación XX1, 28*(2), 147-169. https://doi.org/10.5944/educxx1.39907

Date received: 13/02/2024
Date accepted: 20/12/2024
Published online: 20/06/2025

ABSTRACT

Creativity has been defined as a key competence for the 21st century. Its presence in the educational debate has been intensified by the attention paid by the Organization for Economic Cooperation and Development and the latest educational laws, as is the case in Spain. In this context, the objective of the present study is to assess the creativity of Primary Education students, analyzing the influence of variables such as gender, grade and educational center. Participants were 1679 students from twelve educational centers homogeneously distributed among the six grades of this educational stage, with ages between 5-13 years. A problem-finding and problem-solving test was administered. The results show an increase in creativity throughout Primary Education, but with a clear decrease in 8- and 9-year-old students, which could be related with the so-called "fourth-grade slump". There are also statistically significant differences between men and women both in the search and problem-solving phases. The influence of the educational center on students' creativity is evident, with the average percentile varying between 32.0 and 53.4, and obtaining statistically significant differences between them. This allows us to conclude the unequal attention that creativity is receiving in educational centers and the necessary reflection on instructional changes that contribute to channeling creative thinking in a particularly sensitive stage of development. Future studies will analyze the influence of the different methodologies used in educational centers on students' creativity.

Keywords: creativity, creative thinking, problem-solving, competence assessment, Primary Education

RESUMEN

La creatividad ha sido definida como la competencia clave del siglo XXI. Su presencia en el debate educativo se ha visto intensificada por la atención prestada por la Organización para la Cooperación y el Desarrollo Económico y las últimas leyes educativas, como es el caso español. En este contexto, el objetivo del presente estudio es evaluar la creatividad de los estudiantes de Educación Primaria, analizando también la influencia de las variables género, curso y centro educativo. Los participantes fueron 1679 estudiantes de doce centros educativos distribuidos homogéneamente entre los seis cursos de esta etapa educativa, con edades comprendidas entre 5-13 años, a los que se administró una prueba de búsqueda y resolución de problemas. Los resultados muestran un aumento de la creatividad a lo largo de la Educación Primaria, pero con una clara disminución en los alumnos de 8 y 9 años, que cabría relacionar con la denominada "depresión del cuarto grado". Existen, además, diferencias estadísticamente significativas entre hombres y mujeres en las fases de búsqueda y de resolución del problema. La influencia del centro educativo en la creatividad de los estudiantes queda patente, variando el percentil medio entre 32.0 y 53.4, y obteniéndose diferencias estadísticamente significativas entre ellos. Esto permite concluir la desigual atención que la creatividad está recibiendo en los centros educativos y la necesaria reflexión

sobre cambios instruccionales que contribuyan a canalizar el pensamiento creativo en una etapa de desarrollo especialmente sensible. Futuros estudios analizarán la influencia de las diferentes metodologías empleadas en los centros educativos en la creatividad de los estudiantes.

Palabras clave: creatividad, pensamiento creativo, resolución de problemas, evaluación de competencias, Educación Primaria

INTRODUCTION

Creativity and education

Creativity, understood as "the interaction between aptitude, process, and environment with which an individual or a group produces a perceptible, new, and useful product in accordance with the social context" (Plucker & Beghetto, 2004, p. 154), is demonstrated as a construct in whose definition its social nature is emphasized. This connects with its relevance for educating 21st-century societies, which are characterized by their constant and rapid technological, economic, and social changes (with explicit mention of the Covid-19 pandemic), typical of a new world that demands an innovative attitude (Patston et al., 2021). However, the relationship between creativity and education is relatively recent.

The early studies by Torrance or Guilford in the mid-20th century did not advocate for a conceptualization of creativity as a talent that could be educated. These studies focused on identifying creative individuals, particularly relating it to IQ and personality types. It was not until the late 20th century that an author like Csikszentmihalyi decisively contributed to rethinking creativity, focusing on the possibility of learning how to channel it according to his theory of creative flow (2004). Since then, studies have emerged showing the importance of education and educational institutions in nurturing students' creative skills, with aims that are not only personal or professional but also social (Vincent- Lancrin et al., 2019).

However, without the commitment of the Organization for Economic Co-operation and Development (OECD) to promote creativity in education (OECD, 2019), the recent changes in educational systems in this regard, as seen paradigmatically in Spain, would be difficult to explain. The recent Organic Law on the Modification of the Organic Law of Education (LOMLOE) of 2020 grants great importance to creativity from its preamble, and then firmly adds that "creativity will be worked on in all subjects" (p. 122874). This completes the gradual attention that recent educational laws have demanded, ranging from the vague references in the General Education Law (LGE) of 1970 and the Organic Law on the General Organization of the Educational System (LOGSE), where creativity is identified with innovation or even discovery learning, to the reflection in the Organic Law on the

Quality of Education (LOCE) of 2002 on the social and educational importance of creativity and its role as an indicator of educational quality. As is well known, this law was never passed, but its focus gained traction in subsequent laws: the Organic Law on Education (LOE) of 2006 emphasizes attending to "the students' ability to […] develop creativity" (p. 16) both in Primary Education (art. 16.2 and 17.b) and Secondary Education (art. 33.k); and the Organic Law for the Improvement of Educational Quality (LOMCE) of 2013 defines creativity in its preamble as one of the necessary transversal competencies, as well as one of the indispensable cognitive skills, for shaping active, entrepreneurial, and innovative individuals.

These recent aspects highlight the multidisciplinary attention that creativity has received and underscore its great educational value in clear relation to essential aspects such as communication, teamwork, and adaptability. Special mention should be made of the relationship between creativity and the capacity to find suitable solutions to challenges and complex problems in various domains, such as daily life, academics, professional life, or, among others, personal matters. Therefore, it is not surprising to see a proliferation of studies on problem-finding and problem-solving, particularly in specific disciplines such as Experimental Sciences (Solaz-Portolés & Sanjosé, 2007) but also in Language and Literature (Pont-Niclòs et al., 2024), for example. Regarding mathematical creativity, researchers distinguish between mathematical creativity at the professional and school levels, highlighting that, in the latter case, mathematical creativity involves generating novel solutions and formulating new questions within the field of Mathematics. Thus, mathematical creativity is closely related to problem-solving, and some scholars consider it the ability to generate useful and creative solutions to problems using mathematical models (Nadjafikhah et al., 2012).

All of this, along with the demonstrated direct relationship between creativity and academic performance, explains the proliferation of studies in educational contexts that support the ability to train students in creative and innovative thinking, especially during the sensitive formative years of Primary Education (Alfonso-Benlliure & Santos, 2016). However, it is important to note that research conducted with teachers shows that they do not feel prepared to effectively promote creativity among students, mainly due to the demands of an extensive curriculum and the pressure to achieve good results in standardized national tests (Makel, 2009). It is concerning that teachers who have a positive attitude toward fostering creativity in the classroom do not design activities to develop it in their teaching practices (Bereczki & Kárpáti, 2018), and that there are even studies showing that there is no alignment between certain implicit theories about creativity (often associated with originality or artistic creation) and explicit theories based on research (Mullet et al., 2016). This leads to situations where behaviors that are not creative are considered creative and vice versa (truly

creative behaviors are censured), such that what seems like fostering creativity in the classroom is actually the opposite, what has been defined as an "illusion of knowing" (Skiba et al., 2010). Moreover, the curricula do not provide guidelines or directions on how teachers can implement creativity in the classroom (Patston et al., 2021). In this regard, studies call for intensifying teacher training in creativity (Echegoyen-Sanz & Martín-Ezpeleta, 2021; Martín-Ezpeleta et al., 2024).

These issues help explain the mediocre creativity results in the Programme for International Student Assessment (PISA), where South Korea ranked first with an average score of 38.1 out of a possible 60 points. Spain is at the OECD average, with 32.8 points, indicating that there is much room for improvement (OECD, 2024). These PISA tests measure creativity in 15-year-old students, but they can be seen as a tool for evaluating the health of educational systems in relation to creativity. However, evaluations are needed at other educational levels and critical ages, thus generating creativity maps that detect problems in educational systems or serve to endorse and disseminate best practices.

The Evaluation of Creativity and the Creative Process of Problem-Solving

Although creativity and the creative process are closely related, it is important to note that they refer to different aspects of generating novel and useful ideas. While creativity is the ability to produce those ideas and is centered on the outcome or creative potential of the person, the creative process is the set of stages or steps through which a creative idea is developed, from its initial conception to its materialization. This also explains why the evaluation of creativity has always been a controversial topic due to the variety of existing conceptual definitions and the lack of reliability of the instruments used to measure it, which results in not always measuring the same aspect of creativity (Reiter-Palmon et al., 2019). Creativity tests are based on a variety of approaches and methods designed to measure different extremes of creative ability. Thus, some tests are based on principles of psychometric theory (Torrance, 1990), other assessment approaches are based on theoretical models of creative processes (Dollinger et al., 2004), and some tests are designed to evaluate creativity in specific domains (Hu & Adey, 2002; Singh, 1987). The Torrance model, the most widely used, evaluates creativity in terms of three aspects: fluency (number of ideas), flexibility (variety of ideas), and originality (rarity of ideas).

Numerous studies on the subject have determined that divergent thinking (DT), characterized by generating multiple ideas, solutions, or possible approaches to solve a problem or face a situation, is a fairly reliable predictor of good creative performance. For example, the work by Plucker (1999), based on longitudinal studies initiated by Torrance in the 1950s, shows that nearly half of the variance in

this creative achievement can be attributed to DT test scores. Therefore, these DT tests are among the most used to assess creativity in educational contexts (Reiter-Palmon et al., 2019).

However, creativity can also be assessed as the ability to solve problems creatively. According to Mayer (2003), a problem arises when, in a particular situation, a goal must be reached, but there is no predictable or systematic method to resolve it. The creative problem-solving model by Isaksen et al. (2011) includes three main phases: (1) understanding the challenge, (2) idea generation, and (3) preparation for action. In the first stage, students explore and define their knowledge of the problem, applying problem-finding to identify the issue at hand. In the second stage, the idea generation or problem-finding stage, students are asked to diverge and propose creative ideas to solve the problem. In the last stage, students must evaluate their ideas and identify the most creative ones, which is considered a final step before the ideas can be put into practice.

Another commonly used approach evaluates the creative process through the Problem Finding model by Getzels and Csikszentmihalyi (1976), based on the hypothesis that the way one engages with the problem—by identifying and defining it—determines the creativity of its solution. Additionally, "problem-finding skills" intervene throughout the process, from formulation to resolution. Runco (1994) considers problem-finding as a prerequisite for the following phases of problem-solving, considering it a creative act in itself.

In this regard, Runco and Bower (2023) emphasize the importance of novelty and originality in creativity, noting that only research into processes can determine the actual mechanism that individuals use to generate them. Studies on "problem-finding," which encompass identification, definition, and construction of the problem (Jay & Perkins, 1997; Runco, 1994), show that questioning problems fosters the formation of creative ideas and helps focus on the problem or topic correctly. It is concluded that investing time in finding a problem is just as important as solving it.

In a study with university students who were presented with ill-defined or ambiguous everyday problems, it was shown that the process of problem construction positively influenced the creativity of the solution, although this could depend on the specific aspect of creativity being evaluated (Arreola & Reiter-Palmon, 2016). Similarly, Wigert et al. (2022) affirms that problem construction plays an essential role in creative problem-solving and that combining DT methods with convergent thinking methods (those in which individuals take available information and search for correct or conventional ideas) leads to more creative solutions than using only divergent methods. Also, in tasks involving creative problem-solving (where open-ended and undirected problems were presented in the scientific and social sciences domains) with 4th and 5th grade primary school students, Van Hooijdonk et al.

(2020) concluded that it is more productive to apply fact-finding and problem-searching methods (which are positively related to fluency and originality) than to use idea-searching methods. Indeed, students are able to recognize their most creative ideas but without dismissing other specific elements of creativity when searching for solutions.

It is of interest to understand the different variables that may affect students' creativity or their ability to solve problems creatively, as both abilities are closely related (Abdulla et al., 2020). This allows for identifying factors that enhance or limit creative development and helps design teaching strategies that promote creativity in various contexts. Several studies have addressed the development of different aspects of creativity across educational stages. A recent meta-analysis (Said-Metwaly et al., 2021) of 41 studies involving more than 40,000 students showed a general trend toward the ascending development of DT at all levels, with some discontinuities in 4th and 7th grades. Duval et al. (2023), using convergent and divergent tasks based on drawing, observed dynamic stages of development for both types of thinking (convergent and divergent). Thus, the loss of divergent thinking was counterbalanced by a gain in convergent thinking, especially during the decline in 4th grade. Regarding creative problem-solving and problem-finding, Alfonso-Benlliure and Santos (2016) demonstrated that while the overall value of creativity showed an upward trend as the grade level in Primary Education increased, mainly due to the DT component, the value assigned to other components studied, such as originality or material transformation, followed fluctuating paths, and the component of atypical manipulation remained stable throughout this educational stage.

The influence of gender on creative skills is still unclear, and according to Ivcevic et al. (2022), it is necessary to examine this influence across a wide range of tasks and creative domains. According to a review conducted by Baer and Kaufman (2011) in 21 studies using different DT tests, the remote association test (RAT), or evaluative thinking, no significant differences were found based on gender. Men scored higher than women on three studies analyzing DT, while women scored better in nine of the studies (six of which were DT). In another 19 studies, the results were mixed. In a more recent review of 133 articles published between 1975 and 2020 (Nakano et al., 2021), most studies reported gender differences, with 45.2% favoring women, 23.3% favoring men, and 31.5% showing varying results based on the evaluated content.

According to Rhodes (1961), there are four essential pillars in the study of creativity, known as the 4Ps: Person, Process, Product, and Press. For the "Press" aspect, it is crucial to consider the influence of the educational institution on students' creative performance. A review by Thomas and Berk (1981) highlighted a complex relationship for developing creativity, where an intermediate environment

(neither too structured nor too open or flexible) best promoted creativity. Recent research has shown the positive influence of alternative pedagogies with greater emphasis on individual initiative and action-based learning, such as in Montessori schools (Duval et al., 2023) or Waldorf schools (Besançon et al., 2015) for the case of creativity in children and adolescents, respectively.

Problem-finding and creative problem-solving skills are essential for success in the 21st century. The primary objective of the present study is to assess the creative problem-finding and problem- solving process of Primary Education students and study the variables that influence students' creativity, providing an opportunity to better understand how students are developing these key skills to face future challenges. By evaluating these skills in Primary Education students, we are identifying areas of strength and opportunities for improvement in developing these fundamental skills from an early age. Consequently, by understanding how these skills develop in childhood, educational practices can be improved to better prepare students for future careers and roles in an increasingly complex and changing world. This leads to the following research questions:

(i) What is the creative capacity of Primary Education students in problem-finding and problem-solving tasks?

(ii) How does their creativity evolve throughout this educational stage?

(iii) Do variables such as gender or school environment influence students' creativity?

METHOD

Design and Contextualization

This is an exploratory, quantitative, and cross-sectional study conducted with a convenience sample during the 2021-2022 and 2022-2023 academic years.

Prior to data collection, the school management teams, legal guardians, and participating students were informed about the scope and purpose of the research, as well as the data anonymization system and processing methods used, in accordance with the ethics committee of the University of Valencia. The questionnaires were administered on paper during a normal 45-minute class period in Spain. Both the teacher in charge of the class and a researcher were present while the students completed the task.

Participants

The study was conducted with 1679 students from 12 Spanish schools, both public (83.3%) and semi- private (16.7%), evenly distributed across the six grades of Primary Education, with a similar representation of schools from small towns and large cities. The demographic characteristics of the sample can be found in Table 1.

The gender distribution is quite balanced: 51.3% male, 48.7% female, with no students selecting the "other" gender option. The students' age ranged from 5 to 13 years, with a mean age of 8.84 and a standard deviation of 1.75.

Table 1
Demographic Characteristics of the Sample Studied

Grade	N	Gender	Frequency	Percentage (%)
First	277	Male	156	56.3
		Female	121	43.7
Second	294	Male	159	54.1
		Female	135	45.9
Third	264	Male	129	48.9
		Female	135	51.1
Fourth	296	Male	162	54.7
		Female	134	45.3
Fifth	296	Male	126	42.6
		Female	170	57.4
Sixth	252	Male	130	51.6
		Female	122	48.4

Assessment instrument

To evaluate the creativity of the students, the Child Creativity Test (TCI, for its acronym in Spanish) (Romo et al., 2008) was used. This test is based on the problem discovery model (Getzels & Csikszentmihalyi, 1976) and evaluates certain variables related to the identification, formulation, and solution of problems. The TCI, validated for a Spanish sample, has high validity and reliability, as well as robust

psychometric properties. Reliability was assessed using interrater agreement, with intraclass correlation coefficients of 0.95 for average measures and 0.80 for individual measures. The validity of the instrument, based on the consensus evaluation technique, showed an inter-judge agreement level, evaluated through Cronbach's alpha, of 0.80 (Romo et al., 2008). In the present study, two evaluators conducted the questionnaire scoring, achieving a good degree of agreement (0.876), calculated using Cohen's kappa for average measures. This is a figurative task, appropriate for younger children who may not yet have mastered reading and writing but are accustomed to drawing. The test consists of two phases: "Problem Formulation," in which children create a model using stickers with familiar figures, and "Problem Solving," in which they draw based on the initial model. These features make the test a playful activity that is more likely to bring out creative potential (Romo et al., 2016). Additionally, it has the advantage of covering all phases of the creative process, not just the final outcome as in divergent thinking questionnaires.

In the first phase, two variables are assessed: originality and atypical manipulation (AM). Originality refers to the degree of uniqueness in the choice of stickers among the 28 provided to the students when creating their model, compared to the reference population (Primary Education). AM evaluates atypical exploratory behaviors not included in the instructions (such as drawing, overlapping, or fragmenting the stickers) in creating the model.

In the second phase, five variables are assessed: material change (MC), interaction (IN), verbal elements (VE), deviation from the model (DM), and invented added figures (IAF). Specifically, MC evaluates the use of more than one material in the drawing; IN measures the clear and intentional relationship between two or more elements of the drawing; VE includes the use of verbal resources that complement the graphic expression (such as titles, speech bubbles, numbers, etc.); DM considers the evident distancing of the drawing from the initial model; and, finally, IAF scores the appearance of figures in the drawing that were not present in the initial model or sticker sheet.

The total direct score of the test corresponds to the sum of three sections: PD A, PD B, and PD C. PD A corresponds to the score obtained in the originality variable; PD B or process-product variables corresponds to the sum of AM, MC, IN, VE, and DM; and PD C corresponds to the score for IAF. The total score can be converted into a percentile, following the reference tables provided by the authors of the TCI questionnaire in the correction manual, to place the student within their normative group.

Data Analysis

The statistical analysis of the collected data was carried out using SPSS version 28. First, the mean and standard deviation of each of the creativity variables studied were calculated. To assess the normality of the data, the Kolmogorov-Smirnov test for a single sample was performed. Since all variables showed non-normal distributions, non-parametric tests were applied. The Mann-Whitney U test for independent samples was used to assess gender differences, and the Kruskal-Wallis H test was used to assess differences based on grade and educational institution. In the latter case, a *post hoc* analysis with Bonferroni adjustment was performed to test for significant differences through multiple comparisons. To study the possible differences in the various process-product variables, the Chi-square test was used. The significance level for all tests was set at .05. Effect size was calculated using Hedges' g or Cramér's V (for the Chi-square test), and its magnitude was evaluated according to Cohen's classification for Behavioral Sciences (Cohen, 1988).

RESULTS

General Descriptive Statistics

The general descriptive statistics show, in Table 2, the variables of the creative problem-solving process assessed by the TCI test. The variable PD A (originality) has the highest average score (M = 0.64, out of 1; SD = 0.08), while the group of variables within PD B (M = 2.65, out of 10; SD = 1.95) and PD C (M = 0.20, out of 1; SD = 0.24) show similar, proportionally much lower scores than PD A.

Table 2
Descriptive Statistics of the Various Variables in Creative Problem-solving

Variable	Minimum	Maximum	Mean	Standard Deviation
PD A	0.28	0.95	0.64	0.08
PD B	0.00	10.00	2.65	1.95
PD C	0.00	1.00	0.20	0.24
Total PD	0.35	11.74	3.49	2.07

Note. Scoring ranges: PD A (0-1), PD B (0-10), PD C (0-1), Total PD (0-12).

It is important to highlight that the total average score of the analyzed sample corresponds to a percentile of 46.19, which is very close to the 50% mark, meaning it aligns with the standard population.

Differences by gender

From the analysis based on gender, it is concluded that in the PD A variable, males slightly outperform females, whereas in the PD B variable, females score higher than their male counterparts. Regarding the PD C variable, both genders obtained identical results (see Table 3).

When considering the total score, females achieved a higher average (M = 3.61; SD = 2.07) compared to males (M = 3.37; SD = 2.06). These values correspond to percentiles of 46.35 and 46.04, respectively, which place both genders in the standard population.

To determine whether the differences found were statistically significant, the Mann-Whitney U test for independent samples was applied. The result showed significant differences based on gender in the PD A variable, with a large effect size (g = 0.75), and in the PD B variable, with a small effect size (g = 0.15).

Table 3

Differences in TCI Test Variables by Gender

Variable	Gender	Mean	Standard Deviation	z	p
PD A	Male	0.67	0.07	-16.787	.000***
	Female	0.61	0.09		
PD B	Male	2.51	1.94	3.150	.002**
	Female	2.80	1.95		
PD C	Male	0.20	0.24	0.805	.421
	Female	0.20	0.24		
Total PD	Male	3.37	2.06	0.594	.552
	Female	3.61	2.07		

Note. **p<.01; ***p<.001.

Next, a detailed analysis of the different process-product variables (PD B) was conducted using the Chi-square test. Significant differences were found only in the

MC variable (material change): χ^2 (1, N = 1679) = 31.64, p < .001, with a small effect size (V = 0.137).

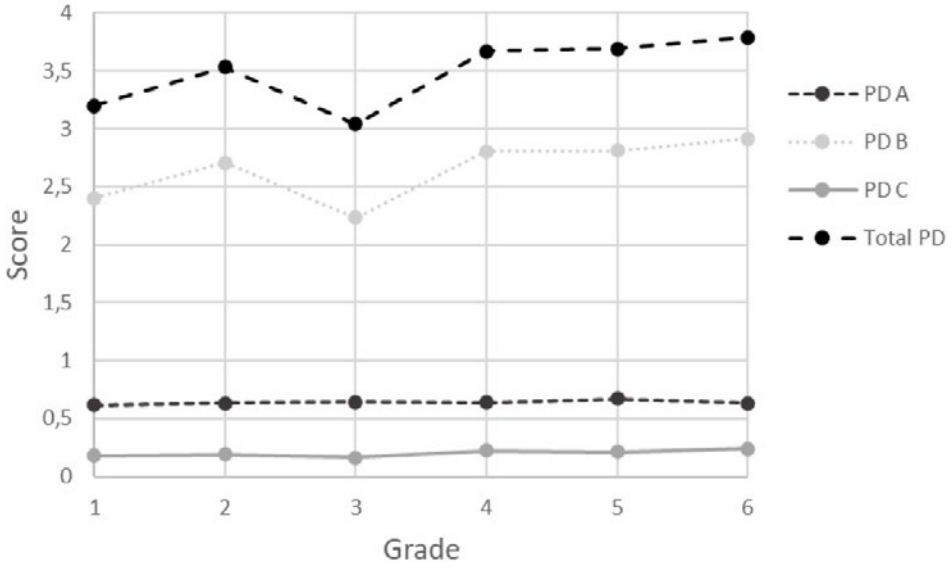
Differences by grade

From the study of the scores obtained for different variables by students from different Primary Education grades, it can be seen (Figure 1) that only the process-product variables (PD B) evolve, while originality (PD A) and IAF (PD C) remain stable with consistent average scores across the grades.

It is noteworthy that for the process-product variables, there is a positive evolution as students progress through Primary Education, with increasingly higher average scores, except for third grade, where there is a notable decrease. The total score shows a similar progression to the PD B variable due to the higher weight of this variable (10 points out of a total of 12).

Figure 1

Scores for the Different Variable Groupings by Grade



To verify if the observed differences by grade were statistically significant, the Kruskal-Wallis test for independent samples was also performed. The results, shown in Table 4, indicate that the differences are significant in all variables (PD A, PD B, and PD C), as well as in the total score.

Table 4
Differences in TCI Test Variable Groupings by Grade

Variable	H	p
PD A	69.815	<.001***
PD B	23.420	<.001***
PD C	18.809	.002**
Total PD	33.699	<.001***

Note. **p<.005; ***p<.001.

Since the PD B variable is made up of different process-product variables, and in order to examine in more detail where these differences lie, the Chi-square test was applied to each one. Significant differences were found in each of the five variables forming the group, all with small effect sizes, as shown in Table 5.

Table 5
Differences in the Variables Comprising PD B by Grade

Variable	Chi-square	p	V
AM	20.13	.001***	.102
MC	21.42	<.001***	.113
IN	27.61	<.001***	.127
VE	19.21	.002**	.107
DM	15.47	.009**	.093

Note. **p<.01; ***p<.001.

Influence of the Educational Institution

To determine whether there were differences between students across primary education grades in the schools studied, the Kruskal-Wallis test for independent samples was applied to the total direct scores. Significant differences were found in all grades except for 6th grade, as shown in Table 6.

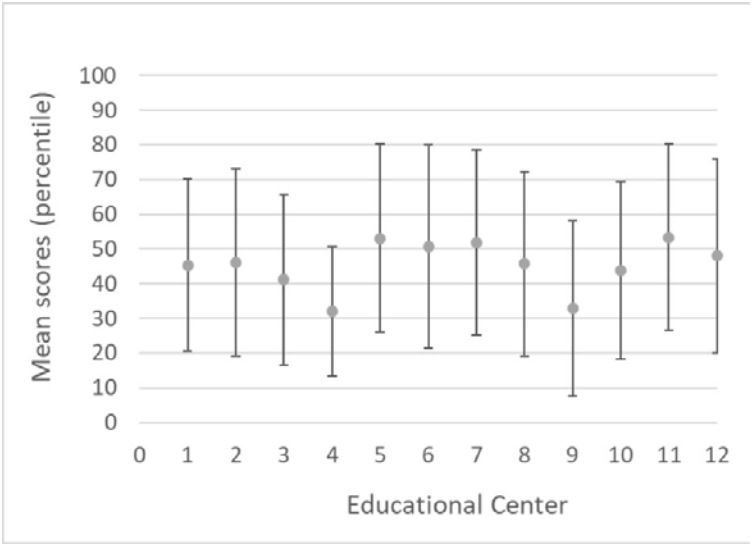
Table 6
Differences in Creativity of Students by Educational Institution for Each Grade

Grade	H	p
First	24.219	.004**
Second	26.790	.002**
Third	40.379	<.001***
Fourth	19.994	.010**
Fifth	55.037	<.001***
Sixth	13.801	.055

Note. **p<.01; ***p<.001.

In Figure 2, the mean scores obtained by students from each of the schools studied are shown. These data are presented in percentiles to eliminate the influence of the grade. It can be seen that some schools have percentiles around the 32% mark (schools 4 and 9), placing them well below the standard population, while others have values just slightly above 50% (schools 5, 6, 7, and 11). To analyze global differences between schools, the Kruskal-Wallis test for independent samples was applied, taking the percentile score to eliminate the influence of grade. Significant differences between schools were found, with H (11, n = 1679) = 56.44, p < .001. *Post hoc* comparisons were conducted using the Mann-Whitney test with Bonferroni adjustment, finding statistically significant differences between school 9 and schools 1 (p = .003), 2 (p = .001), 5 (p = .000), 6 (p = .000), 7 (p = .000), 8 (p = .003), 10 (p = .040), 11 (p = .000), and 12 (p = .004), with no significant differences found between the remaining schools.

Figure 2
Differences in the Average Scores obtained by Students from Different Educational Centers



DISCUSSION AND CONCLUSIONS

The objective of the present study was to examine the creativity of students during Primary Education and analyze the influence of the variables of grade, gender, and educational institution. Based on the obtained results, it is evident that the development of creativity increases as students advance through the Primary Education grades. These findings are consistent with studies conducted by Alfonso-Benlliure and Santos (2016) using the same instrument, as well as with the extensive meta-analysis carried out by Said-Metwaly et al. (2021) and the more recent research by Duval et al. (2023), among others. This upward trend may be due to older students becoming more creative as they gain more experience and knowledge, as a solid and broad knowledge base aids creativity by providing evaluative criteria to assess the quality and relevance of their ideas, thus enhancing their creative potential (Alfonso-Benlliure & Santos, 2016). However, children's creativity is often viewed as a static personality trait that does not consider potential changes over time (Kupers et al., 2019).

From this study, it is clear that not all variable groupings measured by the TCI test showed an increase as the grades advanced. Thus, PD A, which measures "Originality," and PD C, which evaluates "Invented Added Figures (IAF)," remained virtually constant, while the process-product variables, integrated into PD B (which include atypical manipulation, material change, interaction, verbal elements, and model deviation), showed a steady upward trajectory. These variables are those with the highest weight in the final score of the test (10 points out of a range of 12) and, therefore, have a greater predictive power for creative performance (Romo et al., 2008).

The development of creativity throughout childhood and adolescence has been the subject of numerous studies. Research measuring creativity as divergent thinking has identified a non-linear development pattern across childhood (Said-Metwaly et al., 2021). Torrance (1968) described three declines in performance at the ages of five, nine, and twelve. There is some controversy regarding the decline that occurs at age nine, known as the "fourth-grade slump," which has been the subject of numerous studies but with contradictory results. This study confirms a decline at third grade (8–9 years), which aligns with the phenomenon mentioned above, most commonly observed in fourth grade (Saggar et al., 2019), although some studies suggest a range of ages from 8 to 10 years (Duval et al., 2023). Alfonso-Benlliure and Santos (2016) found that global creativity and evaluative thinking skills showed an upward trajectory during Primary Education in Spanish students, in line with other dimensions such as intellectual and developmental, but divergent thinking showed irregularities due to motivation influences. Duval et al. (2023) concluded that there is a depression in divergent thinking in the fourth grade, which is compensated by an increase in convergent thinking. These authors suggest that the observed decrease might be caused by peer pressure and the need to adapt to social norms, such as those found in school environments, as social contexts influence creative thinking (Duval et al., 2023), or by internal factors like brain maturation.

Regarding the influence of gender on creativity, the present study found that females achieved a higher total average score than males, although the differences in percentile scores were minimal (46.35 vs. 46.04), placing both groups within the standard population. Nevertheless, significant differences were found in originality (in the problem-finding phase), where males scored higher, and in the material change variable (in the problem-solving phase), where females scored higher. These findings align with those presented by Ivcevic et al. (2022) in a study of Spanish students. It is worth noting that among reviews of gender differences in creative thinking, between 30% and 50% of studies found no significant differences between males and females, and those that did find differences have not identified a consistent pattern to explain them (Ivcevic et al., 2022; Nakano et al., 2021),

suggesting that gender differences in creative output are contradictory and warrant further research (Alfonso- Benlliure & Santos, 2016).

The role of the educational institution in the development of creativity is critical because, according to Rhodes' (1961) 4Ps theory of creativity, the external context in which the creative process takes place is one of the key factors. Educational institutions can provide the environment for creativity to be either enhanced or inhibited. Schools should offer students opportunities for exploration, experimentation, and problem-solving. Teachers can design activities and projects that stimulate creativity, foster originality, and encourage innovation. It is crucial for students to have the freedom to express themselves and share their ideas creatively and to be encouraged to think beyond conventional responses. In this sense, various studies have demonstrated that the type of institution, perceived teaching styles, and employed methodologies (Thomas & Berk, 1981; Besançon et al., 2015; Duval et al., 2023) influence students' creativity. This study has confirmed the importance of the educational institution in the creativity of its students, as significant differences were found between the schools analyzed. Future research aims to delve deeper into this issue to determine whether these differences are due to the nature of the institution or the methodologies used, comparing more innovative project-based schools with those using traditional methods. This is a promising line of investigation already being explored through a longitudinal study monitoring a school that recently began implementing a project-based approach, which will evaluate the evolution of students' creativity over four years.

Despite the limitations of this study, such as the sample size—which, though large, cannot be considered fully representative—the convenience sampling method, the cross-sectional design rather than longitudinal, and the limitations of the employed instrument (though validated), it can be concluded that the variables of gender, grade, and educational institution influence the creativity of Primary Education students. Furthermore, the results allow for triangulation with previous studies, although most of them come from different educational systems and countries, highlighting the need to complete the map of creativity in Spain. This task is pressing, as we are living in a particularly important moment for creativity, with the implementation of LOMLOE and its transdisciplinary focus on creativity, while international educational debate about this competency construct has never been as intense as it is now. It is worth noting that the results for this sample align with a moderate channeling of creativity in schools, leaving plenty of room for improvement.

Studies like this one are necessary to legitimize instructional changes based on evidence, such as general mediocrity but also excellence in certain schools, which should be carefully analyzed and their best teaching practices shared. Complementary to this, it is especially important to continue fostering

technical debate about creativity in educational institutions. This also involves a transfer process that includes completing teachers' training with scientific reflection on creativity and specific techniques to foster it in early ages. In this regard, the creation of a Creative School Plan is proposed, which, following the established model of the School Reading Plan, would involve planning actions to foster creativity collectively (even inviting creative risks in the classroom); since creativity, as specified by LOMLOE, must be worked on in all subjects—not only due to its transdisciplinary nature but also because it is an excellent strategy for fostering divergent thinking and demonstrating that what has been learned is useful for problem-solving.

ACKNOWLEDGEMENTS

Authors would like to thank all the educational institutions that participated in this study, as well as the funding by Grant PID2021-124333NB-I00 funded by MCIN/AEI/10.13039/501100011033 and by ERDF A way of making Europe and the support of Generalitat Valenciana through project CIAICO/2022/228 (Conselleria de Innovación, Universidades y Empleo).

REFERENCES

Abdulla, A. M., Paek, S. H., Cramond, B., & Runco, M. A. (2020). Problem finding and creativity: A meta-analytic review. *Psychology of Aesthetics, Creativity, and the Arts, 14*(1), 3–14. https://doi.org/10.1037/aca0000194

Alfonso-Benlliure, V., & Santos, M. R. (2016). Creativity development trajectories in Elementary Education: Differences in divergent and evaluative skills. *Thinking Skills and Creativity, 19*, 160-174. https://doi.org/10.1016/j.tsc.2015.11.003

Arreola, N. J., & Reiter-Palmon, R. (2016). The effect of problem construction creativity on solution creativity across multiple everyday problems. *Psychology of Aesthetics, Creativity, and the Arts, 10*(3), 287-295. http://dx.doi.org/10.1037/a0040389

Baer, J., & Kaufman, J. C. (2011). Gender Differences in Creativity. *Journal of Creative Behavior, 42*(2), 75-105. https://doi.org/10.1002/j.2162-6057.2008.tb01289.x

Bereczki, E. O., & Kárpáti, A. (2018). Teachers' beliefs about creativity and its nurture: A systematic review of the recent research literature. *Educational Research Review, 23*, 25-56. https://doi.org/10.1016/j.edurev.2017.10.003

Besançon, M., Fenouillet, F., & Shankland, R. (2015). Influence of school environment on adolescents' creative potential, motivation and well-being. *Learning and Individual Differences, 43*, 178-184. https://doi.org/10.1016/j.lindif.2015.08.029

Cohen, J. (1988). *Statistical power analysis for the Behavioral Sciences*. Lawrence Erlbaum Associates.

Csikszentmihalyi, M. (2004). *Creatividad, el fluir y la psicología del descubrimiento y la invención* (J. P. Tosaus, Trad., 4ª ed.). Paidós.

Dollinger, S. J., Urban, K. K., & James, T. A. (2004). Creativity and openness: Further validation of two creative product measures. *Creativity Research Journal*, *16*(1), 35-47. https://doi.org/10.1207/s15326934crj1601_4

Duval, P. E., Frick, A., & Denervaud, S. (2023). Divergent and convergent thinking across the schoolyears: A dynamic perspective on creativity development. *Journal of Creative Behavior, 57*(2), 186-198. https://doi.org/10.1002/jocb.569

Echegoyen-Sanz, Y., & Martín-Ezpeleta, A. (2021). Creatividad y ecofeminismo en la formación de maestros. Análisis cualitativo de cuentos digitales. *Profesorado. Revista de Currículum y Formación del Profesorado, 25*(1), 23-44. https://doi.org/10.30827/profesorado.v25i1.15290

Getzels, J. W., & Csikszentmihalyi, M. (1976). *The creative vision: A longitudinal study of problem finding in art*. J. Wiley & Sons.

Hu, W., & Adey, P. (2002). A scientific creativity test for secondary school students. *International Journal of Science Education*, *24*(4), 389-403. https://doi.org/10.1080/09500690110098912

Isaksen, S. G., Dorval, K. B., & Treffinger, D. J. (2011). *Creative Approaches to Problem Solving: A Framework for Innovation and Change*. SAGE Publications, Inc.

Ivcevic, Z., Zyga, O., Hoffmann, J. D., & Palomera, R. (2022). Gender and creative ability: Mean differences and performance variability. *Thinking Skills and Creativity, 46*, 101186. https://doi.org/10.1016/j.tsc.2022.101186

Jay, E., & Perkins, D. N. (1997). Creativity's compass: A review of problem finding. In M. A. Runco (Ed.), *Creativity research handbook*, vol. 1, (pp. 257-293). Hampton Press.

Kupers, E., Lehmann-Wermser, A., McPherson, G., & Van Geert, P. (2019). Children's creativity: A theoretical framework and systematic review. *Review of Educational Research, 89*(1), 93-124. https://doi.org/10.3102/0034654318815707

Ley Orgánica 10/2002, de 23 de diciembre, de Calidad de la Educación. *Boletín Oficial del Estado, 307*, de 24 de diciembre de 2002. https://www.boe.es/eli/es/lo/2002/12/23/10

Ley Orgánica 2/2006, de 3 de mayo, de Educación. *Boletín Oficial del Estado, 106*, de 4 de mayo de 2006, 17158-17207. https://www.boe.es/boe/dias/2006/05/04/pdfs/A17158-17207.pdf

Ley Orgánica 8/2013, de 9 de diciembre, para la Mejora de la Calidad Educativa. *Boletín Oficial del Estado, 295*, de 10 de diciembre de 2013. https://www.boe.es/eli/es/lo/2013/12/09/8/con

Ley Orgánica 3/2020, de 29 de diciembre, por la que se Modifica la Ley Orgánica 2/2006, de 3 de mayo, de Educación. *Boletín Oficial del Estado, 340*, de 30 de diciembre de 2020. https://www.boe.es/boe/dias/2020/12/30/pdfs/BOE-A-2020-17264.pdf

Makel, M. C. (2009). Help us creativity researchers, you're our only hope. *Psychology of Aesthetics, Creativity, and the Arts, 3*(1), 38-42. https://doi.org/10.1037/a0014919

Martín-Ezpeleta, A., Saneleuterio, E., Mínguez-López, X., & Echegoyen-Sanz, Y. (2024). Generación de metáforas creativas y percepción de la creatividad de los futuros docentes. *Revista Complutense de Educación, 35*(3), 659-669. https://doi.org/10.5209/rced.86027

Mayer, R. E. (2003). *Learning and instruction*. Prentice Hall.

Mullet, D. R., Willerson, A., Lamb, K. N., & Kettler, T. (2016). Examining teacher perceptions of creativity: A systematic review of the literature. *Thinking Skills and Creativity, 21*, 9-30. https://doi.org/10.1016/j.tsc.2016.05.001

Nadjafikhah, M., Yaftian, N., & Bakhshalizadeh, S. (2012). Mathematical creativity: some definitions and characteristics. *Procedia. Social and Behavioral Sciences, 31*, 285-291. https://doi.org/10.1016/j.sbspro.2011.12.056

Nakano, T. D. C., Oliveira, K. D. S., & Zaia, P. (2021). Gender differences in creativity: A systematic literature review. *Psicologia: Teoria e Pesquisa, 37*, 1-10. https://doi.org/10.1590/0102.3772e372116

OCDE (2019). *PISA 2021 creative thinking framework (third draft)*. OECD Publishing.

OCDE (2024), *PISA 2022 Results (Volume III): Creative minds, creative schools*. OECD Publishing. https://doi.org/10.1787/765ee8c2-en

Patston, T. J., Kaufman, J. C., Cropley, A. J., & Marrone, R. (2021). What is creativity in education? A qualitative study of international curricula. *Journal of Advanced Academics, 32*(2), 207-230. https://doi.org/10.1177/1932202X20978356

Plucker, J. A. (1999). Is the proof in the pudding? Reanalyses of Torrance's (1958 to present) longitudinal data. *Creativity Research Journal, 12*(2), 103-114. https://doi.org/10.1207/s15326934crj1202_3

Plucker, J. A., & Beghetto, R. A. (2004). Why Creativity Is Domain General, Why It Looks Domain Specific, and Why the Distinction Does Not Matter. En R. J. Sternberg, E. L. Grigorenko, y J. L. Singer (Eds.), *Creativity: From potential to realization* (pp. 153-167). American Psychological Association.

Pont-Niclòs, I., Echegoyen-Sanz, Y., & Martín-Ezpeleta, A. (2024). Assessing the linguistic creativity domain of last-year compulsory secondary school students. *Education Sciences*, *14*(2), 153. https://doi.org/10.3390/educsci14020153

Reiter-Palmon, R., Forthmann, B., & Barbot, B. (2019). Scoring divergent thinking tests: A review and systematic framework. *Psychology of Aesthetics, Creativity, and the Arts, 13*(2), 144-152. http://dx.doi.org/10.1037/aca0000227

Rhodes, M. (1961). An analysis of creativity. *The Phi Delta Kappan*, *42*(7), 305-310. http://www.jstor.org/stable/20342603

Romo, M., Alfonso-Benlliure, V., & Sánchez-Ruiz, M. J. (2008). *Test de Creatividad Infantil (TCI)*. TEA Ediciones.

Romo, M., Alfonso-Benlliure, V., & Sánchez-Ruiz, M. J. (2016). The child creativity test (TCI): Assessing creativity through a problem finding task. *Psicología Educativa, 22*(2), 93-101. https://doi.org/10.1016/j.pse.2016.01.005

Runco, M. A. (Ed.). (1994). *Problem finding, problem solving, and creativity*. Ablex Publishing Corporation.

Runco, M. A., & Bower, J. (2023). Processes involved in the generation of novel ideas. In G. Jagadeesh, P. Balakumar & F. Senatore (Eds.), *The Quintessence of Basic and Clinical Research and Scientific Publishing* (pp. 21-29). Springer. https://doi.org/10.1007/978-981-99-1284-1_2

Saggar, M., Xie, H., Beaty, R. E., Stankov, A. D., Schreier, M., & Reiss, A. L. (2019). Creativity slumps and bumps: Examining the neurobehavioral basis of creativity development during middle childhood. *NeuroImage, 196*, 94-101. https://doi.org/10.1016/j.neuroimage.2019.03.080

Said-Metwaly, S., Fernández-Castilla, B., Kyndt, E., Van den Noortgate, W., & Barbot, B. (2021). Does the fourth-grade slump in creativity actually exist? A meta-analysis of the development of divergent thinking in school-age children and adolescents. *Educational Psychology Review, 33*(1), 275-298. https://doi.org/10.1007/s10648-020-09547-9

Singh, B. (1987). The development of tests to measure mathematical creativity. *International Journal of Mathematical Education in Science and Technology*, *18*(2), 181–186. https://doi.org/10.1080/0020739870180203

Skiba, T., Tan, M., Sternberg, R. J., & Grigorenko, E. L. (2010). Roads not taken, new roads to take: Looking for creativity in the classroom. In R. A. Beghetto & J. C. Kaufman (Eds.), *Nurturing creativity in the classroom* (pp. 252-269). Cambridge University Press.

Solaz-Portolés, J. J., & Sanjosé, V. (2007). Cognitive variables in science problem solving: A review of research. *Journal of Physics Teacher Education Online, 4*(2), 25-32. http://www2.phy.ilstu.edu/~cjwennin/jpteo/issues/win2007.html

Thomas, N. G., & Berk, L. E. (1981). Effects of school environments on the development of young children's creativity. *Child Development, 52*(4), 1153-1162. https://doi.org/10.2307/1129501

Torrance, E. P. (1968). A longitudinal examination of the fourth-grade slump in creativity. *Gifted Child Quarterly, 12*(4), 195-199. https://doi.org/10.1177/001698626801200401

Torrance, E. P. (1990). *The Torrance tests of creative thinking norms—technical manual figural (streamlined) forms A & B*. Scholastic Testing Service, Inc.

Van Hooijdonk, M., Mainhard, T., Kroesbergen, E. H., & Van Tartwijk, J. (2020). Creative problem solving in Primary Education: Exploring the role of fact finding, problem finding, and solution finding across tasks. *Thinking Skills and Creativity, 37*, 100665. https://doi.org/10.1016/j.tsc.2020.100665

Vincent-Lancrin, S., González-Sancho, C., Bouckaert, M., de Luca, F., Fernández-Barrerra, M., Jacotin, G., Urgel, J., & Vidal, Q. (2019). *Fostering Students' Creativity and Critical Thinking: What it Means in School*. OECD Publishing.

Wigert, B. G., Murugavel, V. R., & Reiter-Palmon, R. (2022). The utility of divergent and convergent thinking in the problem construction processes during creative problem-solving. *Psychology of Aesthetics, Creativity, and the Arts*, *18*(5), 858–868. https://doi.org/10.1037/aca0000513