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The Bidirectional Relationship between Meta-Creativity and Academic Performance in University Students

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Abstract: Creativity has been studied in relation to academic performance, usually from the perspective of the creative result, with fewer studies focusing on the creative process and the student's awareness of that process, known as meta-creativity. This study aimed to analyze differences in meta-creativity based on academic performance groups (high or low) and determine the predictive power of meta-creativity belonging to the high or low academic performance groups. A total of 172 university students participated. Meta-creativity was assessed using a Meta-Creativity Questionnaire, which evaluated three dimensions (creative motivation, creative leadership, and divergent thinking). Additionally, academic performance was recorded, allowing for the classification of students based on high and low academic performance. The results of the analysis of variance indicated statistically significant differences between students with high and low academic performance in the three dimensions. Discriminant analysis indicated that the dimensions of meta-creativity were able to predict who belonged to the high and low academic performance groups. The model correctly classified 86.6% of the sample. It can be concluded that academic performance is a good indicator of the level of meta-creativity, and, additionally, meta-creativity has a beneficial effect on academic performance. There is a bidirectional relationship between the two variables.

Keywords: meta-creativity; creative leadership; creative motivation; divergent thinking; academic performance; university students

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1. Introduction

Currently, we are immersed in convulsive and frenetic changes that require creative solutions to unexpected situations. Therefore, education must foster the comprehensive development of students as creative thinkers capable of adapting, improvising, and innovating in a constantly changing and evolving society. In short, our students need to be given skills aimed at creative thinking and action. According to Rowe et al. [1], creativity is a natural activity that determines how we can achieve something innovative or different through originality and flexibility. It is a natural, basic characteristic of the human mind that is potentially present in everyone, although different levels of creativity can be established, with some individuals being exceptionally gifted.

Creativity is a cognitive process based on originality, flexibility, and initiative for the development of talents and skills. In this regard, education should also enhance versatility and imagination in response to a changing, constantly evolving society. Providing students with the necessary tools for their personal creative development should be one of our main objectives, as well as stimulating creativity to enhance constructive imagination and original thinking and maintain open, critical attitudes. In this regard, Ramírez and Fuentes [2] have shown that activities that promote creativity and foster student motivation lead to more meaningful learning.

In line with Larraz et al. [3], teaching processes are needed that can guide and accompany students' education from what they know towards creative thinking as a key competence for finding suitable answers to current problems. This approach underscores the importance of having a deeper understanding of creative abilities and processes. We aim to analyze levels of university students' meta-creative knowledge, specifically examining the underlying role of awareness of the creative process and its impact on academic performance, as this aspect seems to not have been explored in sufficient depth. While previous research has indicated the positive relationships between creativity and academic performance [4,5], to the best of our knowledge, no studies have examined the extent to which meta-creative knowledge or awareness of the creative process may affect university students' academic performance, considering the bidirectional relationship between the two (academic performance and meta-creative process).

2. Meta-Creativity: Awareness of the Creative Process

There is no doubt about the importance of creativity in education. More and more frequently, teachers at different educational levels engage in activities to foster students' creative thinking [6]. However, there is still much ground to cover regarding the analysis of the meta-processes involved in creative thinking [7]. In this regard, Kupers et al. [8] argued that there is a need to enhance research on creative processes, as a significant portion of published studies have focused on creative results and creative personalities, neglecting the process dimension.

Meta-creativity involves becoming aware of the creative process. Mevarech [9] highlighted that creative individuals regulate their creative processes, plan, seek additional or new ideas to perform a task, and reflect on their creative activities. Barbot [10] considered meta-creativity to be the awareness of thoughts and feelings during a creative experience, encompassing the ability to manage and control all elements involved in the creative process to produce a new creative product or to resolve an everyday problem. Sun et al. [11] expanded the concept of meta-creativity to include the deliberate implementation of strategies with the potential to foster creativity, in addition to awareness.

Individuals can activate meta-creative processes when performing different tasks creatively. Along these lines, Runco [12] analyzed various techniques for activating meta-creative strategies, specifically through questioning assumptions and changing perspectives. For any creative action, individuals seek original ideas, then reconstruct connections between different ideas, and finally explore various options. Similarly, people implementing meta-creative processes also regulate their solutions but do so by seeking original ideas, making connections between seemingly unrelated ideas, seeking additional solutions, as well as planning the functionality and applicability of their ideas.

Studies addressing creativity primarily focus on three lines of study: from the perspective of the creative process, from the product, and finally, from a combination of the two. This study focuses on analyzing the meta-creativity of the creative process. In this regard, Mevarech [9] considered the creative process to refer to the techniques or strategies used by creative individuals, whether consciously or unconsciously, to produce a new idea or combination, relationship, meaning, perception, or transformation. This process is characterized by several dimensions. According to Torrance [13], divergent thinking is one such dimension, manifested through fluency, flexibility, and originality.

Sun et al. [11] stated that fluency is the quantity of ideas a person can produce on a specific topic, whereas flexibility is the variety and heterogeneity of ideas produced, addressing problems from different angles. Taylor et al. [14] on the other hand, considered originality to be the characteristic that defines the idea or process as something unique or different.

Cropley [15] suggested that certain personality-related variables affect the creative process, including internal motivation, confidence, and nonconformity. He noted that motivation or achievement capacity are personality variables that may be related to the creative process. Sternberg and Lubart [16] believed that to be truly creative, one must be motivated, indicating that motivation is the incentive that leads to action. However,

Runco [12] added that imagination and the ability to work in a team are also characteristics that define a creative person.

At the same time, Kaufman [17] considered creativity to be an interactive, shared feedback process among individuals through teamwork that can influence the creative process. From this perspective, the ability to lead people, motivate them, and encourage their involvement are thought to be attributes that influence creative leadership. Labelle and Reyes [18] stated that such leadership is affected by a leader's sensitivity, their ability to encourage collaboration, their responsibility to the team, and their contribution of ideas.

In sum, considering the previous literature, meta-creativity includes three components or dimensions: creative motivation, creative leadership, and divergent thinking. This makes it all the more interesting to study differences in the meta-creative components based on academic performance.

3. Creativity and Academic Performance

Numerous studies have explored the relationship between creativity and academic performance. Most of these studies have indicated a positive correlation, heavily influenced by the choice of measurement instruments and evaluation procedures [19,20]. Mezcua et al. [21] examined various aspects, including creativity, and its connection to cognitive performance (mathematics and linguistics) through the CREA test, demonstrating a significant correlation unaffected by variables such as age or gender. Similarly, Sun et al. [11] found performance improvement, following a divergent thinking training program, to be an inherent aspect of creativity. However, Cárdenas et al. [22] was less conclusive, finding no definitive relationship between these variables. Along these lines, using structural equation modeling, Sangurima-Quito and Pineda-Quiroz [23] found that creativity had minimal influence on academic performance compared to other factors such as behavior.

Undoubtedly, creativity and academic performance are two variables of considerable interest. Therefore, when looking into the relationship between creativity and academic performance, it is crucial to precisely define performance.

Academic performance is a fundamental element in gauging the effectiveness of the education system. Solano [24] defined it as the level of knowledge demonstrated by a student in the field under evaluation, encompassing skills, knowledge, attitudes, and values developed during the teaching–learning process. Considering this, various authors have argued that a student's grades in a subject are valid indicators of academic performance, e.g., [25–27]. Studies such as Yagci [26] and Ben et al. [27] used students' average grades to determine academic performance.

Rastrollo et al. [28] highlighted that predicting academic performance was a key aim in education, allowing educators to design preventive teaching actions. Our study aimed to examine meta-creativity's ability to predict the academic performance of university students studying Information and Communication Technologies (ICT) applied to Education. This subject requires specific creative skills such as problem-solving and seeking creative solutions, which may affect academic success. Hence, it is essential for students to be aware of their capabilities.

In summary, based on the theoretical and empirical background reviewed above, and considering variables that have been analyzed with regard to meta-creativity, there is growing consensus from various studies that creativity may be influenced by factors such as academic performance. However, to the best of our knowledge, no studies have examined the extent to which meta-creative processes can affect academic performance, considering the bidirectional relationship between them. With these considerations, our study aimed to accomplish the following: (1) Analyze differences in the three meta-creative dimensions (creative motivation, creative leadership, and divergent thinking) based on academic performance group (high or low); (2) Identify which meta-creative dimensions have greater discriminatory and predictive power in classifying students based on their academic performance group. The research question was, what is the role and impact of the meta-creative process in relation to academic performance?

4. Method

4.1. Participants

The study involved a total of 172 university students enrolled in the first year of Early Childhood and Primary Education Degrees, which is a four-year degree. Almost two-thirds were women (110; 64%), while 62 were men. The participants were predominantly aged 18 to 21 years (79.1%), followed by those aged 22 to 25 years (12.2%), 26 to 29 years (5.2%), and lastly, over 30 (3.5%). The sample was selected following a non-probabilistic paradigm, based on convenience and accessibility criteria [29].

Based on academic performance, the low academic performance group comprised 105 students, while the high academic performance group included 67 students.

4.2. Instrument

All the participants (n = 172) completed the questionnaire designed for this study. Beginning from previous studies, which investigated the basic dimensions defining the meta-creative process (creative motivation, creative leadership, and divergent thinking) [13,16,17], we created an instrument called the Meta-Creativity Questionnaire (C-MECREA). The aim of this questionnaire was to facilitate and evaluate university students' reflections about the creative awareness they believe they possessed. The questionnaire is included in Appendix A. It comprises 10 items grouped into three dimensions (3 items on creative leadership, 3 items on creative motivation, and 4 items related to divergent thinking) with four response options (very low, low, high, and very high). The items were formulated by a focus group comprising three experts who specialized in education and educational psychology. The experts based their design of the questionnaire and items on the indicators associated with divergent thinking defined by Torrance [13], Sternberg and Lubart's [16] contributions about creative motivation as an important variable in the creative process, and Kaufman's [17] work on the impact of creative leadership on the creative process.

The questionnaire was statistically validated by means of an exploratory factor analysis. The corrected item–total correlation (ri-t) was positive in all items, with values ranging from 0.395 to 0.694, indicating that all items contributed to measuring the general construct that the instrument assesses, in the same direction. Furthermore, factorial analysis showed correlations above 0.30, reflecting the satisfactory discrimination of the indicators used. Cronbach's Alpha was high (0.806). The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.811, and Bartlett's sphericity test was significant ($p < 0.001$) with a chi-square value of 500.594, with 45 degrees of freedom.

Finally, the measure of academic performance was the students' grades in the subject ICT applied to Education (a compulsory subject lasting one semester in the first year of Early Childhood and Primary Education Degrees). Several authors consider such grades to be valid indicators of academic performance [25–27].

In this subject, both theoretical and practical knowledge are evaluated through four types of activities: (1) exploration and analysis activities, aiming to promote reflection through group dynamics; (2) evaluation and diagnostic activities, mainly of digital and audiovisual materials; (3) design activities for digital and multimedia materials; and (4) didactic integration activities for ICT, involving projects. The final grade for the subject is determined both by a written test assessing theoretical and practical knowledge and laboratory practicals.

4.3. Procedure

This study was conducted in accordance with the World Medical Association Code of Ethics (Declaration of Helsinki), reflecting ethical principles for research involving human subjects [30]. Prior to the survey, participants were informed that their participation was voluntary, and their responses would be treated anonymously. Participants were required to provide informed consent before completing the questionnaire.

All the participants completed the C-MECREA questionnaire digitally in September 2023, accessing it through a link sent to their university email addresses. Students

completed the C-MECREA questionnaire immediately after they had finished designing StoryGames. In this activity, the students had to create digital narratives that required them to use their creative abilities to develop stories in a digital format, enriched with augmented reality resources. The aim was to provide stories with greater interactivity and enhance engagement and immersion in digital narratives. Students had to devise an educationally valuable story, develop a script, design scenarios, take photos to create the story using stop-motion, create augmented reality resources as small games integrated into the story, and finally, assemble an audiovisual montage, resulting in StoryGames. This point was considered an ideal opportunity to enhance reflection and self-analysis of the creative process the students had undergone.

Academic performance was measured three and a half months later, following the completion of a written test and evaluation of three practical projects the students carried out (the development of StoryGames, creation of the augmented reality project, and the design of a notebook for the integration of programming and robotics). Once academic performance data were collected, the variable was recoded into two groups (low and high), with central values of the distribution coded as "missing," resulting in two distinct groups: low performance (grades between 4 and 5.6) and high performance (grades between 7.9 and 9.3).

4.4. Data Analysis

The data were collected digitally, organized, and analyzed using SPSS software, version 27. Initially, a descriptive analysis was conducted, examining the correlation matrix and the distribution of variables. Subsequently, considering the study objectives, univariate analyses of variance (ANOVA) were performed to determine differences between students with high and low academic performance (dependent variable) in the meta-creativity dimensions (independent variables).

Finally, to identify which dimensions of meta-creativity had greater discriminatory and predictive power in terms of belonging to the high and low academic performance groups in ICT applied to Education, a discriminant analysis was performed. In this regard, Richards et al. [31] suggested that when the dependent variable is nominal, applying discriminant analysis is preferable, as it behaves as a more robust form of measurement than logistic regression due to the assumptions involved in the analysis.

The data were analyzed using SPSS 27, with a significance threshold set at $p < 0.05$. Effect sizes were assessed using partial eta squared, with a small effect size when $\eta_p^2 = 0.01$, a medium effect size when $\eta_p^2 = 0.059$, and a large effect size when $\eta_p^2 = 0.080$ [32].

5. Results

5.1. Descriptive Statistics

Table 1 presents the descriptive statistics for the variables, along with the Pearson correlation matrix. The skewness and kurtosis values for creative motivation, creative leadership, divergent thinking, and academic performance were within the ranges indicative of a normal distribution (between −2 and +2) [33].

Table 1. Descriptive statistics and correlation (r) between academic performance in educational technology and the dimensions defining meta-creativity.

	1	2	3	4
1. Academic performance	-	-	-	-
2. Creative motivation	0.506 *	-	-	-
3. Creative leadership	0.676 *	0.373 *	-	-
4. Divergent thinking	0.629 *	0.489 *	0.735 *	-
Asymmetry	0.457	−0.022	−0.059	−0.130
Kurtosis	−1.812	−0.928	−0.819	−0.15
Mean	-	3.33	3.02	3.13
Standard deviation	-	0.442	0.580	0.425

Note: * $p < 0.001$.

The highest means were in the creative motivation and divergent thinking dimensions, while the lowest scores were for creative leadership.

The results of the correlations indicate statistically significant, positive relationships between the variables under study. There was a strong relationship between academic performance and creative leadership, as well as between performance and divergent thinking, while the relationship between academic performance and creative motivation was moderate. Consequently, students with higher academic performance also exhibited elevated levels of meta-creativity.

5.2. Differences in Meta-Creativity on Academic Performance

To determine differences in meta-creativity based on the academic performance group, ANOVA tests were used for each dimension of meta-creativity. The results indicate statistically significant differences between students with high and low academic performance for all three dimensions: creative motivation, $F(1,170) = 58.46$, $p = 0.001$, $\eta_p 2 = 0.25$; creative leadership, $F(1,170) = 143.42$, $p = 0.001$, $\eta_p 2 = 0.45$; and divergent thinking, $F(1,170) = 111.56$, $p = 0.001$, $\eta_p 2 = 0.39$—with medium effect sizes.

The scores show that students with high academic performance reported higher levels of creative motivation (high performance $M = 3.61$, $SD = 0.358$; low performance $M = 3.15$, $SD = 0.397$), creative leadership (high performance $M = 3.51$, $SD = 0.419$; low performance $M = 2.71$, $SD = 0.434$), and divergent thinking (high performance $M = 3.46$, SD = 0.301; low performance $M = 2.91$, $SD = 0.349$).

5.3. Prediction of Membership in the Low and High Academic Performance Groups Based on Meta-Creativity

With the stated objectives in mind, the final analysis focused on assessing the capacity of the independent variables (creative leadership, creative motivation, divergent thinking) to predict membership in the low or high academic performance groups.

Parametric assumptions were examined using Box's M test to confirm that the covariance matrices were different ($p = 0.038$). This allowed us to establish that the covariance matrices were equal across all groups, enabling discriminant analysis. A single discriminant function was found that significantly classified subjects into the two groups of high and low academic performance ($r = 0.737$; $p = 0.001$). Wilks' λ value (0.456) indicated that the discriminant function would be useful for predicting group membership.

Subsequently, the discriminant function was constructed, determining which initially considered independent variables were significant for the model. In our case, all three study variables—creative motivation, creative leadership, and divergent thinking—were included in the analysis (Table 2).

Table 2. Identification of variables in the analysis.

Step		Tolerance	*F*-to-Remove	Wilks' Lambda
1	Creative leadership	10,000	143.428	
2	Creative leadership	0.998	99.773	0.744
	Creative motivation	0.998	26.916	0.542
3	Creative leadership	0.699	35.365	0.552
	Creative motivation	0.924	17.786	0.504
	Divergent thinking	0.654	4.323	0.468

With the standardized coefficients matrix and the structure matrix, which represent the correlations between the discriminant functions and the variables, we can determine which variables exert more influence on the discriminant functions (Table 3). Creative leadership and creative motivation have the most significant weight in the model.

Table 3. Standardized canonical discriminant function coefficients and structure matrix.

Standardized Canonical Discriminant Function Coefficients		Structure Matrix	
	Function 1		Function 1
Creative motivation	0.436	Creative motivation	0.841
Creative leadership	0.676	Creative leadership	0.742
Divergent thinking	0.265	Divergent thinking	0.537

The centroid matrix provided the means of each group for each function. According to the results, the means for each group were different, with 1.359 for high academic performance and −0.867 for low academic performance. The negative values for students classified in the low academic performance group illustrate the negative influence of the selected variables. Higher values in these variables indicate a greater likelihood of subjects being classified in the high academic performance group.

Regarding the discriminant function, the table of standardized coefficients for the discriminant functions identifies the variables with greater weight in the predictive model and facilitates identification of the resulting discriminant function (Table 4).

Table 4. Fisher's linear discriminant functions.

	Low Performance	High Performance
Creative motivation	17.500	20.035
Creative leadership	7.109	10.619
Divergent thinking	16.457	18.238
(Constant)	−61.798	−18.461

Table 5 displays the results of the classification obtained. Through applying the discriminant function, it is evident that 86.6% of the cases were correctly classified based on high and low performance in the subject. Specifically, classification accuracy was 92.4% for low performance and 22.4% for high performance.

Table 5. Classification results.

	Performance *	Low Performance	High Performance	Total
Recount	Low performance	97	8	105
	High performance	15	52	67
%	Low performance	92.4	7.6	100
	High performance	22.4	77.6	100

* 86.6% of original cases grouped correctly classified.

6. Discussion and Conclusions

In the pursuit of academic excellence, educators must not only possess but also cultivate and develop creative abilities along with skills for thinking and acting creatively. Consequently, it is essential to plan and design learning situations that foster the reflection of creativity in action, leading to the identification of meta-creativity.

The overarching objective of this study was to analyze the meta-creativity of a group of university students and its bidirectional relationship with academic performance. There were two specific objectives: (1) Examine differences in meta-creativity among participating university students based on their academic performance; (2) Identify which dimensions of meta-creativity (divergent thinking, creative motivation, and creative leadership) exhibit greater discriminatory and predictive power for belonging to high and low academic performance groups.

With regard to the first objective, there were statistically significant differences in meta-creativity between students with high and low academic performance. The dimension with the greatest explanatory power for these differences was creative leadership, followed by divergent thinking and creative motivation. The results indicated that students exhibiting higher levels of creative leadership, divergent thinking, and creative motivation also demonstrated higher academic performance. These findings are consistent with a meta-analysis by Gajda et al. [34] that concluded that there was an association between academic performance and creativity, which, in our study, was present in the three dimensions analyzed. Consequently, for students with high academic performance, we can anticipate higher levels of meta-creativity, reflected in greater creative leadership, creative motivation, and divergent thinking.

The second objective focused on establishing the extent to which the dimensions of meta-creativity were able to predict membership in the high and low academic performance groups. Huberty [35] emphasized that discriminant analysis facilitates the identification of characteristics that distinguish between two groups and the formulation of a function assigning students to either group. The discriminant function successfully classified 86.6% of students, indicating that nearly 87% of the variation allows for determining the fact that students with lower levels of creative motivation, leadership capacity, and divergent thinking tend to achieve a lower academic performance.

Creative leadership and creative motivation stood out among the variables contributing the most to predicting academic performance, exhibiting the strongest correlations with the discriminant function. Creative leadership emerged as a robust predictor of academic performance, emphasizing the influence of students' ability to lead and collaborate in problem-solving through decision-making. Similarly, creative motivation exerted a strong, positive effect on academic performance, as in previous studies such as Lee et al. [36], with immersive creative experiences optimizing motivation, as Ohuerrou et al. [37] pointed out. Along similar lines, Gómez et al. [38] demonstrated a significant relationship between ICT usage and motivation. Since our study took place in the area of educational technology, this variable may have had an impact on motivation that should be taken into account in future studies.

At the same time, considering the discriminant function as a whole, divergent thinking was included as a predictor of academic performance. Being creative about creativity, or implementing meta-creative processes, involves questioning assumptions and altering perspectives. Our study showed that academic performance was predicted by students' awareness of proposing different solutions and building connections between novel ideas during the design of StoryGames. In the same vein, Taylor et al. [14] detected a positive relationship between divergent thinking and academic performance in a sample of 60 engineering students.

Meta-creativity has proven to be a highly effective tool for encouraging qualitative leaps in problem-solving in diverse contexts that require an alternative perspective for in-depth analysis [39]. Our results suggest that the dimensions defining meta-creativity significantly affect university students' academic performance.

Studies on meta-creativity are only now emerging, and it is a topic deserving of more research. Creativity is indispensable across all domains for providing imaginative solutions to unexpected problems. As Torrance [13] suggested, people must be prepared and trained for continual change, which poses a significant challenge to education. Education must foster motivation, creativity, innovation, and active participation. However, planning creative educational scenarios extends beyond teaching specific creative thinking techniques. Kim and Choi [40] noted the need to adopt creative methodologies to motivate students, develop their capacity to tackle challenges, and be aware of the strategies they use. Consequently, there needs to be a transformation of teacher training programs in order to foster a creative culture, alongside strategies for enhancing the management of meta-creativity.

This study shows that, in our sample, meta-creativity influenced academic performance. However, this study did have certain limitations. Firstly, it involved a small,

gender-imbalanced sample, with a high percentage of female participants. Secondly, academic performance was only considered in the single subject of ICT applied to Education, meaning other areas need to be explored to determine the impact of meta-creativity on academic performance. Additionally, external factors not strictly linked to meta-creativity, such as cognitive and emotional maturity, prior knowledge, etc., were not included, which might have affected the results. Future studies must explore alternative conceptual or measurement approaches, opening up new avenues for meta-creativity analysis.

In conclusion, our results reflect a dual relationship between academic performance and meta-creativity; there are differences between students with high and low academic performance in terms of their meta-creativity, and meta-creativity exhibits predictive power in terms of belonging to the high or low academic performance group in ICT applied to Education.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All the research data are reported in the manuscript.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Meta-Creativity Questionnaire (C-MECREA).
Determined the degree/level of:
Divergent Thinking Id1. Originality embodied in the creative project. Id2. Creation of a novel and original story and project. Id3. Search for creative solutions to solve the problems presented. Id4. Contribution of ideas and options when developing the project.
Motivation Id5. Importance of carrying out creative projects as a future teacher. Id6. Interest to plan, design, and develop the creative project. Id7. Emotional and personal involvement in the creative project.
Creative Leadership Id8. Creative responsibility during the development of the project. Id9. Promotion of enthusiasm to teammates during the creative project. Id10. Encouraging the participation and involvement of teammates.

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