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THE TURNING POINT: SCIENTIFIC CREATIVITY ASSESSMENT AND ITS RELATIONSHIP WITH OTHER CREATIVE DOMAINS IN FIRST YEAR SECONDARY STUDENTS

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#### ABSTRACT

Research on creativity, as well as its application to the education field and its assessment at the different educational stages, have been of increasing interest over the past decades in different countries. In this context, this study aims to evaluate the scientific creativity performance and its relationship with other creativity domains (linguistic and general creativity) of Spanish first year secondary students. This is a key moment both from the point of view of the change in educational level and a critical age in cognitive developments associated to creativity. The research was carried out using a quantitative, descriptive, cross-sectional design. Data was collected using previously validated tests. Results revealed a moderate-to-low performance for the scientific domain, as well as for the linguistic one and for general creativity. Comment0 Comment1 In addition, positive correlations have been found between all the studied domains of creativity. Nevertheless, this correlation was stronger between both scientific creativity dimensions (daily and specific). This research shows the scarce creative competence of students at the early stage of secondary education and gives evidence about the multicomponential nature of creativity. The need of the inclusion of creativity teaching strategies at the secondary education level via transdisciplinary approaches is discussed.

Keywords: creativity domains; scientific creativity; secondary education

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INTRODUCTION Comment2 Comment3

Among the 21st century skills (those needed to prepare students to succeed in their careers during the information age) are a solid education in science and the need for creativity and innovation (Kennedy & Sundberg, 2020). In fact, creativity has been recently placed at the forefront of the educational research agenda. Therefore, an increasing number of countries have embedded this topic at their educational policies, such as several countries of the European Union (Austria, Belgium, Czech Republic, France, Portugal, Spain, among others), as well as Australia, China, England, the United States or Taiwan, for instance (Patston et al., 2021; Pllana, 2019). Education fosters creativity by means of reinforcing acquired knowledge, cognitive skills, willingness to new experiences and collaboration. Moreover, creativity has been associated to problem-solving, communication and metacognitive skills, which may enable not only academic and professional achievements, but also it may meet student's needs at their daily life (Batey & Furnham, 2006). Therefore, creativity has a key role in education, which has been grounded by the development of regulation policies and assessment methods. Research on creativity and education may be divided into four large categories. The first one is focused on personality traits that may hinder or foster creativity, such as conformism or resilience. The second one falls into the cognitive area, and addresses those factors affecting the creative process, for instance, intelligence or problem-solving abilities. The third one emphasizes not on students, but on the educational system. Therefore, it tackles the analysis of curricula and initiatives to develop creativity. The last approach falls into a much more sociopsychological area, investigating the relationship between experience, behavior, environment, and students' creativity. Since all of these categories explore the potential links between creativity and specific concerns, scholars resort to several techniques in order to assess students' creativity. This includes methods ranging from self-report questionnaires (Jonason et al., 2017), divergent thinking tests (Runco et al., 2016) and personality tests (Puryear et al., 2017), to more specific assessments centered in concrete domains by means of different settings (Lemons, 2011; Said-Metwaly et al., 2017). Given the substantial accumulation of assessment approaches, researchers are often involved in controversial debates. The key concern nowadays deals with the lack of an established conceptual and methodological framework, which leads to a vast quantity of scattered literature analyzing some creative processes and phenomena in an isolated manner. To overcome this limitation, reviews have been published compiling creativity assessments in a large variety of settings (Snyder et al., 2019; Karwowski et al., 2019; Acar & Runco, 2019). Furthermore, there are other reviews pointing out to the imperative need of achieving accuracy, homogenization, and transparency of the reported creativity results, which may lead to the refinement of research and assessment methods in creativity (Barbot et al., 2019). Those define a series of guidelines, such as providing transparent evidence of data selection and analysis, properly applying statistical tests according to the given sample and interpreting results in terms of a well-defined creativity construct (Barbot & Said-Metwaly, 2021). Regarding the latter guideline, there is still little consensus in the field about which creativity construct to follow. In this context, the existence of domains and their role in creativity performance have been hot topics of discussion since the early stages of the formal creativity research. Aiming to get insight into the domain specificity of creativity, Baer and Kaufman (2005) proposed the Amusement Park Theoretical (APT) model, which includes both general and domain elements. The structure of the model is hierarchically established within four levels: initial requirements, such as intelligence or motivation; thematic areas, regarding different knowledge disciplines; domains, related to specific areas within those disciplines; and microdomains, corresponding to concrete tasks within those domains. Although the APT model is considered to present some limitations, there is a widespread consensus on the multicomponential nature of the creativity construct (Barbot et al., 2019). In the literature, there are different studies focusing on a certain creativity domain. Some embrace a linguistic approach, such as metaphor generation, since it is considered to be an explicit manifestation of creative thinking (Bergs, 2019). Other domains, such as art, mathematics or music, are also analyzed in several studies (Kladder & Lee, 2019; Mansour, 2018; Erbas & Bas, 2015). Regarding scientific creativity it has been addressed by means of specific scientific productions or problem-solving patterns (de Vries & Lubart, 2019; Chen et al., 2016). In fact, a comprehensive meta-analysis of empirical studies examining the domains of creativity supports the idea of the existence of a mathematical/scientific domain that is consistently distinct from other domains of creativity (Julmi & Scherm, 2016). The existence of a particular scientific domain in creativity is not surprising, since the role of creativity in the processes of generation of knowledge in science is evident, with many similarities between the creative process and the scientific method (Garcés, 2018). Science can foster creativity and creativity should be an essential component of science in school (Antink-Meyer & Lederman, 2013). Ramdani et al. (2022) point out to creativity and curiosity as important variables to support the performance of outstanding science teachers. The influence of aspects such as motivation (Xue et al., 2018), attitudes (Nursiwan & Hanri, 2023), science process skills (Fadlan et al., 2019) or emotions (Feist, 2015) in scientific creativity have been studied. There are some studies showing a positive correlation between scientific and mathematic creativities (Huang et al., 2017). However, to the best of our knowledge no study has addressed before the relationship between the scientific and linguistic domains of creativity. In recent years, the comparison among different creativity domains has attracted a lot of interest, and even more, their relationship with a general creativity construct, which commonly is wrongly associated exclusively to divergent thinking tests (Baer, 2015). However, those approaches are thought to lead to contradictory results (Kaufman et al., 2017). Therefore, researchers are ought to embrace a much more holistic approach, assessing multiple domains of creativity, by means of a more accurate analysis design (Long et al., 2022), as is done in this research. To fill this gap and to gain more insight at the Spanish secondary education context, this study aims to assess a key area of creativity, as is the scientific domain and study its relationship with other creativity domains in first year secondary students. This is a turning point since it corresponds to the change between primary education and secondary education (where educational methodologies usually change with the introduction of scientific disciplines and the

progressive abandonment of project-based learning). This is also a key stage in the development of creativity, since there is a discontinuity between creative potential in childhood and adolescence, with each stage associated with distinct developmental conditions and pathways, as well as biological and psychosocial changes. This has been confirmed by neuroscientific evidence of the decrease of gray matter during adolescence (Raznahan et al., 2010) leading to the observed creative cognition slumps and the decrease of divergent thinking in this developmental stage (Lau & Cheung, 2010). A recent meta-analysis (Said-Metwaly et al., 2021) positions this slump in seventh-grade, in ages 12-13, the population of this study. In this context, the main objective of the present study is to assess the scientific creativity of first year secondary students and explore its correlation with other creative domains (linguistic creativity and general creativity), as this has not been done before. The research questions were as follows: a) Which is the scientific creativity level of first year secondary students? b) Which is their performance in linguistic creativity and general creativity? c) Are there differences according to gender? d) Is there a correlation between the scientific and linguistic domains of creativity? And between those domains and general creativity?

**METHODS**

This study utilized a quantitative, descriptive, cross-sectional research design. Participants were 226 first year secondary students from three different Spanish high school centers, from both rural and urban areas located in eastern Spain. There was gender homogeneity among the participants with 47% male students and 53% female students. Age of participants ranged from 11 to 14 years old, being the average age 12 years old, which is the typical age of students corresponding to this level in Spain. As mentioned above this is a key stage in the development of creativity, coinciding with the discontinuity between creative potential in childhood and adolescence. Data were collected during the 2022-2023 academic year (in paper-based questionnaires) in 50 minutes sessions for every class group. Prior to the sessions, school management team, legal tutors and participants were informed about the treatment of the data and the scope of the research. Three previously reported and validated instruments were used to assess scientific creativity, linguistic creativity and general creativity. a) The scientific creativity dimension was assessed using a problem-setting up questionnaire developed by Hu et al. (2010), which is based on the Torrance model of creativity, and is described as the authors as robust and reliable (with interrater reliabilities between .69 and .85). Therefore, problem finding creativity was assessed in terms of fluency (how many ideas), flexibility (variety of fields corresponding to those ideas) and originality (statistical frequency of those ideas at the analyzed sample). This instrument includes two items. The first one aimed to assess the daily scientific creativity (DSS) consists of an open instruction, in which students are asked to write as many and different questions as they can related to science and based on their everyday life experiences. The second item aimed to assess the specific scientific creativity (SSC) corresponds to a closed instruction. Participants are ought to create scientific questions associated with the image of an astronaut standing on the moon, and, therefore, this item captures a more specific scientific knowledge, which yields the creative questions formulation. Items were presented to students as PowerPoint slides and the time to generate questions was limited to 8 minutes per item. As mentioned above, the scoring was three-folded: the fluency score is associated to the number of valid questions generated, the flexibility score corresponds to the fields in which those are categorized, and the originality score is related to the statistical appearance frequency of a given question. DSC and SSC scores were calculated as the sum of these three values. The different categories for each questionnaire are presented in Tables 1 and 2.

Table 1. Codification of flexibility categories corresponding to DSC Code Field of Knowledge ANT Anthropology (evolution) AST Astronomy BIO Biology (plants, animals, genetics) SCIE Science Spirituality and Feelings CON Constructions and Transport COV COVID PHY Physics GEO Geology (meteorology, earth composition) HUM Human Body, Health PRO Products properties and their usage CHEM Chemistry (materials properties and reactions) TEC Technology

Table 2. Codification of flexibility categories corresponding to SSC Code Field of Knowledge AST Astronomy in general EXT Extraterrestrial life PHY Physics (gravity, space travelling) MOO Moon's composition and meteorology LIG Sunlight, darkness, and sights at the moon TEC Technology and commutations LIF Daily life of the astronaut at the moon

As can be seen, there were 12 different categories for daily scientific creativity and 7 different categories for specific scientific creativity. b) The linguistic creativity dimension was assessed in terms of a metaphor generation task, based on the work of Kasirer and Mashal (2018), which distinguishes between novel creative metaphors from conventional ones. The instrument includes 10 items. Whereas each of them corresponds to an emotion, half of them were presented in order to yield a metaphor (e.g., love is...) and the other half were presented aiming to promote an analogy formulation (e.g., sadness is like...). Students were ought to generate a novel figurative expression, avoiding using synonyms or common-used metaphors. Time of answering was limited to 8 minutes in total. The scores given were 1, 2 or 3 points, for literal responses, conventional figurative expressions, and novel metaphors, respectively. The linguistic creativity was calculated as the sum of all the obtained points. Two judges coded the data independently, with an agreement rate of 90%. Any case of disagreement was discussed by both coders together. c) The general creativity was addressed using a previously validated questionnaire widely used at the Spanish educational context, which is known as CREA. In this case, students are ought to generate as many questions as they can related to what is happening at an image. Hence, several cognitive schemes are tapped into, arising from the interaction between the new mental representation of the image, and their already existent mental network of representations. The time established for the test is 4 minutes. This test has been found to have both predictive and concurrent validity (as measured in concurrence with the Guilford test of creativity) (Corbalán et al., 2015). Prior to assigning the corresponding scores, out of context questions or repetitive questions were invalidated. Each simple question receives 1 point, whereas double or triple questions (which reflect two or three different phenomena or action) are ranked as 2 and 3 points, respectively. The percentile index is afterwards extracted from the CREA Manual (Corbalán et al., 2015) for a Spanish sample. The statistical analysis of the compiled data was performed using SPSS software version 26. Firstly, mean and standard deviation for each of the studied dimensions of creativity was calculated. To get insight into the normality of the data, the Kolmogorov-Smirnov test was carried out. Since all variables presented non-normal distributions, differences according to gender were explored using the Mann Whitney U test. The effect size was calculated using the formula described by Field (2018) for non-parametric samples. The magnitude of the effect size was evaluated according to Cohen's classification for behavioral sciences (1988), being null if  $0 \leq |g| \leq .1$ ; low  $.1 < |g| \leq .29$ ; medium  $.30 < |g| \leq .49$  and large if  $.5 \leq |g|$ . Finally, the correlation among the studied creativity dimensions and the general creativity was evaluated by means of the Pearson's correlation coefficient. In all cases the significance level was .05.

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RESULTS AND DISCUSSION Comment7 Comment8 The main aim of this study was to assess the

scientific creativity of students at the beginning of secondary education. The results associated to both scientific dimensions of creativity (DSC and SSC) are shown in Table 3. This table also includes the scores of the three evaluated properties (fluency, flexibility, and originality).

Table 3. Descriptive statistics for both scientific dimensions of creativity. Creativity dimension Mean SD DSC Fluency 8.63 4.78 Flexibility 4.57 1.87 Originality 0.75 1.15 Total 13.96 6.70 SSC Fluency 9.20 4.67 Flexibility 4.26 1.30 Originality 0.31 0.67 Total 13.73 5.91

As it can be observed in Table 3, fluency scored around 9 for both studied dimensions, meaning each student have formulated 9 questions approximately. Indeed, it has been detected that students tend to formulate many similar questions in their questionnaire answers. As an example, in the case of the daily-scientific dimension, students lay out multitude of queries about the Universe and astronomy, such as: "why the sun rises on the morning and the moon comes out at night?"; "why is the Universe infinite?"; "is there extraterrestrial life?". On the other hand, for the specific-scientific dimension, questions formulated by students tend to be related to the composition of the moon, its morphology and the possible existence of air, oxygen and an atmosphere, e.g.: "is there oxygen at the moon?"; "why is the flag waving if there is no air at the moon?"; "why are there craters at the moon?"; "why is the moon grey?". Regarding flexibility, its score is roughly 4 for both dimensions of scientific creativity, meaning students use approximately 4 different knowledge fields to formulate an average of 9 questions. Figures 1 and 2 represent the number of questions per category for DSC and SSC, respectively. It can be observed that the fields that shown a higher count are "astronomy" and "human body/health" for DSC and "moon's composition and meteorology" and "technology and communications" for SSC.

Figure 1. Number of questions formulated by students, corresponding to each field of knowledge for DSC.

Figure 2. Number of questions formulated by students, corresponding to each field of knowledge for SSC.

Concerning the originality score, it hardly approximates to 1 for both investigated scientific dimensions of creativity. In other words, barely one of the averaged 9 questions formulated by students was unusual or unique (with a percentage of appearance frequency lower than 5%). For DSC original queries were very varied, for instance: "how is paint made?"; "what is the operating mechanism of a microwave machine?"; "why do we have to age?"; "why do we feel pain?". Note that mostly all the original questions are related to daily actions or phenomena related to everyday life. In the case of SSC, some original questions formulated by students were as follows: "why is there a hidden face of the moon?"; "if we reach a gaseous planet, do we fall to its nucleus?"; "are earthquakes possible at the moon?"; "do diseases exist in space?". These results are similar to those reported by Hu et al. (2010). Particularly, the ability to come up with new ideas (originality) and the overall scientific creativity performance is in general limited. Students tend to use the same fields of knowledge to formulate questions (low flexibility), such as astronomy and health (DSC) or technology and physics (SSC). Moreover, queries are often non-related to students' experiences and inquietudes, rather they reflect a decontextualized conception of science as an abstract and complex discipline. On the other hand, the results corresponding to the linguistic dimension of creativity with the different metaphor categories are shown in Table 4.

Table 4. Descriptive statistics for the linguistic dimension of creativity. Creativity domain Mean SD Linguistic Novel metaphor 0.95 1.62  
 Conv. metaphor 1.42 1.43  
 Literal response 5.53 2.99  
 Invalid response 3.04 2.60  
 Total 11.23 5.26

As can be observed, "novel metaphors" is the category with fewer responses. Indeed, hardly one of each students' responses falls into this category. As for conventional metaphors, students come up with a mean of one to two of them at their responses. However, the literal answers are those prevailing over all the other categories, since students tend to give examples of how they feel instead of creating novel metaphors or thinking about preexisting ones. Within this category, typical teenager feelings have been identified, such as friendship, loneliness, or body-image insecurities. Also, comparisons regarding academic issues are recurrent, as well as analogies with videogames, football teams or players. Finally, a large amount of students' responses were invalid, since they were blank or reflected an erroneous concept. Analogously to what happened for scientific creativity, linguistic creativity results indicate a moderate to low performance. This latter observation is similar to the one reported by Kasirer and Mashal (2018), and their capacity to generate novel metaphors is lower than the one obtained by Kasirer and Mashal (2016) with typically developed Hebrew adolescents. Specifically, students tend to generate analogies closer to their experiences, rather than create novel and unique metaphors. It must be considered that at this educational stage, students are not able to fully understand the concept of a metaphor, and therefore, they commonly approach this creativity task using already existing mental representations, regarding their own experiences and observations (Carriedo et al., 2016). In addition, those participants that generate novel metaphors usually use similar stylistic devices, such as personification or apostrophe and comparisons with some meteorological phenomena. Finally, in the CREA test for the assessment of general creativity students formulated an average of approximately 11 queries about the shown image, and the number of extra questions (double or triple) was scarce. They obtained a total mean value of  $11.2 \pm 5.26$ . Results were much lower than those obtained by Donadel et al. (2021) for an adolescent Argentinian sample, although in their case there were also older (up to 16 years-old) students. Most asked questions were related to the feelings of the characters at the image, their age, their appearance, their clothing, and their occupation, as well as the location of the image. Regarding the percentile, it was 39%, below the median value, meaning that the general creativity was moderate-to-low. This reflects that students at this educational stage possess a scarce level of creativity, being below the median percentile. Note that the test used in this study is based on a question formulation process throughout the visualization of an image. Therefore, this test reflects the openness and versatility of the cognitive schemes of students, which results in the reorganization and interconnection of different mental representations. Authors of the test suggest that this behavior may result in a potential ability to develop creative competences (Corbalán et al., 2015).

Table 5. Descriptive statistics for the studied dimensions of creativity according to gender (Nmale=107; Nfemale=119).

Dimension	Gender	Min	Max	Mean	SD	z	p	g	DSC	M	2	33	13.07	6.28	1.748	0.082
F	3	37	14.75	6.98	SSC	M	0	28	12.28	5.81	3.393	>	.001***	.226		
F	4	31	15.03	5.73	Linguistic	M	0	29	10.27	5.45	3.280	.001***	.218			
F	1	29	12.10	4.95	General	M	1	97	30.60	27.83	4.439	>	.001***	.295		
F	1	98	47.56	28.91	***											

\*\*\* There are statistically significant differences at the .001 level.

Once a general overview of the creativity performance was obtained the possible existence of gender differences in all the creativity dimensions was investigated, since not many studies address gender performance in specific creativity dimensions. Table 5 shows data according to gender (the data for general creativity is given as the percentile index). As it can be observed, punctuations corresponding to female participants are higher in all studied creativity dimensions. Particularly, those associated to SSC and general creativity are remarkably higher. As all the dimensions presented non-normal distributions, Mann-Whitney U test was applied to get insight about the existence of statistically significant differences. The results indicate that all the evaluated dimensions of creativity display statistically significant differences between genders, with the exception of DSC. The size effect was low for SSC and linguistic creativity, and medium for general creativity. These findings are in concordance with those reported at prior studies in general creativity (Nakano et al., 2021). Generally, females are regarded as creative beings, especially in arts and performance domains (Elisondo, et al., 2022; Pont-Niclos et al., 2022; Kaufman, 2006), not particularly in scientific or technical domains. However, these results show that gender stereotypes are not always accurate. Finally, to explore the possible existence of any correlation between scientific creativity and the other studied dimensions of creativity, Pearson's correlation coefficients were calculated (see Table 6). As it can be observed, there is a positive and significant correlation in all cases. This means that those students performing in a particular manner at a concrete dimension of creativity display an analogous behavior at the other dimensions. It is worth noting that there is a higher correlation between both scientific dimensions of creativity (DSC and SSC) than between those two with the linguistic dimension. The highest correlation with the general measurement of creativity is with SSC.

Table 6. Pearson's correlation coefficient between the studied creativity dimensions

	DSC	SSC	Ling.	General
DSC	1	.66***	.49***	.54***
SSC		1	.49***	.64***
Ling.			1	.45***
General				1

\*\*\* There are significant correlations at the .001 level

Since the correlation between scientific creativity with other creative dimensions had not been previously studied, only with mathematical creativity (Huang et al., 2017), this fact could be misinterpreted as a point corroborating the general construct of creativity, which validation has a leading role at the debates within this field (Snyder et al., 2019; Baer, 2015). On one hand, students who show a concrete creativity performance at one dimension, typically shown the same efficiency at others. On the other hand, it must be taken into account that the strongest correlation has been detected between both studied scientific creativity dimensions (DSC and SSC), rather than those and the linguistic. Moreover, results point out that the assessment procedure influences the students' performance, since the highest correlation was found between SSC and the general creativity measurement, and both tests are based in the idea of formulating questions on what is happening in an image. Regarding this fact, several studies have shown that different modes of thinking involved in different types of creative work are accompanied by different patterns of brain activity (Kleibeuker et al., 2013). At this point it is important to consider different approaches that can contribute to the development of creativity in science. Although domain knowledge is important in scientific creativity (Sun et al., 2020), teaching styles must encourage students to come up with new and unusual ideas in a respectful environment. This is something pedagogically irrefutable, but not the norm in the Spanish educational system. On the other hand, different approaches such as problem or project-based learning seem a good starting point since they are believed to promote many processes related to creative thinking (Anazifa & Djukri, 2017; Rasul et al., 2018; Sumarmi & Kadarwati, 2020). This type of methodologies is perfectly aligned with the STSE (science-technology-society-environment) approach. Also, establishing rewards or promoting self-fulfillment can be used to enhance students' motivation, particularly the intrinsic one (Begettho & Kaufman, 2014), as well as the use of gamification strategies in science classes (Funa et al., 2021). Moreover, teachers should facilitate creative examples, which students will be able to emulate. Indeed, creativity emulation is an emergent research area (Cotter et al., 2022) focused on how the creativity of students can be fostered via recreation of teachers' creativity performance. Finally, several studies have assessed the creativity demonstrated by preservice primary education and chemistry teachers (Echegoyen & Martín-Ezpeleta, 2021, Martín-Ezpeleta et al., 2022 Apriwanda & Hanri, 2022) with discouraging results. Connected to the above, they should promote a reflection on the process, a metacognitive reflection. Metacognition processes play a key role in creativity capabilities, since it deals with the self-efficacy concept and the proper contextualization of creative actions. Therefore, teachers should incorporate actions at their lessons including different metacognition mechanisms in order to promote the development of creativity (Kaufman & Beghetto, 2013).

## CONCLUSION

The main aim of this work was to assess the scientific creativity of first year secondary students and evaluate their correlation with different creative domains. The results obtained pointed out the scarce creative competence of students at the early stage of secondary education in all three dimensions studied. Although there were correlations between all creative dimensions assessed, those were higher between both kinds of scientific creativity (daily and specific) than between scientific creativity and other creative domains. This points out to a multicomponential nature of the creativity construct. In addition, gender differences in creativity performance have been obtained for all creative dimensions, being female students those with higher creativity scores in all cases. Nevertheless, first some limitations need to be pointed out. Only one level of secondary education has been assessed and the instruments used, although validated, could have their limitations. Future studies will focus on larger and even more delocalized samples. It would also be very interesting to corroborate this low level of creativity in science with longitudinal studies with all courses of secondary education. In spite of these limitations, our results lead to conclude the importance of rethinking the development of creativity in the educational system. As discussed in the previous section, there should be a reorientation of the curricula and teaching methodologies in science lessons, as well as in other subjects. Certainly, different teaching concerns such as the above-mentioned problem-solving, critical, and divergent thinking are transversal key points in education. Accordingly, it is essential to raise awareness among educational professionals about these considerations, as well as to design didactic resources within each subject, which will enable to foster creativity as a collective educational aim. Although some of those factors have been considered recently at the educational agenda, they are not always present in secondary education classrooms in Spain and, particularly, not in science lessons. The present research shows that students' mediocre results should lead to a response in the form of innovative educational designs giving creativity the space it deserves.

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**MATCHING BLOCK 3/21**

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**100%**

**MATCHING BLOCK 2/21**

**W**

The Importance of Domain-Specific Expertise in Creativity. *Roeper Review*, 37(3), 165-178.

**100%**

**MATCHING BLOCK 4/21**

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Baer, J., & Kaufman, J. C. (2005). Bridging generality and specificity: The amusement park theoretical (APT) model of creativity. *Roeper Review*, 27(3), 158-163.

Barbot, B., & Said-Metwaly, S. (2021). Is There Really a Creativity Crisis? A Critical Review and Meta-analytic Re-Appraisal. *The Journal of Creative Behavior*, 55(3), 696-709.

**100%**

**MATCHING BLOCK 5/21**

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Barbot, B., Hass, R. W., & Reiter-Palmon, R. (2019). Creativity assessment in psychological research: (Re)setting the standards. *Psychology of Aesthetics, Creativity, and the Arts*, 13(2), 233-240.

**100%**

**MATCHING BLOCK 6/21**

**SA**

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Batey, M., & Furnham, A. (2006). Creativity, intelligence, and personality: A critical review of the scattered literature. *Genetic, Social, and General Psychology Monographs*, 132(4), 355-429.



Beghetto, R. A., & Kaufman, J. C. (2014). Classroom contexts for creativity. *High Ability Studies*, 25(1), 53-69.

Bergs, A. (2019). What, if anything, is linguistic creativity? *Gestalt Theory*, 41(2), 173-183. Carriedo, N., Corral, A., Montoro, P. R., Herrero, L., Ballestrino, P., & Sebastián, I. (2016). The development of metaphor comprehension and its relationship with relational verbal reasoning and executive function. *PLoS One*, 11(3), e0150289. Chen, B., Hu, W., & Plucker, J. A. (2016). The effect of mood on problem finding in scientific creativity. *The Journal of Creative Behavior*, 50(4), 308-320. Cohen, J. (1988). *Statistical Power Analysis for Behavioral Sciences*. Erlbaum. Corbalán, F. J., Martínez, F., Donolo, D. S., Alonso, C., Tejerina, M., & Limiñana, R. M. (2015). *CREA Inteligencia Creativa: Una Medida Cognitiva de la Creatividad*. TEA Ediciones. Cotter, K. N., Beghetto, R. A., & Kaufman, J. C. (2022). Creativity in the Classroom: Advice for Best Practices. In *Homo Creativus* (pp. 249-264). Springer. De

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Erbas, A. K., & Bas, S. (2015). The contribution of personality traits, motivation, academic risk-taking and metacognition to the creative ability in mathematics.

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pp. 93-108). Routledge. Field, A. (2018). *Discovering statistic using SPSS*. Sage Funa, A. A., Gabay, R. A. E., & Ricafort, J. D. (2021). Gamification in genetics: Effects of gamified instructional materials on the STEM students' intrinsic motivation. *Jurnal Pendidikan IPA Indonesia*, 10(4), 462-473. Garcés, S. (2018). Creativity in science domains: A reflection. *Atenea (Concepción)*, 517, 241-253.

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Huang, P.-S., Peng, S.-L., Chen, H.-C., Tseng, L.-C., Hsu, L.-C. (2017). The relative influences of domain knowledge and domain-general divergent thinking on scientific creativity and mathematical creativity. *Thinking Skills and Creativity*, 25, 1-9.

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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.

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**MATCHING BLOCK 18/21**

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Puryear, J. S., Kettler, T., & Rinn, A. N. (2017). Relationships of personality to differential conceptions of creativity: A systematic review. *Psychology of Aesthetics, Creativity, and the Arts*, 11(1), 59.

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**93%**      **MATCHING BLOCK 19/21**      **SA** 17549\_PS30185\_Research Proposal.docx (D141246614)

Creativity. *Theories–Research–Applications*, 3(1), 4-18. 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, 275-298.

**100%**      **MATCHING BLOCK 20/21**      **SA** Human Performance CA1.docx (D129588638)

Said-Metwaly, S., Van den Noortgate, W., & Kyndt, E. (2017). Approaches to measuring creativity: A systematic literature review. *Creativity. Theories–Research–Applications*, 4(2), 238-275.

**100%**      **MATCHING BLOCK 21/21**      **W**

Snyder, H. T., Hammond, J. A., Grohman, M. G. & Katz-Buonincontro, J. (2019). Creativity measurement in undergraduate students from 1984–2013: A systematic review. *Psychology of Aesthetics, Creativity, and the Arts*, 13(2), 133-143.

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Comment0 this narrative is irrelevant to the stated title and research objectives  
 Comment1 The sentence has been eliminated  
 Comment2 The explanation in the introduction about why this assessment is needed and is a turning point has not been explained  
 Comment3 This information can be found at the end of the introduction section: " However, to the best of our knowledge no study has addressed before the relationship between the scientific and linguistic domains of creativity. In recent years, the comparison among different creativity domains has attracted a lot of interest, and even more, their relationship with a general creativity construct, which commonly is wrongly associated exclusively to divergent thinking tests (Baer, 2015). However, those approaches are thought to lead to contradictory results (Kaufman et al., 2017). Therefore, researchers are ought to embrace a much more holistic approach, assessing multiple domains of creativity, by means of a more accurate analysis design (Long et al., 2022), as is done in this research. To fill this gap and to gain more insight at the Spanish secondary education context, this study aims to assess a key area of creativity, as is the scientific domain and study its relationship with other creativity domains in first year secondary students. This is a turning point since it corresponds to the change between primary education and secondary education (where educational methodologies usually change with the introduction of scientific disciplines and the progressive abandonment of project-based learning). This is also a key stage in the development of creativity, since there is a discontinuity between creative potential in childhood and adolescence..."  
 Comment4 Do you mean that the research method is mix-methods?  
 Comment5 No, we mean exploratory research in the sense that it is an approach that investigates research questions that have not been previously studied in depth, as is the relationship of scientific creativity with the other creative domains. Although exploratory research is often qualitative and primary in nature, a study with a large sample conducted in an exploratory manner can be quantitative as well, as is the case of the present study. In this sense it could not be considered mixed methods, but quantitative.  
 Comment6 However, to avoid any confusion we have removed the word exploratory both from this sentence and in the abstract.  
 Comment7 Because you are using a mixed method, the discussion must be more in-depth and reflect the triangulation of quantitative and descriptive research data. Thus a comprehensive explanation will be obtained as to why there is a positive correlation, why the correlation is strong or weak, and so on.

Comment8 As explained in the previous section, this is not a mixed method, but a quantitative one  
 M. Mahbub Z., T. Kirana, S. Poedjiastoeti / *JPII* 5 (2) (2016) 247-255  
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 M. Mahbub Z., T. Kirana, S. Poedjiastoeti / *JPII* 5 (2) (2016) 247-255

### Hit and source - focused comparison, Side by Side

**Submitted text** As student entered the text in the submitted document.

**Matching text** As the text appears in the source.

1/21	SUBMITTED TEXT	20 WORDS	70% MATCHING TEXT	20 WORDS
	RESULTS AND DISCUSSION Comment7 Comment8 The main aim of this study was to assess the			
	<b>SA</b> Final dissertation 190438.docx (D110637719)			
2/21	SUBMITTED TEXT	12 WORDS	100% MATCHING TEXT	12 WORDS
	The Importance of Domain-Specific Expertise in Creativity. Roeper Review, 37(3), 165-178.		The Importance of Domain-Specific Expertise in Creativity. Roeper Review. 2015;37:165-78.	
	<b>W</b> <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8006241/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8006241/</a>			
3/21	SUBMITTED TEXT	19 WORDS	100% MATCHING TEXT	19 WORDS
	Divergent thinking: New methods, recent research, and extended theory. Psychology of Aesthetics, Creativity, and the Arts, 13(2), 153-158.			
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4/21	SUBMITTED TEXT	24 WORDS	100% MATCHING TEXT	24 WORDS
	Baer, J., & Kaufman, J. C. (2005). Bridging generality and specificity: The amusement park theoretical (APT) model of creativity. Roeper Review, 27(3), 158-163.			
	<b>SA</b> Human Performance CA1 FINAL WORD.docx (D129560723)			
5/21	SUBMITTED TEXT	27 WORDS	100% MATCHING TEXT	27 WORDS
	Barbot, B., Hass, R. W., & Reiter-Palmon, R. (2019). Creativity assessment in psychological research: (Re)setting the standards. Psychology of Aesthetics, Creativity, and the Arts, 13(2), 233-240.		Barbot, B., Hass, R. W., & Reiter-Palmon, R. (2019). Creativity Assessment in Psychological Research: (re)Setting the Standards. Psychology of Aesthetics, Creativity, and the Arts, 13(2), 233-241.	
	<b>W</b> <a href="https://link.springer.com/article/10.3758/s13428-022-01986-2">https://link.springer.com/article/10.3758/s13428-022-01986-2</a>			
6/21	SUBMITTED TEXT	26 WORDS	100% MATCHING TEXT	26 WORDS
	Batey, M., & Furnham, A. (2006). Creativity, intelligence, and personality: A critical review of the scattered literature. Genetic, Social, and General Psychology Monographs, 132(4), 355-429.			
	<b>SA</b> Human Performance CA1.docx (D129588638)			

<b>7/21</b>	<b>SUBMITTED TEXT</b>	27 WORDS	<b>100% MATCHING TEXT</b>	27 WORDS
<p>Vries, H. B., &amp; Lubart, T. I. (2019). Scientific creativity: divergent and convergent thinking and the impact of culture. <i>The Journal of Creative Behavior</i>, 53(2), 145-155.</p>		<p>Vries, H. B., &amp; Lubart, T. I. (2019). Scientific creativity: divergent and convergent thinking and the impact of culture. <i>The Journal of Creative Behavior</i>, 53(2), 145-155.</p>		
<p><b>W</b> <a href="https://www.researchgate.net/publication/357104004_Is_Scientific_Creativity_Possible_in_Early_Childhood">https://www.researchgate.net/publication/357104004_Is_Scientific_Creativity_Possible_in_Early_Childhood</a></p>				
<b>8/21</b>	<b>SUBMITTED TEXT</b>	24 WORDS	<b>100% MATCHING TEXT</b>	24 WORDS
<p>Erbas, A. K., &amp; Bas, S. (2015). The contribution of personality traits, motivation, academic risk-taking and metacognition to the creative ability in mathematics.</p>		<p>Erbas A. K., Bas S. (2015). The contribution of personality traits, motivation, academic risk-taking and metacognition to the creative ability in mathematics.</p>		
<p><b>W</b> <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5289983/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5289983/</a></p>				
<b>9/21</b>	<b>SUBMITTED TEXT</b>	18 WORDS	<b>87% MATCHING TEXT</b>	18 WORDS
<p>Feist, G. J. (2015). Affect in artistic and scientific creativity. In <i>Affect, creative experience, and psychological adjustment</i> (</p>		<p>Feist, G.J. (1999). Affect in artistic and scientific creativity. In S.W. Russ (Ed.). <i>Affect, creative experience, and psychological adjustment</i>. (93-108).</p>		
<p><b>W</b> <a href="https://www.sjsu.edu/people/greg.feist/publications/">https://www.sjsu.edu/people/greg.feist/publications/</a></p>				
<b>10/21</b>	<b>SUBMITTED TEXT</b>	27 WORDS	<b>90% MATCHING TEXT</b>	27 WORDS
<p>Hu, W., Shi, Q. Z., Han, Q., Wang, X., &amp; Adey, P. (2010). Creative Scientific Problem Finding and Its Developmental Trend. <i>Creativity Research Journal</i>, 22(1), 46-52.</p>		<p>Hu, W. P., Shi. Q. Z., Han, Q, Wang, X., &amp; Adey, P. (2010). Creative scientific problem finding and its developing trend. <i>Creativity Research Journal</i>, 22 (1), 1-7.</p>		
<p><b>W</b> <a href="https://pdfs.semanticscholar.org/15bd/895f436ef70479fcdfb9d6263bc32e41a452.pdf">https://pdfs.semanticscholar.org/15bd/895f436ef70479fcdfb9d6263bc32e41a452.pdf</a></p>				
<b>11/21</b>	<b>SUBMITTED TEXT</b>	33 WORDS	<b>100% MATCHING TEXT</b>	33 WORDS
<p>Huang, P.-S., Peng, S.-L., Chen, H.-C., Tseng, L.-C., Hsu, L.-C. (2017). The relative influences of domain knowledge and domain-general divergent thinking on scientific creativity and mathematical creativity. <i>Thinking Skills and Creativity</i>, 25, 1-9.</p>		<p>Huang, P.-S., Peng, S.-L., Chen, H.-C., Tseng, L.-C., &amp; Hsu, L.-C. (2017). The relative influences of domain knowledge and domain-general divergent thinking on scientific creativity and mathematical creativity. <i>Thinking Skills and Creativity</i>, 25, 1-9.</p>		
<p><b>W</b> <a href="https://link.springer.com/article/10.1007/s10763-021-10192-z">https://link.springer.com/article/10.1007/s10763-021-10192-z</a></p>				

<b>12/21</b>	<b>SUBMITTED TEXT</b>	31 WORDS	<b>100% MATCHING TEXT</b>	31 WORDS
<p>Kaufman, J. C. &amp; Beghetto, R. A. (2013). In praise of Clark Kent: Creative metacognition and the importance of teaching kids when (not) to be creative. <i>Roeper Review</i>, 35(3), 155-165.</p>		<p>Kaufman, J. C., &amp; Beghetto, R. A. (2013). In praise of Clark Kent: Creative metacognition and the importance of teaching kids when (not) to be creative. <i>Roeper Review</i>, 35(3), 155±165.</p>		
<p><b>W</b> <a href="https://creativeengagementlab.com/wp-content/uploads/2021/05/AndersonUnderReviewHowAmICreative-.pdf">https://creativeengagementlab.com/wp-content/uploads/2021/05/AndersonUnderReviewHowAmICreative-.pdf</a></p>				
<b>13/21</b>	<b>SUBMITTED TEXT</b>	10 WORDS	<b>100% MATCHING TEXT</b>	10 WORDS
<p>The Cambridge Handbook of Creativity Across Domains. Cambridge University Press.</p>		<p>The Cambridge Handbook of Creativity Across Domains. Cambridge University Press;</p>		
<p><b>W</b> <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8006241/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8006241/</a></p>				
<b>14/21</b>	<b>SUBMITTED TEXT</b>	18 WORDS	<b>MATCHING TEXT</b>	18 WORDS
<p>Beghetto, R. A., &amp; Kaufman, J. C. (2014). Classroom contexts for creativity. <i>High Ability Studies</i>, 25(1), 53-69.</p>		<b>96%</b>		
<p><b>SA</b> FINAL Planning.docx (D106229894)</p>				
<b>15/21</b>	<b>SUBMITTED TEXT</b>	26 WORDS	<b>92% MATCHING TEXT</b>	26 WORDS
<p>Nakano, T. D. C., Oliveira, S., &amp; i Zaia, P. (2021). Gender Differences in Creativity: A Systematic Literature Review. <i>Psicologia: Teoria e Pesquisa</i>, 37, 1-10.</p>		<p>Nakano, T. D. C., Oliveira, K. D. S., and Zaia, P. (2021). Gender differences in creativity: a systematic literature review. <i>Psicologia: Teoria e Pesquisa</i> 37, 1–10.</p>		
<p><b>W</b> <a href="https://www.frontiersin.org/articles/10.3389/fpsyg.2022.874261/full">https://www.frontiersin.org/articles/10.3389/fpsyg.2022.874261/full</a></p>				
<b>16/21</b>	<b>SUBMITTED TEXT</b>	34 WORDS	<b>98% MATCHING TEXT</b>	34 WORDS
<p>Creativity Research Journal, 22, 329-336. Lemons, G. (2011). Diverse perspectives of creativity testing: Controversial issues when used for inclusion into gifted programs. <i>Journal for the Education of the Gifted</i>, 34(5), 742-772. Long, H.,</p>				
<p><b>SA</b> Human Performance CA1.docx (D129588638)</p>				
<b>17/21</b>	<b>SUBMITTED TEXT</b>	25 WORDS	<b>82% MATCHING TEXT</b>	25 WORDS
<p>Cropley, A. J., &amp; Marrone, R. (2021). What Is Creativity in Education? A Qualitative Study of International Curricula. <i>Journal of Advanced Academics</i>, 32(2), 207-230.</p>				
<p><b>SA</b> FINAL Planning.docx (D106229894)</p>				

18/21	SUBMITTED TEXT	31 WORDS	98% MATCHING TEXT	31 WORDS		
<p>Puryear, J. S., Kettler, T., &amp; Rinn, A. N. (2017). Relationships of personality to differential conceptions of creativity: A systematic review. <i>Psychology of Aesthetics, Creativity, and the Arts</i>, 11(1), 59.</p> <p><b>SA</b> Dissertation(190438).docx (D110448993)</p>						
19/21	SUBMITTED TEXT	44 WORDS	93% MATCHING TEXT	44 WORDS		
<p>Creativity. <i>Theories–Research–Applications</i>, 3(1), 4-18. Said-Metwaly, S., Fernández-Castilla, B., Kyndt, E., Van den Noortgate, W., &amp; 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. <i>Educational Psychology Review</i>, 33, 275-298.</p> <p><b>SA</b> 17549_PS30185_Research Proposal.docx (D141246614)</p>						
20/21	SUBMITTED TEXT	23 WORDS	100% MATCHING TEXT	23 WORDS		
<p>Said-Metwaly, S., Van den Noortgate, W., &amp; Kyndt, E. (2017). Approaches to measuring creativity: A systematic literature review. <i>Creativity. Theories–Research–Applications</i>, 4(2), 238-275.</p> <p><b>SA</b> Human Performance CA1.docx (D129588638)</p>						
21/21	SUBMITTED TEXT	33 WORDS	100% MATCHING TEXT	33 WORDS		
<table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Snyder, H. T., Hammond, J. A., Grohman, M. G. &amp; Katz-Buonincontro, J. (2019). Creativity measurement in undergraduate students from 1984–2013: A systematic review. <i>Psychology of Aesthetics, Creativity, and the Arts</i>, 13(2), 133-143.</p> <p><b>W</b> <a href="https://files.eric.ed.gov/fulltext/EJ1289555.pdf">https://files.eric.ed.gov/fulltext/EJ1289555.pdf</a></p> </td> <td style="width: 50%; vertical-align: top;"> <p>Snyder, H.T., Hammond, J.A., Grohman, M.G., Katz-Buonincontro, J. (2019). Creativity measurement in undergraduate students from 1984–2013: A systematic review. <i>Psychology of Aesthetics, Creativity, and the Arts</i>, 13(2), 133–143.</p> </td> </tr> </table>					<p>Snyder, H. T., Hammond, J. A., Grohman, M. G. &amp; Katz-Buonincontro, J. (2019). Creativity measurement in undergraduate students from 1984–2013: A systematic review. <i>Psychology of Aesthetics, Creativity, and the Arts</i>, 13(2), 133-143.</p> <p><b>W</b> <a href="https://files.eric.ed.gov/fulltext/EJ1289555.pdf">https://files.eric.ed.gov/fulltext/EJ1289555.pdf</a></p>	<p>Snyder, H.T., Hammond, J.A., Grohman, M.G., Katz-Buonincontro, J. (2019). Creativity measurement in undergraduate students from 1984–2013: A systematic review. <i>Psychology of Aesthetics, Creativity, and the Arts</i>, 13(2), 133–143.</p>
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