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Creativity and Academic Achievement: A Meta-Analysis Study Article

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Abstract

The ability to think and act creatively is significant for individuals as well as societies. Within the context of education, creativity is considered as one of most the fundamental aspects of cognitive development. In this respect, the purpose of the current study was formed to investigate the impact of creativity on academic achievement. To that goal, a meta-analytic approach was applied in this study with the aim of synthesizing the findings from different research, and studies published in Academic Search Ultimate Database, ERIC and SCOPUS between 2005 and 2022 were included in the analysis. The meta-analysis was confined solely to studies that investigated the relationship between the variables, therefore the correlation coefficient was specified as an indicator to determine the effect size. After reviewing in accordance with the inclusion criteria, 18 relevant papers with a total sample size of 6846 were included in the study. The results revealed that the overall effect size of creativity on academic achievement was .619, which points out the medium effect size. The findings of study and their implications were discussed.

Keywords: Creativity, Academic Achievement, Structure of Intellect Model (SOI), Meta-analysis

Introduction

As the ability to think creatively is essential and significant for individuals along with societies (Batey & Furnham, 2006; Lucas, Venckutė,

& Kampylis, 2020; Olatoye, Akintunde, & Yakasai, 2010; Sa´nchez-Ruiz, Herna´ndez-Torrano, Pe´rez-Gonza´lez, Batey, & Petrides, 2011; van Hooijdonk, Ritter, Linka, & Kroesbergen, 2022), the interest in creativity in the realm of psychology and education has a long history (Bano, Naseer, & Zainab, 2014; Hansenne & Legrand, 2012; Swanzy-Impraim, Morris, Lummis, & Jones, 2022). Despite being an elusive as well as an evolving concept (Swanzy-Impraim, et al., 2022) and the lack of consensus on its definition, which is claimed to impede its development (Acar, Burnett, & Cabra, 2017), creativity is generally referred to find and produce distinct ideas from others (Guilford, 1967; Torrance, 1974), to develop sensitivity to matters and look for remedies to them (Torrance, 1974); the tendency to produce something new and valuable (Amabile, 1988; Martin & Wilson, 2017); to be willing to try new things (Montgomery, Bull, & Baloche, 1993); to generate unique, helpful and practical ideas (Martindale, 1989) and to appreciate both uncertainty and ambiguity (Lucas et al., 2020).

Guilford's contribution to the field with his three-dimensional Structure of Intellect Model (SOI), has allowed researchers to examine the multifaceted nature of creativity. The model is important in terms of making important implications to the literature and making the distinction between convergent and divergent thinking, which is mostly used to explain creative thinking (Simon, & Bock, 2016; Sternberg & Grigorenko, 2001). The distinction that Guilford made between convergent and divergent thinking formed the basis of most theories of creativity and led to the development of many measurement tools. (Eysenck, 1993; Guilford, 1967; Runco, 2013). Convergent thinking is a type of thinking that aims at obtaining the best, most accurate answer or solution to a clearly defined and stated question or problem. This way of thinking, therefore, follows the method in which a ready-made answer is available and it is mostly recalled from stored information (Akers, 2008; Cropley, 2006; Razumnikova, 2013). Divergent thinking, on the other hand, is a thinking process that is based on the assumption that only one answer may not be correct on any problem and is used to generate many different and diverse ideas (Giancola, Palmiero, & D'Amico, 2022; Lu, Luo, & Yang, 2021; Paek, Alabbasi, Acar, & Runco, 2021).

Although it is necessary to employ both divergent and convergent thinking to make creativity functional, since any creative action, whatever its nature, will result in a decision-making process (Lu et al., 2021; Cropley, 2006), divergent thinking focuses on generating a large number of appropriate and unique alternative responses and is, therefore, often associated with creativity, involving the generation of multiple, diverse, original or unusual ideas in response to an open-ended questions (Guilford, 1967; Javaid & Pandarakalam, 2021; Özaşkın & Bacanak, 2016; Roberts et

al., 2021; Runco, 2013). Torrance expanded on the concept of divergent thinking by adding an extra component called elaboration and he created one of the most well-known tests of creative thinking using these components - Torrance Tests of Creative Thinking (TTCT) (Lucas et al., 2020). Amabile (2012) proposed the componential theory of creativity which includes "three components within the individual-domain-relevant skills, creativity-relevant processes, and intrinsic task motivation--and one component outside the individual-the social environment in which the individual is working" (p. 2). Within the context of education, creativity is considered as one of most the fundamental aspects of cognitive development and according to Bloom's revised taxonomy, creativity in particular has been designated as the ultimate cognitive activity (Rojas, 2015). Therefore, creativity playing an important role in educational settings, has drawn attention in view of its association with academic achievement. The study sparking the interest in creativity and academic achievement was that of Getzels and Jackson's (1962). In their research, they compared a group of pupils who performed better on IQ tests with those who performed well on Guilford's creativity tests. They discovered that highly creative pupils outperformed the ones with high IQ in scholastic accomplishment tests (Ai, 1999). As a response to, Torrance developed a hypothesis based on Anderson's (1960) threshold theory and he contended that IQ would have an influence on academic accomplishment up to a particular IQ level (about 120), beyond which additional increases in IQ would have no effect, but creativity would begin to have an effect (Ai, 1999; Weiss, Steger, Schroeders, & Wilhelm, 2020). However, Karwowski and Gralewski (2013), taking into account their findings, argue the belief that once you reach a certain level of intellect, intelligence loses its value for creativity is philosophically and practically questionable.

Numerous studies, examining the link between creativity and academic achievement yield contradictory findings. While some of them have confirmed the significant relationship between creativity and academic achievement (Abedini; 2021; Anwar, Aness, Khizar, Naseer, Muhammad, 2012; Asuk, 2020; Ayverdi, Asker, Aydın, & Sarıtaş, 2012; Bano et al., 2014; Chauhan & Sharma, 2017; De la Pena Alvarez, 2019; Kim, 2020; Naderi, Abdullah, Aizan, Sharir, & Kumar, 2010; Nami, Marsooli, & Ashouri, 2014; Ospid, Raesi, & İrani, 2020; Pastor & David, 2017; Prakoso, Ramdani, Tae, & Riandika, 2020; Safarieh, 2020; Surapuramath, 2014; Zirak & Ahmadian, 2015), the others have reported that the link between them is insignificant or too weak to be evaluated (Arya & Maurya, 2016; Candrasekaran, 2013; Gajda, 2016; Gogoi, 2017; Olatoye, Akintunde & Ogunsanya, 2010; Zabelina, Condon, & Beeman, 2014; Zokaee, Baghbanian, & Abbas Nejad, 2020).

It is worth highlighting that the studies conducted to examine the relationship between creativity and academic achievement have revealed contradictory findings and thus making it unlikely to draw broad conclusions regarding the afore-mentioned association. Against this backdrop, the purpose of the present study is to help scientifically clarify the link between these two concepts through a review of the literature. It is thought that further consideration and insights are considered necessary to apprehend the concept's multidimensional nature and a more thorough view is required to make the relationship more explicit and to comprehend to what extent creativity affects academic achievement in the light of the previous studies. Furthermore, the scarcity of the scientific research examining the aforesaid association in a holistic way is also another rationale for the research. Therefore, the goal of the current study has been formed to identify the overall effect size for the relationship between creativity and academic achievement. To this end, it is believed that examining a number of studies that analyse the relationship between the specified variables in a more thorough and precise manner will result in a better comprehension of the association. Therefore, in order to offer a holistic and comprehensive perspective as well as a reliable generalization and to interpret the data from several studies conducted in different contexts, the meta-analysis method, which makes it possible to compile data from numerous populations, was applied in the current study. Within this context, the answer for the following question emerged as the goal of the current study: What is the effect level of creativity on academic achievement?

Methods

A meta-analytic approach was applied in this study with the aim of synthesizing the findings from several different research studies. The method allows us to compile the data of previous research in order to reach a more reliable and valid overall conclusion. In this methodology, numerous studies that focus on the same subject matter are accumulated to obtain more comprehensive, accurate, valid and unbiased generalizations (Gogtay & Thatte, 2017; Dinçer, 2014).

Data Collection

The related studies in the academic databases were located and scanned after an extensive and meticulous search process. For this purpose, the research studies published in Academic Search Ultimate Database, ERIC and SCOPUS between 2005 and 2022 were scrutinized. In the first step of the study eligibility, the keyword phrases "creativity, creative thinking, creative behaviour, academic achievement, academic success, academic performance, GPA (Grade Point Average)" were searched. The related

articles were further scanned and based on the following criteria: (1) the studies conducted in quantitative methods; (2) the studies that provided the correlation coefficients between creativity and academic achievement; (3) the studies that specify the correlation coefficients that can be converted into r (studies presenting the regression analysis or experimental research patterns were excluded); (4) the studies that are published between 2005 and 2022 in a peer-reviewed journal (thesis and reviews were not considered and excluded); (5) the studies written or provided required information in the abstract in English and Turkish; (6) the studies that have open-access option and accessible through academic databases were included in the study. Figure 1 below illustrates the process of literature review and coding process.

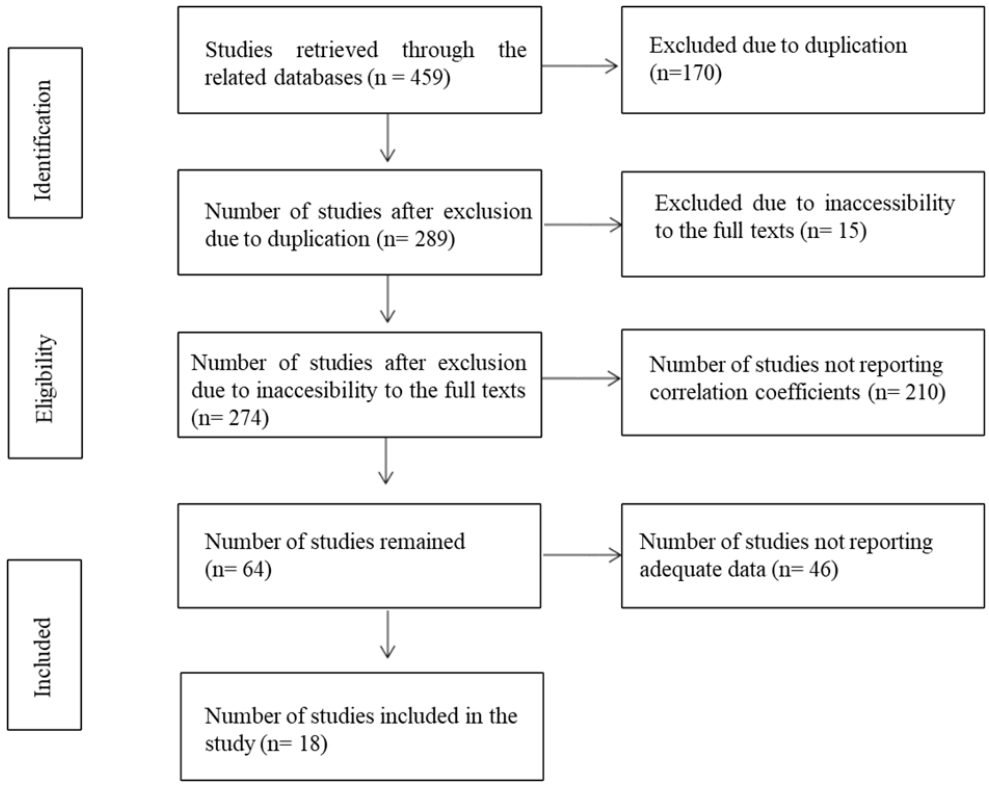

Figure 1. The flowchart of literature review

The data from the literature review were extracted by meticulous and detailed analysis of each research study. Firstly, the titles and abstracts of the relevant studies were examined and were assessed in accordance with the specified inclusion and exclusion criteria. After this step, the articles were analysed whether they reported the correlation coefficients between creativity and academic achievement. A total of 441 studies were excluded

as they failed to meet the required criteria. Finally, 18 publications were decided to be convenient for the purpose of the current study. Table 1 demonstrates the studies included in the meta-analysis along with their publishing date, correlation coefficients, sample size and tools of data collection.

Table 1. Studies included in the meta-analysis

Study	**Date**	**r**	**Sample size**	**Tools of Creativity**	**Tools of Academic Achievement**
Abedini	2021	.22	240	Creative Behavior Inventory (Linger),	GPA
Ayverdi et al.	2012	.38	145	Scientific Creativity Test	GPA
Bano et al.	2014	.66	257	Creativity Rating Checklist (CRC)	5th Grade Promotion Examination
Baran et al.	2011	.14	80	Torrance Test of Creative Thinking – Figural Form A	Test of Early Mathematics Ability- 3 (TEMA-3)
Bernabeu-Brotons & De la Peña	2021	.12	105	PIC-A test	The Average Grade of the Course
Bolandifar & Noordin	2013	.81	100	Nicolas Holt Creativity Test (NHCT)	Cumulative Grade Point Average (CGPA)
Chamorro-Premuzic	2006	.16	307	Alternate Uses Test	Grades of 4-year Period
De la Pena Alvarez	2019	.31	100	Creative Imagination Test for Adults	EvAU (the university admissions test)
Desmet et al.	2021	.09	710	Test for Creative Thinking– Drawing Production (TCT-DP)	The Mean of Student's Final Grades
Gajda	2016	.14	1106	Test of Creative Thinking—Drawing Production (TCT-DP)	GPA
Gralewski & Karwowski	2012	.07	589	Test of Creative Thinking-Drawing Production (TCT-DP)	GPA

Jaberi et al.	2014	.89	91	Khatena-Torrance Creativity Perception Inventory (KTCPI)	General English Proficiency Test
Karwowski et al.	2009	.17	1316	Test for Creative Thinking-Drawing Production TCT-DP	GPA
Olatoye et al.	2010	-.004	235	Nicolas Holt Creativity Test (NHCT)	Student Cumulative Grade Point (CGPA)
Pastor & David	2017	.42	40	Creative Attitude Survey (CAS), Two Samples Of Creativity Tests; Four Tasks Of Generating Alternatives	The Mean Results of Four Subjects: Mathematics, Romanian, Geography
Saw & Han	2022	-.06	328	Kaufman Domains of Creativity Scale (K-DOCS)	GPA
Taylor et al.	2017	.02	60	Torrance Tests of Creative Thinking	GPA
Zhang et al.	2022	.34	1037	Innovative Behavior Scale	Geography Test Scores

Data Analysis

Comprehensive Meta-Analysis (CMA 2.2) software package program was used in the present study in order to measure and to perform the necessary statistical calculations of the individual and overall the effect sizes of creativity on academic achievement. In order to identify the overall effect size, the following scale were used: - 0.15 - 0.15 negligible; 0.15 - 0.40 small; 0.40 - 0.75 medium; 0.75 - 1.10 large; 1.10 - 1.45 very large; 1.45 - excellent (Dinçer, 2014).

While computing the effect sizes in the meta-analysis, it is suggested to decide whether to utilize a fixed effects model or a random effects model. In order to examine if there is any variation among the publications in the analysis, the heterogeneity test is supposed to be carried out. The fixed effects model is applied when the effect sizes are scattered homogeneously while the random effects model is utilized when the effect sizes are distributed heterogeneously (Dinçer, 2014; Karagöl & Esen, 2019).

Results

Having identified the correlation coefficient of each research study, it was attempted to analyse the overall effect. Figure 2 displays the individual effect sizes of each study as well as the total effect size of the studies included in the meta-analysis.

Study Name	Hedges' g	Stand. Error	Lower Limit	Upper Limit	Var.	Z	P	R. Weight
Abedini (2021)	0,450	0,133	0,189	0,710	0,018	3,387	0,001	6,06
Ayverdi et al. (2012)	0,817	0,180	0,464	1,171	0,033	4,528	0,000	5,62
Bano et al. (2014)	1,752	0,167	1,425	2,078	0,028	10,519	0,000	5,76
Baran et al. (2011)	0,280	0,228	-0,167	0,727	0,052	1,228	0,219	5,14
Bernabeu-Brotons & De la Peña (2021)	0,240	0,198	-0,148	0,628	0,039	1,212	0,226	5,45
Bolandifar & Noordin (2013)	2,741	0,344	2,068	3,415	0,118	7,978	0,000	3,98
Chamorro-Premuzic (2006)	0,323	0,116	0,096	0,551	0,013	2,790	0,005	6,20
De la Pena Alvarez (2019)	0,647	0,212	0,232	1,063	0,045	3,053	0,002	5,31
Desmet et al. (2021)	0,181	0,075	0,033	0,328	0,006	2,393	0,017	6,47
Gajda (2016)	0,283	0,061	0,163	0,402	0,004	4,650	0,000	6,54
Gralewski & Karwowski (2012)	0,140	0,083	-0,022	0,302	0,007	1,695	0,090	6,43
Jaberi et al. (2014)	3,871	0,464	2,962	4,780	0,215	8,349	0,000	2,99
Karwowski et al. (2018)	0,345	0,056	0,235	0,455	0,003	6,160	0,000	6,56
Olatoye et al. (2010)	-0,008	0,131	-0,265	0,249	0,017	-0,061	0,951	6,08
Pastor & David (2017)	0,907	0,355	0,211	1,603	0,126	2,555	0,011	3,87
Saw & Han (2022)	-0,120	0,111	-0,337	0,097	0,012	-1,082	0,279	6,24
Taylor et al. (2017)	0,039	0,262	-0,473	0,552	0,068	0,151	0,880	4,79
Zhang et al. (2022)	0,723	0,066	0,593	0,852	0,004	10,933	0,000	6,51
Random	**0,619**	**0,108**	**0,407**	**0,830**	**0,012**	**5,740**	**0,000**	

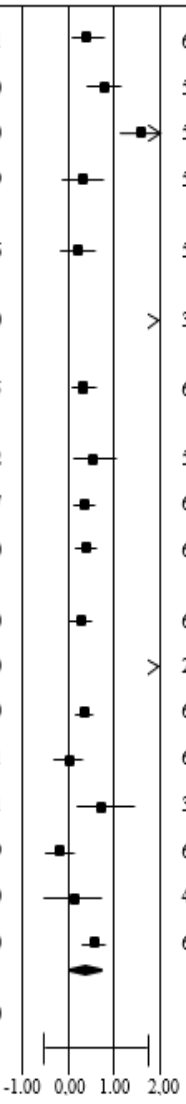

Figure 2. *The distribution of effect size values of the studies*

Figure 2 displays the effect sizes for each study that was a part of the analysis, as well as the lower and upper bounds of the effect sizes within the

95% confidence interval. The data show that except for two studies (Olatoye et al., 2010 (-0,008) and Saw & Han, 2022 (-0,120)) - all the others have positive effects ranging from 0,039 to 3,871.

Following the calculation of the distribution of effect size values, the heterogeneity test, which identifies the presence of variability in the data and specifies the heterogeneous or homogeneous characteristics of the studies in the analysis, was applied following the analysis of the individual and total effect sizes of the studies. By conducting the test, it becomes possible to decide whether to use fixed effects model or random effects model. Table 2 presents the results of the heterogeneity test.

Table 2. Heterogeneity test of the meta-analysis

			95% CI							
Model	N	Estim.	Low.L.	Up. L	Z-val.	P-val.	Q-val.	df (Q)	p-val.	I-squared
Fixed	18	0.217	0.194	0.240	18.177	0.000	393.347	17	0.000	95.678
Randm	18	0.310	0.197	0.416	5.171	0.000				

The studies included in the study is characterized as heterogeneous since the Q value in the x2 significance table for 17 (df) is 35.719 and 393.347 is higher than this value ($p<0.005$). Furthermore, the p value of 0.000 confirms the finding that the random effects model should be applied. Thus, the analysis was conducted applying the random-effects model in accordance with the findings. The findings showed that the overall effect size was 0.619 and this figure points a medium-sized effect according to the classification of effect sizes. In other words, it can be concluded that the total effect size of creativity on academic achievement is medium.

Furthermore, funnel plot and Rosenthal's Safe N methods were conducted to determine the validity and reliability as well as to discover publication bias of the studies included in the meta-analysis. Figure 3 depicts the funnel plot of the collected studies' effect sizes.

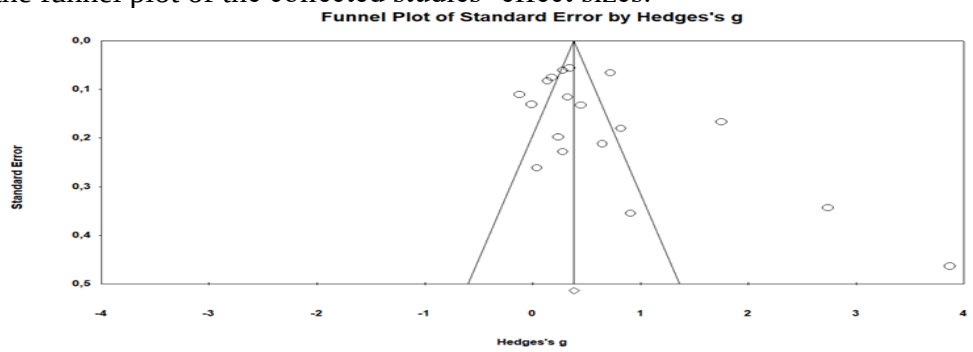

Figure 3. The funnel plot of standard errors

The funnel plot represents the relationship between the size of the study on the vertical axis and the size of the effect on the horizontal axis. The top of the graph shows large studies, which have a tendency to group together close to the mean effect size while the bottom of the graph points to smaller studies. The studies are distributed symmetrically around the total effect size if there is no publication bias. On the other hand, if bias exists, there becomes a bigger concentration of studies on one side of the mean than the other at the bottom of the plot (Borenstein, 2005). Although there are few dots beyond the funnel lines, as can be seen in Figure 3, the majority of the others have a shape that is close to symmetrical, and it can be argued that the scattering indicates that the publication bias is minimal.

Following the funnel plot analysis, the Fail-Safe N analysis was performed to determine the number of studies that must be included in the analysis that are missing before the overall effect becomes insignificant. Table 3 displays the results of the analysis.

Table 3. Classic fail-safe N analysis

Z-value for observed studies	16.60
p-value for observed studies	0.00
Alpha	0.05
Z for alpha	1.95
Number of observed studies	18
Numb. of missing studies to bring p-value to > alpha	1274

The results of the fail-safe N analysis in Table 3 show that the p value (0.00) is lower than the alpha value (0.05), suggesting that the analysis' publication bias is admissible. Further, the table also demonstrates that, in order to invalidate the results of the current meta-analysis, 1274 additional non-significant studies are needed in order to raise the p value over the alpha value.

Discussion and Conclusion

The present meta-analysis synthesized the data of the previous research examining the relationship between creativity and academic achievement. The analysis comprised papers published between 2005 and 2022 in the Academic Search Ultimate Database, Education Resources Information Center (ERIC) and SCOPUS with a total sample size of 6846. Following the heterogeneity test, the analysis was carried out using the

random effects model, and the total effect size was found to be r=.619 across 18 studies, corresponding to a medium effect size.

That the link between creativity and academic achievement is noteworthy is also be evidenced in Gajda, Karwowski and Beghetto's (2017) meta-analysis in which the average correlation was found r = .22. The findings also confirm the results of many studies, indicating positive and significant link between the two variables (Anwar et al., 2012; Asuk, 2020; Naderi et al., 2010; Nami et al., 2014; Ospid et al., 2020; Surapuramath, 2014). However, there are those whose findings yield negative and mostly non-significant relationships (Arya & Maurya, 2016; Gajda, 2016; Olatoye et al., 2010; Zabelina et al., 2014). The contradictory results among the studies highlight the sophisticated and multifaceted nature of creativity as well as the complex representation of the relationships.

What should also be noted is that the search for moderators could be important due to heterogeneity of effect size values in the current study. Many factors are thought to have an impact on the alleged relationship between creativity and academic achievement, and heterogeneity may result from these variables. Hence, it could make remarkable differences to take into account any potential influences on the correlation between creativity and academic achievement such as cultural backgrounds, age, gender, size of the sample, assessment criteria for academic performance or success, data collection tools to measure creativity, characteristics of the participants, various pedagogical approaches, schools' climate, even dynamics of the classrooms and teacher manners (Gajda et al., 2017b) and so forth, suggesting that additional moderating factors might be involved and might have a role in terms of the association.

In short, it should be mentioned that creativity serves as a crucial key component for learning, future career, and even for continuous development (Zhang et al., 2022) and it is a natural part of learning. As extensive knowledge and effective application of information are prerequisites for creativity, it increases deep cognitive processes (Patston, 2021). In the light of the findings of the present meta-analysis, it can be concluded that fostering creativity in educational settings will lead an upsurge in academic achievement.

The findings of the current research highlight valuable insights to consider in terms of creativity. For one thing, creativity is a multi-faceted construct and needs a methodical and systematic understanding in educational settings. As Runco (2008) states, when given the opportunity, students can generate their own unique and original interpretations. Therefore, the curriculum along with educators and policy makers should support it and provide adequate opportunities for students to have the chance to contemplate on vague, open-ended assignments and projects that do not

require merely memorizing and rote learning. What is required for this is to nurture children's natural talents and potentials.

The present study is undoubtedly subject to certain limitations. To begin with, the research studies in the meta-analysis were chosen using a specific statistical procedure - the correlation coefficients. Therefore, it would be advisable to take into account the studies examining the mentioned link between the variables in a different method for future studies. Furthermore, while gathering relevant studies from databases, it is probable that certain papers that should have been included in the meta-analysis were ignored or misevaluated by the researcher unintentionally.

Conflicts of interest

The author of this paper certify that they have NO affiliations with or involvement in any organization or entity with any financial or non-financial interest (such as honoraria; educational grants; membership, employment; affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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