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EXPLORING THE RELATION BETWEEN HIGH CREATIVITY AND HIGH ACHIEVEMENT AMONG 8TH AND 11TH GRADERS

Research Article

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Abstract

This study explores the relationship between high creativity and high scholastic achievement in mathematics, reading, and science among 8th and 11th grade students. A quantitative methodology was used in the study. Data were collected from 941 eighth-grade students and 605 eleventh-grade students at an independent public school district in Minnesota, a Midwestern State in the U.S.A. The data collection instruments included a general personal questionnaire, the Torrance Tests of Creative Thinking (TTCT) Figural Form A, and the Minnesota Comprehensive Assessment Test (MCA). Correlations were computed and chi-square analyses were performed to address research questions. Grade-based standard scores were used in the measurement of creativity and academic achievement with the top 20% cutoff scores being used to identify students with high achievement and students with high creativity. The results indicated that the relation between high creativity and high academic achievement varies among eighth and eleventh graders. High mathematics and high reading achievement are related to high creativity among both eighth- and eleventh-grade students, but with small effect sizes. High achievement in science is related to high creativity among eleventh-graders. Our results indicate that high creativity and high achievement in reading, mathematics, and science achievement tend to be positively related, but those relationships are at best weak, indicating that there are substantial components to high creativity that are not shared by high achievement in mathematics, reading, and science and vice versa.

Keywords: creativity, academic achievement, eighth grade, eleventh grade

1. Introduction

The relationship between creativity and scholastic achievement has been increasingly the focus of empirical research. However, a systematic understanding of the relation between creativity and scholastic achievement is still lacking. The related literature offers contradictory findings between creativity and achievement (Gralewski & Karwowski, 2012). Some of the

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studies indicate that there is no significant (e.g., Olatoye, Akintunde, & Yakasai, 2010; Yamamoto, 1967) or limited (Renzulli, 2005) relation between creativity and scholastic achievement; whereas, other studies indicate a positive relationship between creativity and scholastic achievement (e.g., Ai, 1999; Asha, 1980; Getzels & Jackson, 1962; Freund & Holling, 2008). Gralewski and Karwowski (2012), who found contradictory results within the same study, posited that the contradictory results might be due to different mediating factors which relate to different (a) measures of creativity in studies (e.g., teacher nominations, divergent thinking tests), (b) tools used to assess school grades, (c) statistical approaches to control for the influence of general intelligence, (d) methods of analysis, and (e) places and times of the research. Thus, it becomes much more important to replicate studies about creativity and scholastic achievement in different cultures and times using different measures of creativity and achievement as well as different data analytic approaches.

When the related literature is examined, it is seen that one group of studies provided no evidence in support of a strong positive association between creativity and scholastic achievement. To illustrate, in one of the earliest studies, using data based on 75 ninth-grade and 84 eleventh-grade students responding to the Lorge-Thorndike Intelligence Tests, the IOWA Tests of Educational Development, and the Minnesota tests of creative thinking, Yamamoto (1967) found that creativity did not have a strong relation to school achievement. He found high correlations between achievement and IQ but low correlations between IQ and creativity.

Bowers (1969) is among the earliest researchers to investigate the relationships among creativity, achievement, and IQ. 278 ninth graders participated in his study. He used grade point averages (GPAs) with ninth-grade norms, the IOWA Tests of Educational Development Form YS to assess student achievement levels; the Torrance Tests and some other creativity measures to measure creativity; and the Otis Quick Scoring Mental Ability Test, Form Beta to assess IQ. The results indicated "a mild interactive effect of IQ and creativity upon achievement" and suggested that "the regression of achievement on IQ decreases as creativity score increases, and the regression of achievement on creativity score decreases as IQ rises" (Bowers, 1969, p. 175).

Similarly, Gralewski and Karwowski (2012) conducted a study on the relation between creativity and school achievement among 589 high school students in Poland using the Test of Creative Thinking-Drawing Production (TCT-DP) and GPA to assess creativity and school achievement respectively. Controlling for the effect of gender and intelligence, they found no evidence of a significant relation between creativity and achievement for students.

Ai (1999) conducted a study on the relationship between creativity and achievement among 2,264 students in Spain. He used the TTCT, the Abedi-Schumacher Creativity Test, the Villa and Auzmendi Creativity Test, and teacher ratings to assess creative thinking. As for the scholastic achievement, he used self-reports of student achievement in Spanish, Basque, English, natural science, social science, and mathematics. The results indicated a relationship between creativity and academic achievement when teacher ratings were used to assess creativity. However, there was only a slight relationship between creativity and achievement when creativity tests were used.

Gajda (2016) carried out a study on the relationship between creativity and achievement among 1,106 students enrolled in Polish primary, secondary, and high school students. She used the Test of Creative Thinking-Drawing Production (TCT-DP) to assess creativity and grade point average (GPA) and standardized achievement test scores for the available grades to measure school achievement. The results indicated a positively weak relationship between creativity and school achievement as assessed by GPA. However, this relationship was stronger

when standardized achievement test scores were used instead of the GPA. Apart from the overall relationship between creativity and achievement, she also found that elaboration and fluency were related to school grades but originality and nonconformity were not related to school grades.

Freund and Holling (2008) conducted a study on the relationships among creativity, reasoning ability, and scholastic achievement among 1,113 students in Germany using a multilevel analysis. They used GPA to assess achievement and the Berlin Structure of Intelligence Test for Youth: Assessment of Talent and Giftedness (BIS-HB) to assess student creativity and reasoning ability. The result indicated "a rather strong effect for reasoning ability and, to a somewhat lesser degree, also for creativity when predicting GPA" (p.317).

Similarly, Hansenne and Legrand (2012) conducted a study among 73 elementary school students in Belgium using the TTCT figural and verbal to assess creativity. As for school achievement, they used the mean scores for French and mathematics courses. The results indicated that creativity as assessed by the TTCT predicted achievement in both mathematics and French.

In a recent study, Zhang, Ren, and Deng (2018) collected data from 1082 primary school students in Beijing, China. The participants were from the fourth, fifth, and sixth grade levels. The authors utilized TTCT Figural Form A and students' self-reported achievement scores in Chinese and mathematics. They found that there was a significant positive relationship between creativity and academic achievement as assessed by the teachers.

In a meta-analysis study of 120 studies conducted since 1960s, Gajda, Karwowski, and Beghetto (2017) found a modest, yet significant relationship between creativity and achievement ($r = .22$). As for the factors impacting that relationship, they found that when creativity tests were used rather than self-report scales to measure creative thinking abilities, the association between creativity and scholastic achievement was significantly stronger. Similarly, the effect size was found to be stronger when standardized achievement tests were used instead of GPA to assess student achievement level. Another major result was that verbal tests to assess creativity were found to have a stronger correlation with scholastic achievement when compared to figural forms of creativity. Gajda et al. (2017) suggests that "... the best that can be said about whether there is a link between creativity and academic achievement is this: It depends." (p. 269).

The inconsistent findings regarding the relation between creativity and achievement highlight a need for further studies to explore whether there is a relation across two different domains, i.e. achievement and creativity. As populations are changing, there is a need to understand that relation in different times and settings. In this study which is a part of a larger project, a quantitative methodology is employed to explore the relation between creativity as measured by the Torrance Tests of Creative Thinking (TTCT) Figural Form A and achievement as measured by a standardized test, i.e., the Minnesota Comprehensive Assessment Test (MCA). The research questions being investigated in this study are as follows:

1. Is there a relation between high creativity and high scholastic achievement in mathematics, reading, and science for eighth-grade students when the top 20% of students for each measure (i.e., science, math, reading, creativity) are considered for each grade?
2. Is there a relation between high creativity and high scholastic achievement in mathematics, reading, and science for eleventh-grade students when the top 20% of students for each measure (i.e., science, math, reading, creativity) are considered for each grade?

3. Is the relation between high creativity and high scholastic achievement in mathematics, reading, and science for eighth-grade students different from that of eleventh-grade students when the top 20% of students for each measure (i.e., science, math, reading, creativity) are considered for each grade?

2. Method

A quantitative methodology was used in the study to answer the research questions. The data collection instruments included a general personal questionnaire, The Torrance Tests of Creative Thinking (TTCT) Figural Form A and the Minnesota Comprehensive Assessment (MCA) test. Information about the participants, instruments, and data collection procedures are explained in the subsequent sections below.

2.1. Participants

The participants in this study were students in an independent public school district in Minnesota, a Midwestern State in the U.S.A. The sample included 941 eighth-grade students (473 boys and 468 girls; $M_{age} = 14.10$ years, $SD_{age} = .34$ years) and 605 eleventh-grade students (322 boys and 283 girls; $M_{age} = 17.32$ years, $SD_{age} = .34$ years).

2.2. Instruments

Three different instruments were utilized in the study. First of all, a general personal questionnaire was used to collect data about the participants. The Torrance Tests of Creative Thinking (TTCT) Figural Form A served as the measure of creativity. Developed by Torrance and his associates, the TTCT has three activities: picture completion, repeated figures of lines or circles, and picture construction, and five subtests: fluency, originality, elaboration, abstractness of titles, and resistance to premature closure (Torrance, 1990, 1998, 2008). TTCT Figural forms are less biased as they deploy the use of figures and drawings instead of requiring participants to display their ability to use the language (Kim, 2006).

As for the assessment of achievement, the Minnesota Comprehensive Assessment (MCA) test served as the primary measure of scholastic achievement. The MCA provides data on student achievement in mathematics, reading, and science. The MCA helps "districts measure student progress toward Minnesota's academic standards and also meet federal and state legislative requirements" (MDE, 2020). Student scores in mathematics, reading, and science were used as the primary data source for scholastic achievement in the study.

2.3. Procedure

The approval of the university human subjects review board and the approval of associated parents for the study were received prior to conducting the study. Participating students completed the TTCT-Figural Form A and the MCA. Any identification data were removed from the data set by the related District office before the researchers started to work on the data set. Thus, confidentiality of the data was maintained.

There are different suggestions about determining the cutoff points in the literature to determine students who have high achievement and creativity. Among the first who investigated the relation between creativity and achievement were Getzels and Jackson (1962), who viewed the top 20% of students as high achievers and the lower 80% of students as the general level of students. Similarly, Renzulli (2005) stated that "I clearly have in mind persons who are capable of performance or possess the potential for performance that is representative of the top 15 to 20 percent of any given area of human endeavor" (p. 260). In line with this perspective, the decision was made to use the 20% score as the cutoff score in the data analysis for the four measures (i.e., creativity, science, mathematics, reading) in the current study. Table

1 presents the cut-off points for both eighth-grade students and eleventh-grade students with percent values rounded to the nearest percent.

Table 1. *Cut-off points for 8th and 11th graders*

	8th grade		11th Grade	
	Cut off score	Number of High Achievers	Cut off score	Number of High Achievers
Creativity	116	191	114	130
Science	863	191	1059	125
Math	863	197	1162	137
Reading	866	194	1066	135

Note. Cut off Percentile Rank=80%

3. Results

Cross-tabulations involving chi-square analyses were performed using SPSS version 20 (IBM Corp, 2011) to explore the relation between high creativity and high academic achievement among 8th grade and 11th grade students using the top 20% score as the cutoff point. Cross-tabulation with chi-square analysis allowed us to "determine whether the variables are statistically independent or if they are associated" (Michael, 2001, p.1).

The creativity scores used in the data analysis were the grade-based standard scores for the five dimensions of creativity, i.e., fluency, originality, elaboration, abstractness of titles, and resistance to premature closure. The achievement scores used in the data analysis were the grade-based standard scores for academic achievement in mathematics, science, and reading. Through use of the phi coefficient (ϕ), effect sizes were computed. Tables 2 and 3 present the results of the cross-tabulation analyses for eighth-grade students and eleventh-grade students using the top 20% scores for high creativity and achievement respectively.

Table 2. *Relation between high creativity and high achievement among 8th graders (top 20% as high creativity and high achievement - low 80% for general creativity and achievement)*

	Low Creativity				High Creativity			
	Low (%)	High (%)	Chi-S (Sig)	Phi (Sig.)	Low (%)	High (%)	Chi-S (Sig)	Phi (Sig.)
Science	606 (64.4%)	144 (15.3%)	2.75 (.097)	.05 (.097)	144 (15.3%)	47 (5%)	2.75 (.097)	.05 (.097)
Math	604 (64.2%)	146 (15.5%)	4.81 (.028)	.07 (.028)	140 (14.9%)	51 (5.4%)	4.81 (.028)	.07 (.028)
Reading	611 (64.9%)	139 (14.8%)	9.80 (.002)	.10 (.002)	136 (14.5%)	55 (5.8%)	9.80 (.002)	.10 (.002)

Table 3. *Relation between high creativity and high achievement among 11th graders (top 20% as high creativity and high achievement - low 80% for general creativity and achievement)*

	Low Creativity				High Creativity			
	Low (%)	High (%)	Chi-S (Sig)	Phi (Sig.)	Low (%)	High (%)	Chi-S (Sig)	Phi (Sig.)
Science	384 (63.5%)	91 (15%)	5.30 (.021)	.09 (.021)	93 (15.4%)	37 (6.1%)	5.30 (.021)	.09 (.021)
Math	379 (62.6%)	96 (15.9%)	7.48 (.006)	.11 (.006)	89 (14.7%)	41 (6.8%)	7.48 (.006)	.11 (.006)
Reading	381 (63%)	94 (15.5%)	8.13 (.004)	.12 (.004)	89 (14.7%)	41 (6.8%)	8.13 (.004)	.12 (.004)

The results indicated that when the top 20% of students were identified as high creative individuals and high achievers in three basic disciplines, namely, mathematics, science, and reading, there were the following results: (a) high creativity is positively related to high achievement in mathematics [$\chi^2(1, 941) = 4.81, p < .05, \phi = .07$] and reading [$\chi^2(1, 941) = 9.80, p < .05, \phi = .10$], for eighth graders, and (b) high creativity is positively related to high achievement in science [$\chi^2(1, 605) = 5.30, p < .05, \phi = .09$], mathematics [$\chi^2(1, 605) = 7.48, p < .05, \phi = .11$], and reading [$\chi^2(1, 605) = 8.13, p < .05, \phi = .12$], for eleventh graders.

However, all of the effect sizes are quite small. For eighth graders, the effect size relating high creativity to high achievement in mathematics is small with $\phi = .07$ and to high achievement in reading is also small with $\phi = .10$. For eleventh graders, the effect size relating high creativity to high achievement in mathematics is small with $\phi = .11$, to high achievement in reading is small with $\phi = .12$, and to high achievement in science is small with $\phi = .09$.

4. Conclusions and Discussion

This study was an investigation as to whether high creativity as assessed by TTCT Figural form A is associated with high achievement in basic disciplines, namely, mathematics, reading, and science as assessed by the MCA. Thus, the present study explores whether high ability is generalizable across two domains, i.e., creativity and achievement. We found that the relationships between high creativity and high achievement in mathematics, reading, and science achievement tend to be positively related, but those relationships are at best weak. Specifically, high achievement in mathematics and reading achievement is related to high creativity among both eighth-grade and eleventh-grade students. In addition, high achievement in science is related to giftedness in creativity among eleventh-grade students.

Although our results suggest that high creativity is related to high achievement in the basic disciplines, one should note that the effect sizes of the relations between high creativity and high achievement in mathematics, science, or reading are small. Thus, these results should be interpreted with caution as there seem to be substantial components to high creativity that are not shared by high achievement in mathematics, reading, and science and vice versa.

In accordance with the present results, some previous studies have demonstrated that there is a positive relation between creativity and scholastic achievement (e.g., Ai, 1999; Asha, 1980; Freund & Holling, 2008; Gajda, 2016; Hansenne & Legrand, 2012; Zhang et al., 2018). However, the degree of this relationship depends on various factors, as posited by Gralewski and Karwowski (2012). Gralewski and Karwowski (2012) suggested that different measures of creativity in studies (e.g., teacher nominations, divergent thinking tests); the tools used to assess school grades; statistical approaches to control for the influence of general intelligence;

methods of analysis, and places and times of the research could be regarded as factors affecting the existence and degree of a relationship between creativity and achievement.

Our findings could be discussed considering these mediating factors. Specifically, our results seem to be consistent with that of Ai (1999) who found that there was only a slight relationship between creativity and achievement when creativity tests were used rather than teacher ratings. Our results are also in agreement with the evaluation of Renzulli (2005) who suggested a limited relation between creativity and scholastic achievement.

In their meta analysis study, Gajda et al. (2017) found that verbal tests to assess creativity had a stronger correlation with scholastic achievement when compared to figural forms of creativity. Thus, it would have been interesting to use TTCT verbal forms within the same sample to find out whether the relationship between creativity and scholastic achievement would be stronger with verbal measures of creativity.

As Gajda (2016) indicated: “it would be ideal if school achievement and creativity went hand in hand” (p.247). However, our results suggest that being a high achiever in mathematics, reading, or science does not guarantee that the individual is highly creative, or being highly creative does not guarantee that the individual is a high achiever in mathematics, reading, or science. High achievement in mathematics, reading, or science may rely more on memorization and application of skills and knowledge than the creative production of novel ideas and methods.

The reader should bear in mind that this study involved data from Minnesota and thus may not be generalizable to students in eighth and eleventh grades in other educational regions as well as other grades. Further research is needed to replicate this study in different educational settings to determine the extent to which the relation between high creativity and high scholastic achievement is generalizable. Another limitation is that although the top 20% was used as the cut-off score in the sample of 8th and 11th grade students, we do not have sufficient information about the extent to which the high achievers in mathematics, science, and reading in our sample would be considered high achievers in a nationally normative sense.

5. Conflict of Interest

The authors declare that there is no conflict of interest.

6. Ethics Committee Approval

The authors confirm that the study does not need ethics committee approval according to the research integrity rules in their country.

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