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Relationship between Divergent Thinking in Mathematical and Non-Mathematical Situations

-Based on the TTCT; Figural A and the MCPSAT-

Dong Jou Hwang(Korean Educational Development Institute)*
Kang Sup Lee(Dankook University)
Jong Jin Seo(Kongju University)

Abstract

We examined the relations between the score of the divergent thinking in mathematical (Mathematical Creative Problem Solving Ability Test; MCPSAT: Lee etc. 2003) and non-mathematical situations (Torrance Test of Creative Thinking Figural A; TTCT: adapted for Korea by Kim, 1999). Subjects in this study were 213 eighth grade students(129 males and 84 females). In the analysis of data, frequencies, percentiles, t-test and correlation analysis were used. The results of the study are summarized as follows; First, mathematically gifted students showed statistically significantly higher scores on the score of the divergent thinking in mathematical and non-mathematical situations than regular students. Second, female showed statistically significantly higher scores on the score of the divergent thinking in mathematical and non-mathematical situations than males. Third, there was statistically significant relationship between the score of the divergent thinking in mathematical and non-mathematical situations for middle students was r= .41 (p< .05) and regular students was r= .27 (p< .05). A test of statistical significance was conducted to test hypothesis. Fourth, the correlation between the score of the divergent thinking in mathematical and non-mathematical situations for mathematically gifted students was r = .11. There was no statistically significant relationship between the score of the divergent thinking in mathematical and non-mathematical situations for mathematically gifted students. These results reveal little correlation between the scores of the divergent thinking in mathematical and non-mathematical situations in both mathematically gifted students. Also but for the group of students of relatively mathematically gifted students it was found that the correlations between divergent thinking in mathematical and non-mathematical situations was near zero. This suggests that divergent thinking ability in mathematical situations may be a specific ability and not just a combination of divergent thinking ability in non-mathematical situations. But the limitations of this study as following: The sample size in this study was too few to generalize that there was a relation between the divergent thinking of mathematically gifted students in mathematical situation and non-mathematical situation.

key words : mathematics, gifted, mathematical situations, non-mathematical situations, divergent thinking

* 교신저자 : 황동주(djhwang@kedi.re.kr)

Ⅰ. INTRODUCTION

The divergent thinking theory of creativity has a great deal of intuitive appeal, especially the suggestion that creativity will be enhanced by considering, in the process of looking for new ideas or designing a solution to a problem, all of the following: (a) many, as opposed to only a few, ideas; (b) a wide range of ideas; and (c) unusual (as well as more typical) ideas.

Divergent thinking tests are the most commonly used procedures for assessing creative potential. Although several kinds of divergent thinking tests are available (Bachelor & Michae, 1991; Runco, 1991), they all share a common characteristic. More specifically, people are asked to generate multiple alternative answers to a series of ill-defined, open-ended problems (Fredericksen, 1984).

Anastasi(1982), in a discussion of divergent-thinking tests of creativity, concluded that evidence of relation between the Torrance Tests and everyday-life criteria of creative achievement is meager. Anastasi also noted that a major factor analytic study of the performance of 800 fifth-grade students provided no support for a single-factor interpretation. The factors identified in this study were highly task specific.

Runco(1986, 1990) suggested the need to consider the domain-specificity of creativity when analyzing the ability of divergent-thinking measures to predict creative performance. It is possible, under this these skills is relevant only to one of many specific performance domains (such as Gardner, 1983, "intelligences," as Runco, 1990, suggested) or to even more narrowly defined tasks within those domains.

NCTM(2000) Standards suggests that, in order to prepare for the 21st century, today's students should equivalent themselves with the ability to use mathematical knowledge for problem solving, the ability to communicate mathematically, and the ability to reason mathematically and a mathematical propensity. It also states that students need to be provided with challenging problems that can stimulate them to develop divergent and sound mathematical thinking and produce creative thinking. It adds that guiding students to solve a single problem using multiple methods and strategies helps them develop and extend their mathematical thinking. Creative thinking ability and expressive ability in the field of mathematics can be measured using 'open-ended' or 'open-response' problems and questions that require more than one answer. Yoshihiko(1997) think that openness like "open-ended approach" and "from problem to problem" is one aspect of fostering creativity. Because, "open-ended approach" means end products are open, and "from problem to problem" means ways to develop are open. It is important that students can combine different ways of thinking in one problem. We can often see "creativity" in mathematics appear by combining seeming different aspects.

Torrance and Horng(1974) correlated scores on the Kirton Adaption-Innovation Inventory (KAI; Kirton, 1976, 1987a) with scores on a selection of tests from the Torrance Tests of Creative Thinking Battery (TTCT; Torrance, 1974). Significant correlations were found between the total KAI score and Fluency ($r= .36$, $p< .04$), Flexibility ($r= .34$, $p< .05$), and Originality ($r= .43$, $p< .01$). However, the sample size interpretation, that divergent-thinking skills are important in creative performance, but that each of in this study was small, ($N=33$), and a more robust result has been reported by Isaksen and Puccio (1988).

Thus, we need to find out if this result from the study on the relationship between said kind of divergent thinking in mathematical and non-mathematical situations is related with mathematical creativity.

The purpose of this study is to find out how the divergent thinking in non-mathematical situations of seven grade is related with the divergent thinking in mathematical situations as well as what kind of relations are there among sub-components factors.

I .1. A Study Purpose and Objectives

The purpose of this study was to determine what kind of differences in relationship between divergent thinking in mathematical and non-mathematical situations in middle school students. The specific objectives for this study were:

To investigate whether group differences exists in divergent thinking between Mathematical and Non-Mathematical Situations.

To investigate whether gender differences exists in divergent thinking between Mathematical and Non-Mathematical Situations.

To investigate what relationship exits between performance on measures of divergent thinking in Mathematical and Non-Mathematical Situations.

Ⅰ.2. Definition of Terms

The following terms will be used throughout this study: The divergent thinking theory of creativity has a great deal of intuitive appeal, especially the suggestion that creativity will be enhanced by considering, in the process of looking for new ideas or designing a solution to a problem, all of the following: (a) many, as opposed to only a few, ideas; (b) a wide range of ideas; and (c) unusual (as well as more typical) ideas.

Ⅱ. METHOD

Ⅱ.1. Design

This study consists of two substudies a characteristic of the divergent thinking in mathematical and non-mathematical situations and a correlation study. The correlation study was conducted to investigate whether a statistically significant relationship exists between performance on Mathematical Creative Problem Solving Ability Test (MCPSAT: Lee et al., 2003) and on Torrance Test of Creative Thinking Figural A (TTCT; adapted for Korea by Kim, 1999) which are required for middle schools. Therefore, for the correlation study, the two variables were the scores of the divergent thinking in mathematical situations and the scores of the divergent thinking in non-mathematical situations within each group.

Ⅱ.2. Participants

The participants for this study were 213 Korean middle school students. The participants were 195 of Daejeon Byeondong middle school (122 males and 73 females) and 18 of the Gifted Education Center of Hanbat National University in Daejeon (7 males and 11 females) each as the object. The were 195 of regular students and 18 of mathematically gifted students each as object.

Ⅱ.3. Instrumentation

The figural TTCT-Form A was administered as the test for divergent thinking in non-mathematical situations. A test booklet, which included detailed instructions and three 10-minute exercises were provided to each participant. The three exercises were picture construction, picture complete, and parallel lines. All tests included an incomplete or abstract sketch, which the participant was asked to complete and label (Torrance, 1992).

The Korean standard of TTCT was made by Kim, Y and verified of its reliability and adequacy as it is standardized into Korean version taking children from preschool grade to 12th grade. The TTCT exercises are used to generate five indices of creativity: Fluency, Originality, Abstractness of Titles, Elaboration, and Resistance to Premature Closure. In addition, a checklist of Creative Strengths was also generated from the answers, which provided 13 criterion-referenced measures. The TTCT Creativity Index was calculated and standardized on the basis of these indices, and this index serves well as an overall indicator of creative potential (Kim, 1998).

According to Chase (1985) and Davis (1989), many studies have found the TTCT to be reliable: Typical test-retest reliability of the TTCT is around .70, and inter-rater reliabilities are mostly above .90.

The MCPSAT was administered as the test for divergent thinking in mathematical situations. The MCPSAT are asked to generate multiple alternative answers to a series of ill-defined, open-ended problem. A test booklet, which included detailed instructions and five 10-minute exercises were provided to each participant. The fives exercises were selected as the open-ended problems for this study. Problem 1 is a sixteen-dot problem, a transformed version of the nine-dot problem that was used by Haylock (1978) and Kim, et al. (1997). Problem 2 is a regular hexagon problem, a transformed version of the quadrangle problem that was used by Kim et al.(1997). Problems 3 to 5 are the water-flask, marble and classifying several solid figure problems that were used by Becker & Shimada (1997). The MCPSAT exercises are used to generate third indices of creativity: Fluency, Flexibility, and Originality. According to Lee, Hwang, & Seo, studies have found the MCPSAT to be reliable: Typical test-retest reliability of the MCPSAT is around .80. In order to evaluate item-internal consistency reliability and discrimination, Cronbach α. was calculated using SPSS 10.0K (Lee & Hwang, 2003; Lee, Hwang & Seo, 2003). Internal validity and difficulty were calculated using BIGSTEPS (Livacre & Wright, 2003) based on Rasch's 1-parameter item-response model.

<Table 1> Analysis of Quality of Test Instruments (MCPSAT)

Item		1	2	3	4	5	Total
Reliability		Chronbach α : 0.80					
Internal Validity	Infit	1.05	1.10	.85	.90	1.08	1.00
	Outfit	1.01	1.02	.83	.90	1.05	.96
Difficulties		-.22	-.41	.23	.40	-.01	0.00
Discrimination		.73	.73	.67	.51	.56	1.00

Ⅱ.4. Procedure

The research object got tested of TTCT and MCPSAT. It was performed and evaluated by the operator at the end of first semester. A test booklet and pencils were provided to each participant. The TTCT and MCPSAT were administered following the instructions in the manual.

Ⅱ.5. Data analysis

In the analysis of data, the frequency and percentage per type to find out the divergent thinking in mathematical and non-mathematical situations of seven grade, average, standard deviation, t-test. Data was processed through SPSS/PC 10.0K static program for Windows.

Ⅲ. Review of related Literature

We see the preceded studies on the relationship between divergent thinking in mathematical and non-mathematical situations, firstly, divergent thinking in mathematical situations are not related to divergent thinking in non-mathematical situations(Balka, 1974; Dirkes, 1974; Dunn, 1976). Secondly, divergent thinking in mathematical situations are highly related to divergent thinking in non-mathematical situations(Evans, 1964; Haylock, 1978; Lee & Hwang, 2003).

Balka(1974) undertook a factor analysis of the scores of 6-8th grade on a variety of tests, including Lorge-Thorndike Intelligence Test, Iowa Tests of Basic Skills, Minnesota Tests of Creative Thinking (MTCT) and Creative Ability in Mathematics Test (CAMT). The multiple correlation coefficient was computed to be r=0.20, with the coefficient of multiple determination being R^2 = 0.04. There is a positive relationship between creative ability in mathematics as measured by the CAMT and general creative ability as measured by the MTCT (Minnesota Tests of Creative Thinking). As might be expected, from the nature of the test items on the two tests, correlations between convergent items on the CAMT and factors on the MTCT were very low, ranging from 0.00 to 0.12. He conclusion is that mathematical creativity is not related to general creativity. He conclusion is that creativity is not depended to range.

Dirkes(1974), using the Torrance (1966) figural and verbal tests of creative thinking as pre-and post-tests, investigated the effects of a training program for children which emphasis divergent thinking in mathematics. She conclusion is that mathematical creativity is not related to general creativity. Dunn(1976) undertook a factor analysis of the scores of 12-13 year old pupils on a variety of tests, including six mathematics divergent production tests, some general divergent thinking tests, IQ and mathematics attainment. The mean correlation between the six mathematics divergent production tests was low (0.26) and they certainly did not group together as an identifiable factor.

Evans(1964) reported significant positive correlations between mathematical creativity scores and IQ, arithmetic achievement, mathematics grades, mathematics attainment and general creativity. The correlations between mathematical creativity and other mathematics scores is not entirely surprising, since it is to be expected and generally found to be the case that the number and range of responses a pupil can make in an open-ended mathematical situation will be related to the level of mastery of mathematical skills and knowledge. Haylock(1978) reported highly significant correlations between two general creativity tests and highly significant correlations between two mathematical divergent productions tests used with 14-15 years olds. But for the group of students of relatively high mathematics attainment it was found that the correlations between general and mathematical creativity was near zero. This suggests that creativity in mathematics may be a specific ability and not just a combination of general creative ability and mathematics attainment. Lee & Hwang(2003) reported highly significant correlations between general creativity tests (TTCT; adapted for Korea by Kim, 1999) and highly significant correlations between mathematical divergent productions tests (MCPSAT, Kim. et al., 1997) used with 10 years olds.

Ⅳ. Result

Ⅳ.1. Comparative study

Table 2 provides the means and standard deviations for scores on the divergent thinking in mathematical and non-mathematical situations of the regular students and gifted students.

The aim of the present study is an attempt to examine the differences between gifted and regular students in the divergent thinking in mathematical and non-mathematical situations among a Korean sample.

<Table 2> Means and Standard Deviations of the Scores on the divergent thinking in mathematical and non-mathematical situations

Components		Regular Students (n=195)						Gifted Students (n=18)						Students (n=213)					
		Male (n=122)		Female (n=73)		Total (n=195)		Male (n=7)		Female (n=11)		Total (n=18)		Male (n=129)		Female (n=84)		Total (n=213)	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
TTCT	1	30.51	9.02	32.82	8.46	31.37	8.86	37.57	3.82	37.36	3.50	37.44	3.52	30.89	8.95	33.42	8.12	31.89	8.70
	2	24.30	8.33	27.56	7.49	25.52	8.16	44.14	5.82	39.36	4.95	41.22	5.66	25.37	9.35	29.11	8.22	26.85	9.09
	3	5.75	1.33	6.52	1.50	6.04	1.44	9.43	1.72	7.91	1.14	8.50	1.54	5.95	1.58	6.70	1.53	6.24	1.60
	4	3.30	2.72	2.92	2.68	3.15	2.71	12.14	6.26	4.91	2.39	7.72	5.51	3.78	3.59	3.18	2.72	3.54	3.28
	5	3.80	2.81	4.99	2.98	4.24	2.93	18.43	3.36	14.36	5.64	15.94	5.19	4.59	4.37	6.21	4.66	5.23	4.54
	6	67.64	18.77	74.81	18.12	70.32	18.80	121.7	15.27	103.9	12.72	110.8	16.04	70.57	22.25	78.62	20.04	73.75	21.72
MCPSAT	7	15.64	7.00	14.22	6.75	15.12	6.93	25.71	6.40	26.18	4.83	26.00	5.31	16.19	7.32	15.79	7.67	16.03	7.44
	8	10.14	3.83	9.47	3.67	9.89	3.77	14.29	2.63	13.82	2.36	14.00	2.40	10.36	3.88	10.04	3.81	10.24	3.85
	9	2.83	3.39	3.62	4.69	3.12	3.93	9.29	6.21	7.64	4.48	8.28	5.11	3.18	3.85	4.14	4.83	3.56	4.28
	10	28.61	12.65	27.30	13.18	28.12	12.83	49.29	11.15	47.64	9.22	48.28	9.73	29.73	13.39	29.96	14.44	29.82	13.78

Note. 1–Fluency; 2–Originality; 3–Elaboration; 4–Abstractness of Titles; 5–Resistance to Premature Closure; 6–Creativity Index; 7–Fluency; 8–Flexibility; 9–Originality; 10–Mathematical creativity Index; MCPSAT–score on the divergent thinking in mathematical situations; TTCT–score on the divergent thinking in non-mathematical situations.

The result of t-test (see Table 3) showed a significant difference on divergent thinking scores on two the mathematical and non-mathematical situations, both favoring gifted. And the result of t-test (see Table 2) showed a significant difference on the divergent thinking scores on each component of the mathematical and non-mathematical situations. The result of t-test (see Table 3) showed a significant difference on the total creativity scores on one tests (divergent thinking in non-mathematical situations: TTCT) favoring females. Statistically significant difference was found on the component of Fluency (t=-2.09, p= .04), Originality (t=-2.98, p= .00), Elaboration (t=3.46, p= .00) and Resistance to Premature Closure (t=-2.59, p=.01). No statistically significant difference was found on the component of Abstractness of Titles (t=1.30, p= .20). On the other hand, each component of the MCPSAT showed slight but not significant differences between males and females except to originality. No statistically significant difference was found on the component of Fluency (t= .37, p= .71), Flexibility (t= .09, p= .93) and Mathematical Creativity Index (t=-.55, p= .59). Statistically significant difference was found on the component of Originality (t=-2.21, p= .03).

<Table 3> Differences of Divergent Thinking in Mathematical and Non-Mathematical Situations of children with performance for Group and Gender

Components		Group						Gender					
		Gifted students		Regular students		t	p	Males		Females		t	p
		M	SD	M	SD			M	SD	M	SD		
TTCT	1	37.44	3.52	31.37	3.52	-5.81	.00**	30.89	8.95	33.42	8.12	-2.09	.04*
	2	41.22	5.66	25.52	8.16	-7.98	.00**	25.37	9.35	29.11	8.22	-2.98	.01**
	3	8.50	1.54	6.04	1.44	-6.90	.00**	5.95	1.58	6.70	1.53	-3.46	.00**
	4	7.72	5.51	3.15	2.71	-3.48	.00**	3.78	3.59	3.18	2.72	1.30	.20
	5	15.94	5.19	4.24	2.93	-14.99	.00**	4.59	4.37	6.21	4.66	-2.59	.01*
	6	110.83	16.04	70.32	18.80	-8.84	.00**	70.57	22.25	78.62	20.04	-2.68	.01**
MCPSAT	7	26.00	5.31	15.11	6.93	-9.12	.00**	16.19	7.32	15.79	7.67	.37	.71
	8	14.00	2.40	9.89	3.77	-8.66	.00**	10.50	4.08	10.45	4.43	.09	.93
	9	8.28	5.13	3.12	3.93	-6.91	.00**	3.12	3.69	4.67	5.71	-2.21	.03*
	110	48.28	9.73	28.12	12.84	-8.05	.00**	29.81	13.53	30.93	16.01	-.55	.59

Note. MCPSAT=score on the Divergent Thinking in Mathematical Situations; TTCT=score on the Divergent Thinking in Non-Mathematical Situations. *p < .05. ** p < .01.

Ⅳ.2. Correlation Study

The Pearson product-moment correlation coefficient r was computed between Divergent Thinking in Mathematical and Non-Mathematical Situations. The correlation between the divergent thinking in mathematical and non-mathematical situations for middle students was $r = .41$ ($p < .05$). There was statistically significant relationship between the score of the divergent thinking in mathematical and non-mathematical situations for middle students. A test of statistical significance was conducted to test the hypothesis. The divergent thinking in mathematical situations was also significantly correlated with the divergent thinking in non-mathematical situations for middle students($r = .16$ to $r = .44$).

The correlation between the divergent thinking in mathematical and non-mathematical situations for regular students was $r = .27$ ($p < .05$). There was statistically significant relationship between the score of the divergent thinking in mathematical and non-mathematical situations for middle students. A test of statistical significance was conducted to test the hypothesis. The divergent thinking in mathematical situations was also significantly correlated with the divergent thinking in non-mathematical situations for regular students ($r = .17$ to $r = .26$).

The correlation between the divergent thinking in mathematical and non-mathematical situations for gifted students was $r = .11$. These results reveal little correlation between the scores of the divergent thinking in mathematical and non-mathematical situations in both gifted students. There was no statistically significant relationship between the score of the divergent thinking in mathematical and non-mathematical situations for gifted students.

<Table 4> Correlation between the divergent thinking in mathematical and non-mathematical situations for gifted and regular students

Components			Regular Students									
			General Creativity					Mathematical Creativity				
			1	2	3	4	5	6	7	8	9	10
Gifted Students	General Creativity	1	-	.92** (.86**)	.60** (.59**)	.03 (.11)	.08 (.19**)	.93** (.86*)	.17* (.22**)	.22** (.25**)	.23** (.27**)	.23* (.56**)
		2	.26	-	.66** (.72**)	.07 (.29**)	.16* (.46**)	.95** (.96*)	.17* (.31**)	.21** (.32**)	.21** (.36**)	.22* (.37*)
		3	.13	.51*	-	.30** (.46**)	.56** (.67**)	.78** (.82*)	.20** (.33**)	.23** (.31**)	.26** (.37**)	.25* (.38*)
		4	.20	.73**	.64**	-	.24** (.47**)	.25** (.45*)	.10 (.20**)	.08 (.16*)	-.02 (.18**)	.07 (.21*)
		5	.09	.48*	.68**	.47	-	.34** (.60*)	.23** (.43**)	.23** (.35**)	.17* (.36**)	.24* (.44*)
		6	.42	.86**	.74**	.86*	.74*	-	.22** (.36**)	.26** (.35**)	.24** (.39**)	.27* (.41*)
	Mathematical Creativity	7	-.40	-.23	.09	-.34	.14	-.23	-	.92** (.92**)	.43** (.48**)	.94* (.94*)
		8	-.42	.07	.06	-.16	.14	-.07	.73**	-	.53** (.56**)	.95* (.95*)
		9	.08	.67**	.31	.39	.23	.49*	.09	.45	-	.69* (.72*)
		10	-.28	.25	.23	-.02	.23	.11	.77*	.88*	.68*	-

Note. MCPSAT-Divergent Thinking in Mathematical Situations; TTCT-Divergent Thinking in Non-Mathematical Situations; *p < .05. ** p < .01; ( ) - Correlation between the divergent thinking in mathematical and non-mathematical situations for total middle students.

V. CONCLUSIONS AND DISCUSSION

The findings of this study indicated statistically significant differences between gifted students and regular students on the scores of divergent thinking tests. Overall, the findings suggest that gifted students are more divergent thinking ability than regular students as measured by the divergent thinking in mathematical and non-mathematical situations. The gifted students appear to be better at the all component of the divergent thinking in mathematical and non-mathematical situations. And the findings suggest that females are more divergent thinking ability than males as measured by the non-mathematical situations. The Females appear to be better at Fluency, Originality, Elaboration and Resistance to Premature Closure. However, there was a lack of difference in other creativity areas, such as Abstractness of Titles. On the other hand, each component of the mathematical situations showed slight but not significant differences between males and females except to originality.

The Pearson product-moment correlation coefficient r was computed between divergent thinking in mathematical and non-mathematical situations. The correlation between the divergent thinking in mathematical and non-mathematical situations for middle students was $r= .41$ ($p< .05$) and regular students was $r= .27$ ($p< .05$). There was statistically significant relationship between the score of the divergent thinking in mathematical and non-mathematical situations for regular students and middles students contain to gifted students. This support to divergent thinking in mathematical situations is highly related to divergent thinking in non-mathematical situations (Evans, 1964; Haylock, 1978; Lee & Hwang, 2003). On the other hand, there was no statistically significant relationship between the score of the divergent thinking in mathematical and non-mathematical situations for gifted students. This result indicates that very small sample of the gifted students are associated with the performance on the divergent thinking in mathematical and non-mathematical situations. Also but for the group of students of relatively mathematical gifted students it was found that the correlations between divergent thinking in situations mathematical and non-mathematical situations was near zero. This suggests that divergent thinking ability in mathematical situations may be a specific ability and not just a combination of divergent thinking ability in non-mathematical situations. But the limitations of this study as following: The sample size in this study was too few to generalize that there was a relation between the divergent thinking of mathematically gifted students in mathematical situation and non-mathematical situation.

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국 문 요 약

수학적 상황과 비수학적 상황에서의 확산적 사고의 관계 연구

- TTCT의 도형검사와 MCPSAT를 중심으로 -

황동주(한국교육개발원)

이강섭(단국대학교)

서종진(공주대학교)

본 연구의 목적은 수학적 상황에서의 확산적 사고와 비수학적 상황에서의 확산적 사고의 관계를 조사하기 위하여 중학교 2학년 학생 215명을 대상으로 검사를 실시하여 자료를 분석하였다. 자료 분석은 빈도, 퍼센트, t-검증과 상관 분석을 사용하였다. 본 연구의 결과는 첫 번째, 수학 영재 학생이 일반 학생보다 수학적 상황에서의 확산적 사고(MCPSAT)와 비 수학적 상황에서의 확산적 사고(TTCT)는 통계적으로 유의미하게 높은 점수를 받았다. 두 번째, 여학생이 남학생보다 비 수학적 상황에서의 확산적 사고(TTCT)에서 제목의 추상성을 제외하고 모든 요소에서 통계적으로 유의미하게 높은 점수를 받았다. 세 번째, 남학생이 여학생보다 수학적 상황에서의 확산적 사고에서 유창성과 융통성은 평균이 높게 나타나고 있으나 통계적으로는 유의미하지 않고 여학생이 남학생보다 수학적 상황에서의 확산적 사고에서 독창성의 평균이 높게 나타나고 있으며 통계적으로 유의미하게 나타나고 있다. 네 번째, 수학적 상황과 비 수학적 상황에서의 확산적 사고 점수사이의 상관관계는 통계적으로 유의미하게 나타나고 있으며 중학생 전체에서는 r=.41($p<.05$)이고 r= .21에서 r= .56까지 분포하고 있으며 일반 학생은 r=.27($p<.05$)이고 r = .07에서 r= .27까지 분포하고 있다. 다섯 번째로 수학 영재학생의 경우는 수학적 상황과 비 수학적 상황에서의 확산적 사고 점수사이의 상관관계는 r=.11이며 통계적으로 유의미하지 않게 나타나고 있다. 이 결과는 수학 영재학생의 경우 수학적 상황과 비 수학적 상황에서의 확산적 사고 점수사이의 상관관계는 거의 0에 가깝다고 할 수 있다. 이것은 수학적 상황에서의 확산적 사고

능력은 비 수학적인 상황에서의 확산적 사고 조합된 능력이 아니라 다른 특별한 능력이라고 볼 수 있다. 그러나 본 연구에서 수학 영재 학생들의 사례수가 적어서 수학 영재 학생의 수학적 상황과 비 수학적 상황에서의 확산적 사고 점수 사이의 상관관계가 있다는 주장을 일반화하기에는 충분치 않을 수 있다는 제한점을 가지고 있다.

주요어: 수학, 영재, 수학적 상황, 비수학적 상황, 확산적 사고