대한수학교육학회지 수학교육학연구 제 16 권 제 4 호
Journal of Educational Research in Mathematics
Vol. 16, No. 4, 313-326. Nov 2006

A Study on the Relationship between Mathematical Creativity and Psychological Types in Middle School Students

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I. Introduction

The 21st century is regarded as the age of information, but in fact, it will be more precise to call it the age of creativity (CQ). It is great advantage we have obtained a lot of information easily and quickly with the progress of Internet and other communication media in the age of information. It requires us not only ability to solve the problem through the use of this information appropriately but also creative ability to create new knowledge from the information. In the past, the creative ability to solve problem was considered as "gifted nature", however, nowadays, it is considered as a practical demand, which is general ability for everyone to come by. The creativity given to everyone as latent capacity would be considered differently from each other with various viewpoint regarding creativity, no matter what kind of factor is considered, such as an ability, process, results, personality, or integration of all. (Treffinger, Isacksen & Firestein, 1983). In other words, neither the concept of creativity nor the concept of mathematical creativity is basically clear. Creative person can be characterized in terms of personality traits out of 60 ones (Torrance, 1965) such as "courageous in convictions", "independent in judgment", "curious", "intuitive", "willing to take risks". MacKinnon(1961) reported that the highly creative people were characterized by strong self-concepts and unwillingness to accept anything on the mere say-so of others in authority. According to MacKinnon(1978), creative people were intelligent, original, intuitive, and independent.

Aiken(1973) suggested that the mathematically gifted tend to be curious, persistent, and highly intelligent with a good memory, reluctant to accept the obvious with a dislike for repetitiousness and routine, highly independent, frequently unconventional, flexible, and well-adjusted. Aiken also identified that the famous mathematicians' personality was creative in their achievements, even though no particularly clear picture emerges from these studies.

Mathematical creativity is revealed when the sensing, emotional, and environmental factors are integrated at the same time. In addition, one who has high mathematical ability is assumed to have a unique characteristic and propensity in his/her taking and behavior. When we consider that the

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personality is a unique characteristic and behavior style performed by persons on the basis of their experience, creativity and mathematical creativity are presumed to be deeply related with the personality which tells the individual differences. Therefore, it is valuable to study whether psychological types has any relationship with mathematical creativity or not.

The purpose of this study was to find out how the psychological types shown by the eighth grade are related with the mathematical creativity and what kind of relationships there are among sub-components factors. The research questions for this study were:

1. What kind of characteristics on the psychological types by eighth graders emerge?

2. What kind of differences emerge between psychological temperament type (SJ/SP/NT/NF) by MMTIC and mathematical creativity factors?

II. Review of literature

1. Mathematical Creativity in school

Mathematicians have considered mathematical creativity as the significant component factor in mathematical ability. Aiken(1973) defined the mathematical creativity as "process and various products" after integrating all the related documents and studies on the mathematical creativity. Putting these together, we can categorize it into two. First, the mathematical creativity is defined as sensing ability, emphasizing creative thinking (Krutetskii, 1969; Laycock, 1970; Romey, 1970; McNulty, 1969; Weaver & Brawley, 1959; Balka, 1974; Krutetskii, 1976; Haylock, 1987; Fouche, 1993). Second, the mathematical creativity is defined as essentials related with product(Spraker, 1960; Jensen, 1973).

Summing it up, the essence of creativity is viewed in two categories as follows. First, the mathematical creativity emphasizes creative thinking as sensing ability, which is (1) ability to connect with other things easily and freely from one mental operation(Krutetskii, 1969), (2) ability to analyse a problem in many ways, observe the patterns, see likenesses and differences (Laycock, 1970), (3) ability to combine approaching ways of mathematical idea, matter, technique, new method(Romey, 1970), (4) ability to identify mathematical creativity with the abilities for pattern-spotting and for insightful solutions (McNulty, 1969), (5) ability to think and carry out quantity situation flexibly not with fixed methods, but with intuition, imagination, creativity, originality, self-direction, independence, passion, concentration, and tenacity (Weaver & Brawley, 1959), (6) ability to gain a solution from mathematical context by breaking existing thoughts (Balka, 1974), (7) ability to overcome self-limit by breaking fixed forms and making by breaking various (Krutetskii, 1976), (8) ability to flexibility to device various solution over same problem, ability including originality which combine problem factors with new methods (Fouche, 1993), and (9) ability to see new relationships between techniques and areas of application and to make associations between possibly unrelated ideas (Haylock, 1987). Especially Balka and Krutetskii believed that overcoming fixations(mental sets) was necessary for creativity to emerge.

Second, the definition of mathematical creativity is essentially related to the product. Spraker(1960) called it an ability to product original or unusual, applicable methods of solutions for problems in mathematics. Jensen (1973) used operational definition which emphasize problem posing, rather than on problem-solving: he said it is an ability given numerous, different and applicable questions when presented in a mathematical situation in written, graphic or chart form.

Especially, Balka(1974) has defined the sub-abilities which compose the mathematical creativity reforming to hundred of mathematicians, mathematics educators and middle school teacher respectively. The factors with 80% agreement include follows: the ability which sets hypothesizes related to cause and effect in mathematical education, the ability to set patterns in mathematical situation, the ability to find solutions in mathematical situation by breaking fixed thoughts, the ability to think and evaluate unusual mathematical idea, to figure out the possible result in mathematical situation, the ability to perceive the omission from the given mathematical context and to enabled question to fill it up, and the ability to divide the general mathematical problems into specified sub-problems.

On the other hand, mathematical creative problem solving ability is defined as "convergent thinking and divergent thinking function together and appear in each steps of problem solving"(Kim., Kim., Bang., & Hwang, 1997).

2. Psychological type

Recently, the study related to the psychological types is very actively on progress nation widely especially using MBTI (Myers-Briggs Type Indicator). The characteristics of children are applied mainly to the subject from 2nd grade to 8th grade according to MMTIC (Murphy-Meisgeir Type Indicator) which has been developed in consideration of growing characteristics based on MBTI.

Kim and Sim(1993) sampled 1117 students from the age of 13 to 15 and the characteristics for 2nd grader of middle school were as extroversion (E: 39.6%), introversion (I: 25.4%), sense (S: 45.4%), intuition (N: 21.3%), thinking (T: 11.7%), feeling (F: 16.2%), perception (P: 18.3%), and judging (J: 11.7%).

Kim. Lee, and Chung(2001) tested temperament taking 148 second graders from normal middle school, and it appeared as sensing judging type (SJ: 18.9%), sensing perception type (SP: 51.4%), intuition feeling type (NF: 8.8%), intuition thinking (NT: 20.9%), per functions, sensing thinking (ST: 54.7%), sensing feeling (SF: 15.5%), intuition feeling (NF: 8.8%), and intuition thinking (NT: 20.9%).

3. The Relationship between Psychological Types and Creativity

With the preceded studies of the relationship between creativity and personality type we conclude the following: (1) sense sensing type-intuitional sensing type is very closely related with creativity(Cuttel, Ebert & Tasuoka, 1970; Lee, 1997), (2) creative thinking factors (elaboration, flexibility, originality) followed by sense judging type (SJ), sense perception type (SP), intuition thinking type (NT), intuitional emotion type (NF)

show statistically meaningful differences (Lee & Lee, 1999). (3) Gryskiewicz and Tullar (1995) have reported that there were more creative and innovative problem solving method manifested from the intuition type and sensing type. Kumar(1981) has confirmed that highly creative students are extrovert and have lower anxiety level compared to the less creative student.

Cuttel, Ebert and Tasuoka(1970) have researched the interrelationship between MBTI (Myers-Briggs Type Indicator) and creativity. Their research on the co-relation between the sensing perception-intuition perception and creativity proved the intuition preference rate, which .95 ($p<.001$) has an intimate relationship with creativity.

Lee(1997) has proven that there is significant difference in the entire score of fluency, originality, creativity between the sensing perceiving group and the intuitional perceiving group. The result indicated that the highly creative person tends to prefer intuitional perceiving and the intuitional (N), perceiving (P), intuitional perceiving (NT) are high in creativity.

Kim(1996) has found there is typical difference in the relationship between psychological temperament type and school adjustment indicating, and intuitional feeling type is higher in school adjustment. Lee and Lee(1999) have declared that the difference followed by the psychological temperament according to MMTIC (SJ type, SP type, NT type, NF type) from the creative thinking factors (elaboration, flexibility, originality, fluency) appeared significant in elaboration(.0001), flexibility(.0001), originality (.0001) statically, intuitional thinking type (NT) high in elaboration and intuitional feeling type (NF) high in originality and flexibility accordingly.

III. Method

1. Design

This study consisted of two sub studies, characteristics of personality types and a correlation study. The correlation study was conducted to investigate whether statistically significant relationship exists between on the mathematical creativity test type A and on the Murphy-Meisgeier Type Indicator for Children tests required for middle schools. Therefore, for the correlation study, the two variables were the scores of the MMTIC and the MCPSAT within each group. The personality type of this study was about the psychological temperament types (SJ/SP/NT/NF) according to the MMTIC (Murphy-Meisgeier Type Indicator for Children). The mathematical creativity of this study is an ability to solve mathematical problem newly relating the previously known knowledge, concept, principle, problem solving methods and etc. It is defined by total marks of 3 sub-factors (fluency, flexibility, originality) produced by MCPSA (Mathematical Creative Problem Solving Ability) tests type A, part 1 of Korea Education Development Institute (Kim., Kim., Bang., & Hwang, 1997).

2. Participants

The participants in this study were 141 Korean middle school students. The participants were the

eighth grade students from 2 classes of S middle school and 2 classes of D middle school.

3. Instrument

The Murphy-Meisgeier Type Indicator for Children (MMTIC) was administered as the test for personality type. A test booklet including detailed instructions and 20-minute exercise was provided to each participant. MMTIC test sheet was composed of 70 questions in total and tried to understand human being according to 4 criteria. It was divided into functional type and temperamental type combining 2 out of the 4 criterions out of extroversion (E) - introversion (I), sense (S) - intuition (N), thinking (T) - feeling (F), and judging (J) - perception (P). The functional type divided into sensing thinking type (ST), sensing feeling type (SF), intuitional thinking type (NT), and intuitional feeling type (NF). The temperamental type was divided into sensing judging type (SJ), sensing perceiving type (SP), intuitional feeling type (NF), and intuitional thinking type (NT). MMTIC was performed to diagnose the personality type of the study objects and help self-understanding as MBTI (Myers-Briggs Type Indicator), the psychological test for adult was based on the psychological typical theory of C. Jung, personality type test for children & teenagers was developed (MMTIC) by doctor C. Meisgeier and doctor E. Murphy of USA based on the same theory. Therefore, this test is called MMTIC (Murphy-Meisgeier Type Indicator for Children). The Korean standard of MMTIC was made by Kim and Sim(1993). Its reliability and adequacy as it is standardized into Korean version and taken by children from second grade to eight grades were verified. The reliability by test-retest was EI index .76, SN index .65, TF index .63, JP index .63 and the concurrent validity among personal diagnostic tests of Chung-Ang Aptitude Publishing was verified as .58 ($p< .001$).

The Korean version MMTIC test sheet used in this study is composed of 70 questions and could be hand-scored. The average time for this test was around 30 minutes, and it was in terms of analyzed the mathematical creative problem solving ability according to the preference index of personality and temperament type (SJ/SP/ NT/NF) considering the characteristics of preference criteria.

The mathematical creative problem solving ability tests (MCPSAT) A type part 1 was administered as the test for mathematical creativity. A test booklet, which included detailed instructions and 70-minute exercise, was provided to each participant. The mathematical creative problem solving ability test's A type part 1 was used to measure mathematical creativity, which is standardized by Korea Educational Development Institute (Kim., Kim., Bang., & Hwang, 1997). The reliability of this test was $r= .79$ and it measure 3 sub-factors of fluency, flexibility and originality.

The fluency was the ability to win various reactions, idea as meaningful answer in a problem contexts and flexibility was an ability to make idea in different category and originality new. The unique is high quality reaction and idea.

4. Procedure

The research object took the test of MMTIC and the mathematical creativity test. 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 MMTIC and the MCPSAT were administered following the instructions in the manual.

5. The data analysis.

Data were analyzed in terms of frequency and percentage per type to find out the psychological characteristics of eighth grade. There was average, standard deviation, t-test, ANOVA and Duncan test ex-post validation to verify the difference of mathematical creativity according to personality types. The stepwise multiple regressions was completed to prove explanatory adequacy of personality type regarding mathematical creativity. Data were processed through SPSS/PC 10.0K static program for Windows.

IV. Result

1. The characteristics of personality types of middle school student

The frequency analysis to observe the personality types of middle school has been resulted that frequency index was more in extrovert (E: 50.4%), sensing (S: 46.8%), feeling (F: 67.4%), perceiving (P: 71.6%) than introvert (I: 22.7%), intuition (N: 25.5%), thinking (T: 18.4%), judging (J: 7.8%) as <Table IV-1>. Per temperament, it appeared in order of sensing perceiving type (SP: 54.5%), intuition feeling type (NF: 28.6%), intuition thinking type (NT: 10.4%), and sensing judging type (SJ: 6.5%). In the functional types, it appeared in order of sensing thinking type (ST: 13.0%), sensing feeling (SF: 48.1%), intuition feeling type (NF: 28.6%), intuition thinking (NT: 10.4%).

This result indicated that the middle school students in this study group is high in extrovert (I: 2.7%) and judging (J: 3.9%) at the preference index comparing to the eight grade of standardized group of Kim and Sim (1993) in the <Table IV-1>.

At temperamental prospect, the general students were higher in sensing judging (SJ: 12.4%), intuition thinking (NT: 10.5%) as the students in the research group compared with general middle school student of <Table IV-2> by Kim., Lee., and Chung (2001). At functional prospect, the students in the research group in the preference

<Table IV-1> The distribution of personality types of middle school student (N=141)

	EUI			SUN			TUF			JUP		
	E	U	I	S	U	N	T	U	F	J	U	P
Research group (%)	50.4	27.0	22.7	46.8	27.7	25.5	18.4	14.2	67.4	7.8	20.6	71.6
Standardized group - Eight grades (%)	39.6	35.0	25.4	45.4	33.3	21.3	11.7	72.1	16.2	11.7	70.0	18.3
Standardized group - Research group (%)	-10.8	8.0	2.7	-1.4	5.6	-4.2	-6.7	57.9	-51.2	3.9	49.4	-53.3

index were high in sensing thinking type (ST: 41.7%), intuition thinking (NT: 10.5%) compared with the students in the standardized group.

2. Difference analysis on the mathematical creativity according to the personality types of middle school student

I divided the middle school students into different categories, according to different personalities. When I studied the result of mathematical creativity grade according to the preference index in <Table IV-3>, extroversion (E) appeared $p<.05$ low in flexibility and mathematical creativity than introversion (I). Introversion appeared higher in even fluency and originality than extroversion but this was not significantly different.

The result of this study was different from that of Kumar(1981) in that; generally students who were highly creative tend to be more extrovert than the ones who were low creative. This proved that the students tend to be more introvert since they feel more interested in and satisfied with the math task, through "writing" with the emphasis of inner state of learning, whereas the students tend to be more extroversion through "communicating" with the emphasis of outer state of learning. In this point, the creativity in math task must be interpreted differently when compared to that of the other tasks generally, which indicate that the learners' introvert aspects must be considered in developing programs for math creativity.

In the relationship between SN index and mathematical creativity, the figure of intuition type (N) appeared all higher in fluency, flexibility, originality, and mathematical creativity. In addition, there was not dramatically higher than sensing type (S) in total. There was statistically significance (.95) in fluency aspect with the results of higher intuition than sensing.

The final results indicated that the intuition from understandings the meanings, relationships, and possibilities as well as accumulating information is more critical than the sensing from dealing with the facts practically in real life. Intuition consists of two things. One is primary intuition which comes before instructional learning, and the other is secondary intuition after intellectual learning in terms of psychology.

The ability of developing logical reasoning must be considered to meet the need of mathematical intuition, and this is one of goals in higher math education.

Therefore, developing secondary intuition

<Table IV-2> T-test result per preference trends on mathematical creativity

	SJ	SP	NF	NT	ST	SF
Research group (%)	6.5	54.5	28.6	10.4	13.0	48.1
General middle school student (%)	18.9	51.4	8.8	20.9	54.7	15.5
Research group - General middle school student	12.4	-3.1	-19.8	10.5	41.7	-32.6

expressed as the results from the intellectual instruction and its instructional strategies are critical in promoting the fluency from the mathematical creativity with the consideration of investigation, conceptual learning, a midwife method by Socrates, and problem solving learning.

<Table IV-3> T-test result per preference trends on mathematical creativity

Mathematical creativity	Preference Trends	N	M	SD	t
Fluency	E	38	19.58	11.08	0.076
	I	21	25.24	12.32	
	S	47	19.49	9.71	0.011*
	N	30	26.13	12.41	
	T	18	21.83	15.23	0.952
	F	53	21.64	10.02	
	J	6	25.00	16.54	0.509
	P	67	21.92	10.32	
Flexibility	E	38	18.47	6.17	0.013*
	I	21	23.33	8.21	
	S	47	19.83	5.86	0.531
	N	30	20.90	9.08	
	T	18	22.22	8.90	0.141
	F	53	19.25	6.73	
	J	6	22.33	9.11	0.447
	P	67	20.05	6.84	
Originality	E	38	2.53	3.97	0.272
	I	21	3.71	3.87	
	S	47	2.85	3.34	0.817
	N	30	3.07	4.83	
	T	18	4.28	3.99	0.101
	F	53	2.49	3.93	
	J	6	3.50	4.03	0.637
	P	67	2.73	3.79	
Mathematical creativity index	E	38	40.58	17.58	0.027*
	I	21	52.29	21.14	
	S	47	42.17	14.37	0.073
	N	30	50.10	23.9	
	T	18	48.33	25.24	0.352
	F	53	43.38	17.07	
	J	6	50.83	28.09	0.428
	P	67	44.70	17.07	

* $p<.05$

In the relationship between TF index and mathematical creativity, the figure of thinking type (T) was all higher in fluency, flexibility, originality, mathematical creativity, and in total than feeling type (F), but not significantly higher. In the relationship between JP index and mathematical creativity, judging type (J) appeared higher in fluency, flexibility, originality, and mathematical creativity and it was higher than perceiving type (P) in total, but there was not a dramatic change.

However, the analysis on the creativity according to the temperament pattern revealed significant difference in the fluency, flexibility, mathematically creativity and in total per temperament pattern as in <Table IV-4>.

According to the result of Duncan verification, intuition feeling type (NF) was significantly high in fluency, flexibility, mathematical creativity and in total compared with sensing judging (SJ), sensing perceiving type (SP), again sensing judging type (SJ) was significantly higher than sensing perceiving type (SP). This result almost supports that of research creative thinking factors (elaboration, flexibility, originality), according to sensing judging (SJ), sensing perceiving type (SP), intuition thinking type (NT), and intuition feeling type (NF) reveals statically significant difference.

SJ, SP and NF are grouped together because they do not differ from each other as in <Table IV-5>. NT is also grouped together because they

<Table IV-4> The change analysis and the result of Duncan verification on the mathematical creativity

Mathematical creativity	Temperament Patterns M (SD)				F
	SJ(n=5)	SP(n=42)	NF(n=8)	NT(n=22)	
Fluency	20.80(14.48)	19.33(9.22)	33.13(15.38)	23.59(10.41)	3.982*
Flexibility	19.80(7.46)	19.83(5.76)	27.75(8.52)	18.41(8.08)	3.748*
Originality	3.20(4.44)	2.81(3.25)	5.63(4.53)	2.14(4.68)	1.591
Total	43.50(24.81)	41.98(13.08)	66.50(25.50)	44.14(20.81)	4.314*

* p<.05

<Table IV-5> The result of Duncan verification on the mathematical creativity(Post Hoc test)

	Mathematical creativity						
	Subset for alpha=.05		Subset for alpha=.05		Subset for alpha=.05	Subset for alpha=.05	
	Fluency		Flexibility		Originality	Total	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 1	Group 2
SJ	*		*		*	*	
SP	*		*		*	*	
NF	*		*		*	*	
NT		*		*	*		*

do not differ from each other, but are different to Groups 1 and 2. Statistically significant differences between Group 1 and Group 2 except to originality.

V. Discussion and Conclusion

1. Discussion

The purpose of this study was to improve the mathematical creativity. In the eighth grade, I divided the student into different categories by different characters. The result of mathematical creativity can be concluded as follows.

First, in the personality types of eighth grade, the extroversion (E: 50.4%), sensing (S: 46.8%), feeling (F:67.4%), perceiving (P: 71.6%) appeared higher than introversion (I: 22.7%), intuition (N: 25.5%), thinking (T: 18.4%), judging (J: 7.8%). Due to the result, it showed the students whose were in the research group were higher in introversion (I: 2.7%), extroversion (J: 3.9%) at preference index compared with the standardized group of Kim, & Sim (1993). In temperament prospect, it appeared in order of sense perceiving (SP: 54.5%), intuition feeling type (NF: 28.6%), intuition thinking type (NT: 10.4%), and sense judging type (SJ: 6.5%). In the functional type, it appeared as sense thinking type (ST: 13.0%), sense feeling type (SF: 48.1%), intuition feeling type (NF: 28.6%), and intuition thinking type (NT: 10.4%). Per temperament, the general students were higher in sensing judging (SJ: 12.4%), intuition thinking (NT: 10.5%) as the students in the research group compared with general middle school student shown in the simplified diagram of <Table IV-2> by Kim., Lee., & Chung(2001). At functional prospect, the students in the research group at the preference index were higher in sensing thinking type (ST: 41.7%), intuition thinking (NT: 10.5%) compared with the students in the standardized group. It turned out that the eight grade of research group prefers introversion (I) type and judging (J) type compared with the general eighth grade.

Second, the result of the mathematical fluency, flexibility in the temperament depended on the different personalities. Compared to the sense judging type (NF), sense perceiving (SP), intuition feeling type (NF) in the entire mathematical creativity were significantly high in addition the sense judging type (SJ) was significantly high compared to the sense perceiving (SP). This result agrees to the research result of Lee and Lee(1999) that the creative thinking factors(elaboration, flexibility, originality) according to the sense judging type (SJ), sense perceiving (SP), intuition thinking type (NT), intuition feeling type (NF) have statically significant difference.

Intuition feeling type (NF) appeared highest since it preferred indirect learning, creative problem solving learning, enabled assignment of self-expression/value-describing and class where there was flexibility and imagination. On the other hand, intuition thinking type (NT) preference on investigating, conceptual learning, Socratic method or class where independent spirit was encouraged appeared insignificant statically in

mathematical creativity. It appeared as lowest per temperament patterns. Therefore, mathematical creativity education must be done considering personality types.

Thirdly, according to the research result, the best factor to represent the mathematical creativity of 8th grade students was intuition(N) type, extroversion(E) type being noted as variables in mathematical creativity.

2. Conclusion

The results of this study imply sometimes the limitation and the suggestion for the future study as follows.

First, it could be unfair to generalize this research result by taking eighth grade students from a certain region as general eighth grade of our country. Thus, it is limited that one should be very cautious to interpret the result. However, the result of this research will be useful suggestions. It provided a way to improve creativity of middle school student by proving the relationship between the different personalities types of 8th grade students and the mathematical creativity. It is necessary to extend sampling in the following researches.

Second, it is required to analyze the inter-relationship of the personality types and mathematical creativity by the product moment correlation among their sub- dimension.

Third, developing secondary intuition expressed as the results from the intellectual instruction and its instructional strategies is critical to promote the fluency in the mathematical creativity with the consideration of investigation, conceptual learning, a midwife method by Socrates, and problem solving learning.

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수학 창의성과 성격유형과의 관계 연구

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본 연구는 중학교 2학년 141명의 학생을 대상으로 수학 창의성(Mathematical Creative Problem Solving Ability Test: KEDI, 1997)과 성격유형(Murphy-Meisgeier Type Indicator for Children: 심혜숙 · 김정택, 1993)과의 상관관계를 조사하였다. 자료 분석은 중학생의 성격 특성을 알아보기 위하여 유형별로 빈도와 백분율을 산출하였고, 성격유형에 따른 수학 창의성의 차이를 검증하기 위하여 평균, 표준편차, t-test, ANOVA와 Duncan 사후검증을 실시하였다.

본 연구 결과는 다음과 같다. 첫 번째, 일반 중학교 2학년과 비교해 볼 때, 선호지표에서 연구 집단의 중학생은 표준화집단(심혜숙 · 김정택, 1993)보다 I(2.7%), J(3.9%)가 높았다. 두 번째, 수학 창의성과 성격유형을 살펴본 결과, 기질적 측면에서 유창성, 융통성, 수학 창의성 전체에서 NF형이 SJ, SP형에 비해 의미 있게 높았고, SJ형도 SP형에 비해 의미 있게 높게 나타났다. 세 번째, 성격유형 중에서 어떤 요인이 중학교 2학년의 수학 창의성을 잘 예측해 주는지를 살펴본 결과, 직관(N), 내향(I)이 수학 창의성의 예인변인으로서 유의하였다. 이러한 결과와 관련하여 수학 창의성 검사도구 및 수학 창의성 프로그램 개발 시 직관과 내향을 우선적으로 고려하여야 한다. 네 번째 NT와 {SP, SJ, NF}는 통계적으로 유의미하게 같은 수준의 집단이 아니므로 직관적사고형(NT)이 감각적 감정형(SF), 감각적 사고형(ST), 직관적 감정형(NF)과는 독립된 특별한 요인으로 보인다. 직관적사고형(NT)은 조사와 개념 학습이나 소크라테스식의 문답법적인 학습과 문제해결학습을 선호하고 독립심이 지지되는 분위기의 학급을 선호한다. 따라서 수학 창의성 증진과 관련된 교육과정이나 프로그램 개발 시 조사와 개념 학습이나 소크라테스식의 문답법적인 학습과 문제해결학습을 우선적으로 고려하여야 할 것이다.

연구 결과와 관련하여 연구의 제한점과 후속 연구를 위한 제언은 다음과 같다. 첫째, 연구대상이 특정지역의 중학교 2학년 학생이므로 연구 결과를 우리나라 중학교 2학년으로 일반화 시키는 데는 무리가 있을 수 있다. 따라서 후속연구에서는 연구대상의 표집을 확대하여 볼 필요가 있다. 둘째, 수학 창의성과 성격유형간의 관계와 관련하여 수학 창의성과 성격유형의 각 하위 차원들 간에 적률 상관계수를 통해 상관관계를 분석해 보는 것이 필요하다. 셋째 직관과 내향 및 조사와 개념 학습이나 소크라테스식의 문답법적인 학습과 문제해결학습을 고려한 수학 창의성 프로그램이 개발할 필요가 있다.

* **Key words** : mathematical creativity(수학 창의성), psychological types(심리 유형), intuition(직관)

논문접수 : 2006. 9. 26
심사완료 : 2006. 11. 10