# Creativity, Self-Efficacy, Anxiety, and Problem-Solving Performance of the Potential Mathematically Gifted

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## Abstract

This descriptive research is grounded on the objectivist epistemology and informed by positivism. It used Path Analysis to examine the predictive and mediational role that creativity, self-efficacy, and anxiety play in the mathematical problem-solving performance of potential mathematically gifted Grade Six pupils from selected elementary schools in Iloilo. The eighty-three participants were given the Kuhlmann-Anderson Test to determine their cognitive ability. The results of the test were also used as the basis for their classification into High Potential Mathematically Gifted (HPMG) and Low Potential Mathematically Gifted (LPMG). Based on the results, 40 pupils were classified as HPMG while 43 as LPMG. The instruments used to gather data were the Mathematics Anxiety Rating Scale (MARS), Mathematical Creativity Test (MCT), Mathematics Self-Efficacy Rating Scale (MSRS), Mathematical Problem-Solving Test (MPS), and Parental Support Rating Scale (PSRS). Means, standard deviations, and percentages were used for descriptive data analyses and the Pearson's Product-Moment Correlation, Multivariate Analysis of Variance (MANOVA), Multiple Linear Regression, and Path Analysis (PA) for inferential data analyses, all set at .05 level of significance. Results showed that as a whole group, the participants reported a moderately high cognitive ability and self-efficacy, low anxiety; and average creativity and problem-solving performance. MANOVA revealed a statistically significant multivariate effect between the high and low potential mathematically gifted groups on the combined dependent variables. In the final path model, cognitive ability significantly influenced all endogenous variables; parental support predicted self-efficacy and anxiety; self-efficacy predicted anxiety and creativity; and creativity predicted problem-solving performance. The total effect of cognitive ability, sex, and parental support on problem-solving performance suggests that part of their influence was mediated by pupils' self-efficacy perceptions, anxiety, and creativity. Self-efficacy, anxiety, and creativity, on the other hand, mediated the effect of cognitive ability and parental support as their respective total effects on problem-solving performance were much stronger than their direct effects. It is inferred, then, that a potential mathematically gifted pupils' innate ability, if coupled with high sense of mathematics efficacy, and ability to produce many ideas, to generate varied approaches observed in a solution, and to come up with novel and unique ideas will make them a successful problem solver.

*Keywords:* math anxiety, mathematical creativity, math self-efficacy

The advent of the Information Age has brought with it new problems that make the genius of humankind more baffled and desperate for solutions. In our interpersonal relationships as well as in occupations in high-tech society, problem solving is a major human activity (Lesgold, 1988). Brown and Walter (1993) stated that the art of problem solving is the heart of mathematics. More especially in today's technologically evolved society, the role of mathematics is of prime importance. Thus, mathematics instruction should be designed so that pupils experience mathematics as problem solving.

This study explores the predictive and mediational role of creativity, self-efficacy, and math anxiety play in the problem solving performance of potential mathematically pupils. Chamberlain and Moon (in Shriki, 2010) defined creativity of students, in the context of mathematics, as "having an unusual ability to generate novel and useful solutions to simulated or real applied problems using mathematical modeling". One can say, then, that it is the creative people who produce new solutions, novel inventions, and unique innovations. No wonder that educational psychologists agree that creativity, like problem solving, is very important in the educational process (Kaplan, 1990). Empirical studies also attest to the predictive role of self-efficacy in mathematical problem solving. Bandura (1977) first introduced the construct of self-efficacy with the seminal publication of "Self-efficacy: Toward a Unifying Theory of Behavioral Change." Later, Bandura (1986) also situated the construct within a social cognitive theory of human behavior that diverged from the prevalent cognitivism of the day and embedded cognitive development within a socio structural network of influences. He states that students' beliefs about their capabilities to successfully perform academic tasks, or self-efficacy beliefs, are strong predictors of their capability to accomplish such tasks. Thus, the behavior of individuals, the choices they make, and where they direct their actions are greatly influenced by their beliefs in their capabilities. If self-efficacy and creativity may produce a positive influence on problem-solving performance, math anxiety, on the other hand, may negatively affect it. Mathematics anxiety is defined by Buckley and Ribordy (1982) as an "irrational dread of mathematics that interferes with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations. Further, Skemp (1971), posited that anxiety is more particularly true of the study of mathematics because "mathematics offers what is perhaps the clearest and most concentrated example" of intelligent learning, "which is, to say, the formation of conceptual structures communicated and manipulated by means of symbols."

In the light of the aforementioned theories and studies, the present research ascertained whether creativity, self-efficacy, and anxiety have predictive and mediational role in the mathematical problem-solving performance of potential mathematically gifted pupils.

Figure 1 shows the theoretical path model of the study.

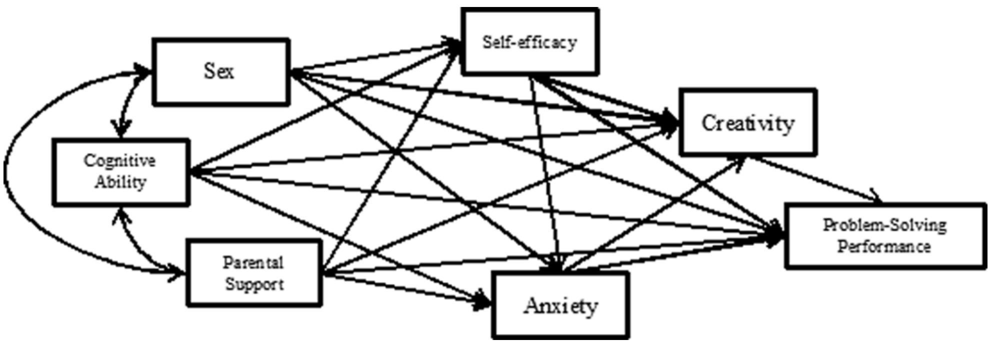


*Figure 1.* Hypothetical theoretical path model representing relationships among variables predicting mathematical problem solving of the potential mathematically gifted.

Specifically, it sought answers to the following questions:

1. What is the level of cognitive ability, self-efficacy, anxiety, creativity, and problem-solving performance when participants are taken as a whole group and when classified as to cognitive ability, sex, and parental support?

2. Are there significant differences in self-efficacy, anxiety, creativity, and problem solving performance when participants are classified as to cognitive ability, sex, and parental support?

3. Does each of the variables and constructs, namely, cognitive ability, sex, parental support, self-efficacy, anxiety, and creativity make an independent contribution in the prediction of problem-solving performance when all other variables are parts of the path analysis model?

4. Do creativity, self-efficacy, and anxiety have mediational role in the mathematical problem-solving performance of potential mathematically gifted pupils when they are classified as to cognitive ability?

## Methodology

### Research Design

This study is grounded on the objectivist epistemology which holds that meaning, and therefore meaningful reality, exists as such apart from the operation of any consciousness (Crotty, 1998) and that careful research can attain that objective truth and meaning (Esterberg, 2003). This epistemology underpins positivism--the theoretical perspective which informs the present study. The paradigm of positivism assumes that the social world is inherently knowable and that people can all agree on the nature of social reality (Esterberg, 2002). Esterberg further advanced that in the tradition of positivism, the goal of social research is to discover a set of causal laws that can be used to predict general patterns of human behavior and so research done in this theoretical perspective, according to Crotty (1998), might select to engage in survey research and employ quantitative method of statistical analysis.

Path analysis was used to examine the predictive and mediational role that creativity, self-efficacy, and anxiety play in the mathematical problem-solving performance of participants. The study focused on mathematical problem solving because, as what Pajares and Miller (1994) advanced, the solving of mathematics problems afforded a clear and more reliable assessment than was possible in other academic contexts, but results will nevertheless inform social cognitive theory and its claims about self-efficacy in general.

### The Participants

The study used eighty-three (83) Grade Six pupils who were ranking in the top of their respective classes in terms of their mathematics grade-point average in grade 5 and in the first grading period in grade 6. Of the 83 pupils, 30 were boys and 53 were girls. The participants were given the Kuhlmann-Anderson Tests which served as the basis of their classification into low and high potential mathematically gifted groups. Based on the results, 40 pupils were classified as high potential mathematically gifted (HPMG) while 43 as low potential mathematically gifted (LPMG).

**Data-gathering Instruments**

**Kuhlmann–Anderson tests (KA)-nonverbal component**. This standardized test was used to determine the cognitive ability of the participants and at the same time to identify the mathematically gifted. Since the focus of the present study was on the mathematical ability of pupils, only the nonverbal component was administered to the participants. Participants whose scores ranged from 89th to 99th percentile were classified as HPMG while those whose scores were below the 89th percentile were classified as LPMG. The following scale was used to interpret the means obtained: 52-65=High; 39-51=Moderately High; 26-38=Average; 13-25=Moderately Low; 0-12=Low.

**Mathematics Anxiety Rating Scale (MARS)**. The researcher-made MARS was used to measure the mathematics anxiety level of participants. This instrument includes thirty (30) 4-point Likert type items. Responses range from “Never” to “Always”. The rating scale was examined by a panel of experts and was revised accordingly. It was among the comparable nonsample grade six pupils that determined its administrability and reliability using Cronbach alpha. The instrument proved to be reliable with a reliability coefficient of 0.96. The following scale was used to interpret the means obtained: 3.01-4.00=High; 2.01-3.0=Moderate; 1.00-2.00=Low.

**Mathematical Creativity Test (MCT)**. The MCT was employed to determine the level of creativity of the participants. This test has two subtests--Problems with Multiple Answers and Problem Posing and are based on three factors: fluency, flexibility, and originality. For Problem with Multiple Answers, the pupils were asked to generate as many original solutions as possible for each of two given problems. For the Problem Posing component, pupils were to pose as many original problems as possible based on the researcher-made problem situations. The total score for mathematical creativity test was measured by a summation of the three factors. The scale used was based on the highest score attained by the participants which could not be determined until all responses were checked. The highest score was divided by 5 to determine the five levels of the scale, which are as follows: Top 20%=Very High; Second 20%=High; Middle 20%=Average; Fourth 20%=Low; Bottom 20%=Very Low.

**Mathematics Self-efficacy Rating Scale (MSRS)**. This instrument, which was validated by a panel of three experts, allowed pupils to express their confidence in successfully solving 20 mathematical problems. Students used a 6-point Likert scale ranging from 1 (no confidence at all) to 6 (complete confidence) to rate the level of their confidence in solving each problem as presented to them in a multiple-choice format under high-stakes testing situation. Higher scores signify higher confidence. The instrument reported a reliability coefficient of 0.93 using Cronbach alpha. The following scale was used to interpret the means obtained: 5.00-6.00=High; 4.01-4.99=Moderately High; 3.01-3.99=Average; 2.01-2.99=Moderately Low; 1.01-1.99=Low.

**Mathematical Problem-Solving Test (MPS)**. This twenty-item test was constructed by the researcher and was validated by a jury of experts. The instrument was pilot tested among the nonsample gifted grade six pupils of a special education school to determine its administrability. Each problem is scored as correct 6 points, incorrect 1 point, or partial 2-5 points. The six possible points are consistent with the 6-point Likert scale of the self-efficacy instrument. The following scale was used to interpret the means obtained: 100-120=High; 80-99=Moderately High; 60-79=Average; 40-59=Moderately Low; 20-39=Low.

**Parental Support Rating Scale (PSRS)**. The researcher-made PSRS was used to assess the level of support the parents extended to their children and their mathematics-related activities.

### Data-gathering Procedure

The pupils who participated in the research were identified by their respective mathematics teachers based on the criteria set by the researcher, that is, the pupils must exhibit potentials in mathematics on the basis of classroom performance and active participation in mathematics activities and competitions. Classroom performance was based on the grade-point average of the pupils in the four grading periods in Grade 5 and in the first grading period in Grade 6. Those who were selected were then invited to participate in the study. The pupils who signified to join were furnished with parent consent forms.

The participants were grouped according to cognitive ability using the standardized Kuhlmann-Anderson tests. The non-verbal or quantitative component of the test comprises 65 items. The 40 pupils whose scores belonged to the 89th to 99th percentile were identified as HPMG. The 52 pupils whose scores were below the 89th percentile were classified as LPMG.

## Results and Discussion

### Level of Self-efficacy, Anxiety, Creativity, and Problem-Solving Performance of the Participants

Table 1

*Means and Standard Deviations in Cognitive Ability, Self-efficacy, and Anxiety When Participants are Taken as a Whole Group and When Classified as to Cognitive Ability, Sex, and Parental Support*

| | | Cognitive Anxiety | | | Self-efficacy | | | Anxiety | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | M | D | SD | M | D | SD | M | D | SD |
| Group | | | | | | | | | | |
| | LPMG | 41.91 | MH | 7.11 | 4.67 | MH | 0.64 | 1.77 | L | 0.40 |
| | HPMG | 58.88 | H | 3.99 | 5.16 | H | 0.62 | 1.54 | L | 0.32 |
| Sex | | | | | | | | | | |
| | Boys | 53.13 | H | 9.09 | 4.98 | MH | 0.64 | 1.60 | L | 0.32 |
| | Girls | 48.36 | MH | 10.63 | 4.86 | MH | 0.69 | 1.70 | L | 0.41 |
| Parent Support | | | | | | | | | | |
| | Average | 52.08 | H | 10.17 | 5.08 | H | 0.66 | 1.60 | L | 0.41 |
| | High | 49.18 | MH | 10.33 | 4.82 | MH | 0.67 | 1.69 | L | 0.37 |
| | Whole Group | 50.08 | MH | 10.31 | 4.90 | MH | 0.68 | 1.66 | L | 0.38 |

*Note:* M = mean; SD = standard deviation; D = description; HPMC = high potential mathematically gifted (scores ranged from 89th to 99th percentile); LPMG = low potential mathematically gifted (scores were below the 89th percentile); 52-65 = high (H); 39-51 = moderately high (MH); 26-38 = average (A); 13-25 = moderately low (ML); 0-12 = low (L)

Table 2

*Means and Standard Deviations in Creativity and Problem-Solving Performance When Participants are taken as a Whole Group and When Classified as to Cognitive Ability, Sex, and Parental Support*

| | | Creativity | | | Problem solving | | |
|---|---|---|---|---|---|---|---|
| | | M | D | SD | M | D | SD |
| Group | | | | | | | |
| | LPMG | 37.98 | L | 20.09 | 55.58 | ML | 19.29 |
| | HPMG | 58.05 | A | 20.46 | 89.92 | MH | 17.19 |
| Sex | | | | | | | |
| | Boys | 49.50 | A | 26.00 | 77.10 | A | 26.50 |
| | Girls | 46.60 | A | 20.50 | 69.32 | A | 23.98 |
| Parent Support | | | | | | | |
| | Average | 45.38 | A | 24.59 | 74.85 | A | 23.84 |
| | High | 48.68 | A | 21.68 | 70.89 | A | 25.68 |
| | Whole Group | 47.65 | A | 22.53 | 72.13 | A | 25.04 |

*Note:* M = mean; SD = standard deviation; D = description; HPMC = high potential mathematically gifted (scores ranged from 89th to 99th percentile); LPMG = low potential mathematically gifted (scores were below the 89th percentile); 52-65 = high (H); 39-51 = moderately high (MH); 26-38 = average (A); 13-25 = moderately low (ML); 0-12 = low (L)

Tables 1 and 2 present the means, descriptions, and standard deviations of pupils' scores according to cognitive ability, sex, and parental support. An inspection of the mean scores reveals that the potential mathematically gifted pupils reported a moderately high cognitive ability and self-efficacy; low anxiety; and, average creativity and problem-solving performance. Results in problem solving contradict the findings of Topping, Kearney, McGee, and Pugh (2004), which noted that children have low-level applied problem-solving skills. When pupils were classified as to cognitive ability, HPMG pupils outscored LPMG pupils in all tests and had lower mathematics anxiety. When classified as to sex, boys outperformed girls in all tests and were less anxious. Results regarding sex and math anxiety are parallel to those of Laffarty (1996), who found higher self-reported anxiety by girls. The study of Pajares and Miller (1994) which reported that males have higher mathematics self-efficacy, while females expressed higher anxiety also supports the findings of this present investigation. Pupils who received average parental support registered higher mean scores than those who received high parental support in cognitive ability, self-efficacy, and problem-solving performance.

**Differences in Self-efficacy, Anxiety, Creativity, and Problem-Solving Performance**

A one-way between-groups Multivariate Analysis of Variance was performed for each of the independent variables to investigate differences between the independent variable and the set of dependent variables. Four dependent variables were considered-self-efficacy, anxiety, creativity, and problem solving performance. The independent variables were cognitive ability, sex, and parental support. Preliminary assumption testing was conducted to check for normality, linearity, and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted.

MANOVA results revealed a statistically significant multivariate effect between the low and high potential mathematically gifted groups on the combined dependent variables: $F(6, 77) = 14.85$, $p = .000$; wilk's lambda = .51; partial eta squared = .49. When the results for the dependent variables were considered separately using a Bonferroni adjusted alpha level of .008, differences on each dependent variable still reached statistical significance. Results regarding significant effect for cognitive ability on anxiety, and self-efficacy are consistent with those of Pajares (1996) which indicated that high potential mathematically gifted pupils are reported to have stronger math self-efficacy and lower mathematics anxiety than those who are low potential mathematically pupils. However, the differences did not reach significant level when participants were classified to sex and parental support. The findings of the present study, when participants are classified as to sex, contradict those of Pajares (1996). Table 3 presents the results of the Multivariate Analysis of Variance (MANOVA).

Table 3

*Differences in Self-Efficacy, Anxiety, Creativity, and Problem-Solving Performance When Participants are taken as a Whole Group and When Classified as to Cognitive Ability, Sex, and Parental Support*

| | | Cognitive | Self-efficacy | Anxiety | Creativity | Problem solving |
|---|---|---|---|---|---|---|
| Group | | | | | | |
| | LPMG | 41.91* | 4.67* | 1.77* | 37.98* | 55.58* |
| | HPMG | 58.88* | 5.16* | 1.54* | 58.05* | 89.92* |
| Sex | | | | | | |
| | Boys | 53.13 | 4.98 | 1.60 | 49.50 | 77.10 |
| | Girls | 48.36 | 4.86 | 1.70 | 46.60 | 69.32 |
| Parent Support | | | | | | |
| | | 52.08 | 5.08 | 1.60 | 45.38 | 74.85 |
| | | 49.18 | 4.82 | 1.69 | 48.68 | 70.89 |

*Note:* HPMC = high potential mathematically gifted (scores ranged from 89th to 99th percentile); LPMG = low potential mathematically gifted (scores were below the 89th percentile)

*$p < .05$.

The study shows that there is no significant difference between boys and girls in terms of problem solving. This finding is consistent with those of Pajares and Kranzler (1995) and Camarista (2006). However, this finding is not parallel with that of Pajares and Miller (1994), Kiamanesh and Noori (1997, 1998), and Kabiri (2003), that revealed boys outperforming girls in mathematics.

The findings of this study also demonstrate that, although boys reported a higher self-efficacy mean score than girls, the difference was not significant. This conforms to the research findings of Randhawa, Beamer, and Lundberg (1993), Pajares and Miller (1994), Pajares (1996), and Seegers and Boekarts (1996). However, the findings about boys having higher self-efficacy than girls contradict those obtained by Ghanbarzadeh (2001) and, King (1995) and Matsui, Matsui, and Ohnishi (1990).

Findings regarding sex and math anxiety are parallel to those of Rexes (1995) who did not detect any significant difference in mathematics anxiety among elementary school pupils. However, the studies of Pajares and Miller (1994), Pajares and Kranzler (1995), Shokrani (2002) and Kabiri (2003) reported a higher math anxiety for boys. Tobias (1993), a leading researcher on math anxiety, feels that the differences between males and females in terms of math anxiety cannot be attributed to differences in innate ability.

**Independent Contribution of each of the Variables and Constructs in the Prediction of Problem-Solving Performance**

In the path model shown in Figure 2, cognitive ability significantly influenced all endogenous variables--self-efficacy, anxiety, creativity, and problem- solving performance; parental support predicted self-efficacy and anxiety; self-efficacy predicted anxiety and creativity; and creativity predicted problem-solving performance. Figure 2 shows the path models when paths which are not significant were removed.

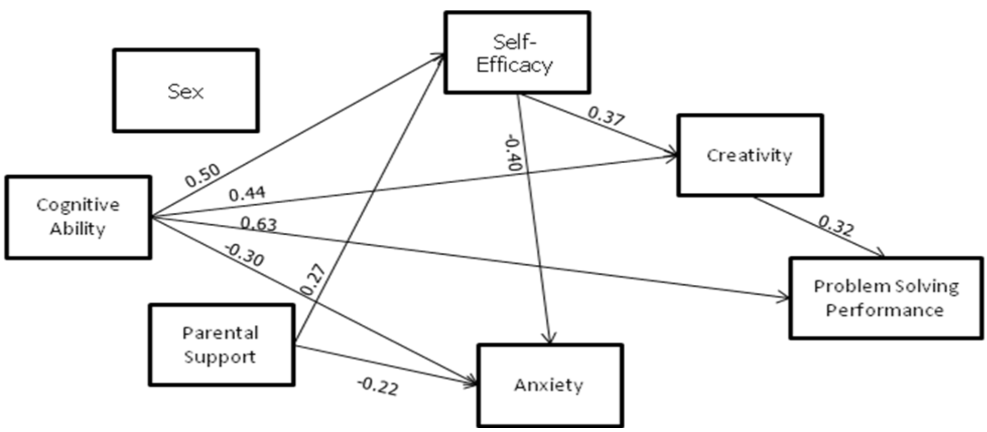


*Figure 2.* Final Path Model for the Whole Group.

The finding that self-efficacy is a significant predictor of math anxiety is supported by the findings of Pajares and Kranzler (1995), and Adams and Holcomb (1986). The study of Pajares (1996) also showed a significant effect of self-efficacy on anxiety in each of the ability groups. Contrasting results were reported in the predictive role of parental support while sex was not a significant predictor of problem-solving performance. This result is parallel with the findings of Pajares and Miller (1994) which found gender differences in mathematics problem solving. Also, in their study, Yailagh, Lloyd and Walsh (2009) reported that a direct standardized path between gender and mathematics achievement indicated a non-significant causal relationship between the two variables. Unexpectedly, self-efficacy's influence on problem-solving performance did not reach significance level.

**Mediational Role of Creativity, Self-Efficacy, and Anxiety in Mathematical Problem- Solving Performance**

Path analysis also provided data regarding the mediational role of self-efficacy, anxiety, and creativity in the mathematical problem-solving performance of potential mathematically gifted pupils.

In terms of total effect, Table 3 shows that the first three variables with the strongest influence on problem-solving performance when the potential mathematically gifted pupils were taken as a whole group, were cognitive ability (*B* = .80), creativity (*B* = .65), and self-efficacy (*B* = .40). Table 3 also reflects that the effect of cognitive ability and parental support were mediated by self-efficacy, anxiety, and creativity since each of the total effect is stronger than the respective direct effect (see Figure 2).

Table 4 presents the correlation matrix of all variables in the study.

Table 4

*Correlation Matrix for Variables in the Study among Potential Mathematically Gifted Pupils*

| | Self-efficacy | Anxiety | Creativity | Problem solving |
|---|---|---|---|---|
| Sex | - | - | 0.70 | - |
| Cognitive ability | 0.42 | -0.12 | 0.52 | 0.80 |
| Parental support | 0.12 | -0.03 | - | -0.16 |
| Self-efficacy | | -0.55 | 0.56 | 0.40 |
| Anxiety | | | -0.21 | -0.28 |
| Creativity | | | | 0.65 |

As expected, the influence of cognitive ability, sex, and parental support on problem-solving performance suggests that part of their influence was mediated by pupils' self-efficacy perceptions, anxiety, and creativity. The results indicating that sex influenced problem solving performance through the mediational role of mathematics self-efficacy conformed to the findings of Pajares (1996) for the middle school regular education students. However, they are not in accord with Pajares and Kranzler's (1995) findings, and neither those of Pajares (1996) for middle-school gifted students.

Table 4 also shows that the total effect of cognitive ability is stronger than its direct effect on problem-solving performance and than its direct effect on each of self-efficacy, anxiety, and creativity.

The direct influence of sex on problem-solving performance is very weak, the reason why each path between the two variables was excluded in the final model.

Another finding worth mentioning is the influence of self-efficacy on anxiety, creativity, and problem-solving performance. Its total effect--when all other variables are a part of the path analysis model--was strong at $B = -.55$, $B = .56$, $B = .40$, respectively.

The variables with strongest total effect on problem-solving performance were cognitive ability, creativity, and self-efficacy. Self-efficacy, anxiety, and creativity, on the other hand, mediated the effect of cognitive ability and parental support as their respective total effects on problem-solving performance were much stronger than their direct effects.

Pajares and Kranzler (1995) provided support for self-efficacy mediating the effects of ability and mathematics experience on anxiety and performance. Yailagh, Lloyd, and Walsh (2009) also reported that the effect of self-efficacy on mathematics achievement was indirect.

## Conclusions

Although the participants of the study are considered as potential mathematically gifted and are considered to be the best in elementary schools in the area of mathematics, their problem-solving performance was only average. The potential mathematically gifted pupils may have high cognitive ability as shown by the cognitive ability test results; yet, when it comes to problem solving, their performance was not on a par with their ability. One possible reason for their underachievement or the mismatch between their ability and performance in problem solving is the incongruency between what is expected of pupils and what teachers teach them in the classrooms. Children ought to be ready for the real-world problems, yet they are trained to memorize and do repetitive tasks in the classroom; and so in the process, they are deprived of opportunities to be exposed to various word problems that may develop and enhance their problem-solving skills. Another possible reason is that most textbooks being used in schools today usually contain routine problems only. A very small number of books may provide non-routine problems and divergent tasks, yet to a very limited extent. Since it is difficult and time-consuming to prepare supplementary and enrichment exercises, especially for mathematical problems, teachers usually resort to using exercises on calculation skills which do not require higher-order thinking skills. Furthermore, children may either be not familiar with the assessment tools of their teachers, or teachers' assessment tools may not be appropriate to measure performance in problem solving.

Boys performed better than girls in all tests probably because the tests did not require much preparation. The general notion is that boys are not as diligent as girls when it comes to classroom academic tasks and requirements, so there are more girls who excel in schools than boys. However, the tests the pupils took in the present investigation did not require them to study and prepare for the tests. The contribution of the "diligence" factor was quite neutralized, preferably making performance of boys better than girls.

The effects of parental support vary depending on the kind of measures taken by the potential mathematically gifted pupils. For pupils, especially potential mathematically gifted ones, to succeed in problem solving, to be creative, less anxious, and highly efficacious, require an average parental support.

Time and again, it was proven that cognitive ability is the best predictor of academic performance. One very pronounced conclusion that can be drawn from the results of the study is that cognitive ability and creativity are very essential factors for potential mathematically gifted pupils to succeed in problem solving. Pupils' innate ability, coupled with the ability to produce many ideas, to generate varied approaches observed in a solution, and to come up with novel and unique ideas, make them successful problem solvers.

Results also suggest that successful problem solving needs innate ability, mathematical creativity, and high sense of efficacy. The direct influence of sex on problem-solving performance of potential mathematically gifted pupils was very weak. The effect of sex on problem-solving performance was indirect and was mediated by other constructs included in the model. A potential mathematically gifted pupil's being a boy or girl does not determine his/her performance in problem solving but may be influenced by the interplay of other factors.

The results of the study confirm the notion that the two categories of pupils varying in cognitive ability reflect two categories of pupils who also vary in mathematical problem-solving performance, creativity, anxiety, and self-efficacy. Finally, it can be assumed that cognitive ability is one of the components that contribute to the development of problem-solving ability, creativity, and self-efficacy, and it may lessen anxiety.

## Recommendations

Since the problem-solving performance of potential mathematically gifted pupils seemed to be below the expected innate ability and maximum potentials, then it is deemed necessary the teachers, school administrators, and curriculum developers need to re-examine the content and focus of the mathematics curriculum in all levels of basic education. They may plan, select, and provide pupils with opportunities that enhance students' problem-solving skills to the fullest. Mathematics instruction may be made problem solving-based, and problem solving should therefore be made as an important component in the school mathematics curriculum. Teachers are encouraged to offer young children a great variety of problems to solve--problems that provide them with the opportunity to engage in more diverse and flexible thinking.

The re-examination of the problem solving provided in mathematics textbooks is also found necessary. The mathematics curriculum need to emphasize problem solving to also promote greater gender equity, particularly as these skills are taught in the elementary grades. Starting at a young age, girls may be given experiences conducive to the development of problem-solving skills, and supported in their acquisition of these skills across the age span.

Teachers may provide creative applications of mathematics in the exploration of problems and in the teaching of mathematical content in the classroom. The importance of mathematical creativity in combination with computational accuracy need to be emphasized among potential mathematically gifted pupils to further develop their mathematical ability and understanding. A constructivist classroom where pupils are free to explore, to express their views and to ask questions, and are provided open tasks needs to be promoted among elementary schools.

Development and enhancement of pupils' self-efficacy may be made as an integral part of mathematics teaching and learning. It has been verified once again, this time with elementary pupils, that these constructs constitute an important component of motivation and behavior.

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