Self-concept and Performance of Secondary School Students in Mathematics

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Abstract

The study investigated the relationship between self-concept and performance in Mathematics as well as the influence of gender on self-concept and performance in Mathematics. 320 SS1 students (male=160, female=160) were used for the study. They were selected from 16 secondary schools (urban=8, rural=8) in eight local government areas of Ekiti State. Random sampling was used to select the local government areas, while stratified random sampling technique was used to select the schools and the participants. Data were collected using a 20-item self-concept questionnaire and a 30-item multiple-choice Mathematics Achievement Test with reliability coefficients of 0.74 and 0.83 respectively, and analysed using Pearson product moment correlation and t-test statistics, tested at 0.05 level of significance. The results showed that self-concept moderately correlated with performance in Mathematics, while gender had no significant influence on self-concept and performance in Mathematics. However, the mean scores of male and female students in Mathematics were below average. It was suggested that teachers should develop in their students positive self-concept towards Mathematics and pleasant teaching experiences to enhance higher self-concept and better performance in mathematics.

Keywords: Self-concept, Performance, Secondary school students, Mathematics test

1. Introduction

The literature on psychological assessment is flooded with studies on self-concept and its related constructs designated as self-esteem, self-efficacy, self-image and others (e.g., Banyard & Grayson, 2000; Anastasi & Urbina, 2007; Bowling, 2009). Intriguingly, there seems to be diverse opinions on the definition of self-concept. While some authors refer to it as a construct closely related to personality, that is, a relatively stable and distinctive patterns of behaviour that characterise an individual and his or her reactions to the environment (e.g., Kossowka, 2002; Kaplan & Saccuzzo, 2005; Anastasi & Urbina, 2007), some others view it as domain-specific evaluations of the self (e.g., Santrock, 2005; Whiston, 2005). However, in the context of this study, self-concept is defined as the way an individual thinks, feels, acts, values and evaluates himself or herself in relation to performance in Mathematics.

Several studies have examined the relationship between self-concept and academic achievement or performance. Most of these studies support the belief that self-concept is a strong facilitator of academic achievement and that a positive or negative change in self-concept tends to produce a commensurate change in academic achievement or performance (Yara, 2010; Valentine, Dubois & Cooper, 2004; Hamachek, 1995). For example, in a meta-analysis of 128 studies, Hanford & Hattie (1982) found the overall correlation between general self-concept and achievement to range from -0.77 to 0.96 with a mean correlation co-efficient of 0.21. However, the 95 percent confidence interval also spanned 0, indicating a positive relationship. In another large scale study of 4,500 college students, Pascarella, Terenzine & Wolfe (1986) concluded that pre-college academic self-concept generally has a unique, positive and direct influence on collegiate academic achievement even when other factors such as high school achievement and degree aspiration were taken into consideration. Similarly, Wheat, Turnell & Monday (1991) found that students' self-concept in Mathematics significantly relates to high grades in a college algebra course. Interestingly, House (1993) found that academically under-prepared students with higher academic self-concept obtained higher grades in college course after controlling for the effects of prior academic achievement.

Some more recent studies in this area also support the existence of relationship between self-concept and academic achievement. For example, in a study involving 500 pupils randomly selected from primary schools in Kebbi State of Nigeria, Kamba (2009) found a correlation co-efficient of 0.695 (0.70) between self-concept and academic performance, indicating a positive moderately significant relationship. In another study involving 1,722 Senior Secondary School II students in selected schools in southwestern Nigeria, Yara (2010) found that students with high and positive self-concept perform satisfactorily in Mathematics. On this premise, it could be conjectured that students who think positively about their mathematics abilities feel highly delighted in solving mathematical problems, act promptly in learning mathematics, place high value on the benefits accruable to them in having good grades in mathematics and evaluate themselves as being capable of performing favourably in mathematics, are likely to perform creditably in the subject. Moreover, students with high and positive self-concept may likely develop internal motivation to strive for excellence in mathematics rather than being indifferent and passive.

Meanwhile, Bachman, O'Malley & Johnson (1986) did not find a significant relationship between high school junior students' academic self-concept and education obtained six years later. Further, in a study designed to uncover psychological differences between academically weak and gifted students using the Tennessee self-concept scale (TSCS), Garzarelli, Everhart & Lester (1993) did not find the two 33-member groups to differ in mean self-concept.

Some authors have also attempted to resolve the issue of casual relationship between self-concept and academic achievement, that is, which variable comes first, self-concept or academic achievement or is the relationship reciprocal? Indeed, Skaalvik & Hagivet (1990) found achievement to be predominant over academic self-concept among 3rd and 4th year primary school pupils while by 6th year, the relationship had become reciprocal. However, Muijs (1997) found that academic self-concept and academic achievement were strong predictors of one another, even controlling for other variables and stability of both over time. Meanwhile, Marsh (1993) invoked a more fundamental argument which goes beyond the question of relationship between variables but suggested that if the issue of casual predominance is to be resolved, researchers need to measure academic self-concept and academic achievement at least twice and preferably more frequently and all latent constructs on the basis of multiple indicators. Undoubtedly, such an exercise would require careful definition of the groups for the study and careful selection of variables for measurement.

A large body of literature has also reported the relationship between gender and self-concept and consequently academic achievement (e.g., Skaalvik & Ramkin, 1994; Wigfield & Eccles, 1994; Johnsson-Smaragali & Johnsson, 1995; Funk & Bachman, 1996; Manger & Eikeland, 1998). Indeed, Funk & Bachman (1996) reported that boys seem to have a more positive self-concept in a number of dimensions such as mathematics and general self-esteem than do girls. Relatedly, Johnsson-Smaragali & Johnsson (1995) reported differences in the strength of relationship between self-concept and achievement which seems to be stronger for boys. Further, in a study to find the effect of mathematics self-concept on mathematics achievement among Norwegian elementary school students, Manger & Eikeland (1998) found that boys showed significantly higher mathematics self-concept than girls. Meanwhile, researchers working in the area of gender issues have not resolved the long-smouldering debate on gender difference in Mathematics performance. For example, Mullis, Martin & Foy (2008) reported that despite comparable academic preparation and within classroom performance, males continue to outperform females at the elementary, middle and high school levels on standardised tools measuring Mathematics performance whereas, Ingels & Dalton (2008) reported that females complete comparable levels of Mathematics coursework as their male peers. Moreover, Fisher (2008), having examined mountains of data including Scholastic Aptitude Test (SAT) results and Mathematics scores from 7 million students who were tested in accordance with the "No Child Left Behind Act" reported no significant difference in Mathematics performance of male and female students.

From the foregoing, it appears the question of whether relationship exists or does not exist between self-concept and performance in Mathematics has not been concisely answered because both the theoretical and empirical studies reviewed in this study have produced diverse and contradictory results. Similarly, the issue of gender difference in self-concept and performance in Mathematics has not been resolved and therefore subject to further investigation. Consequently, there emerge three questions in the present study: One, "Does self-concept relate to performance in mathematics?" Second, "Does gender difference influence self-concept towards mathematics?" Third, "Does gender difference influence performance in Mathematics?" In candor, the answers are unknown. Perhaps the outcome of this study would provide concise answers to the questions raised.

1.1 Research Hypotheses

The following research hypotheses were tested at 0.05 level of significance:

HO_1: Self-concept and performance in Mathematics are not significantly related

HO_2: Gender has no significant influence on self-concept of students towards Mathematics

HO_3: Gender has no significant influence on performance of students in Mathematics

2. Methodology

2.1 Research Design

The study was a survey design in order to describe the degree of relationship between students' self-concept towards Mathematics and their performance in Mathematics as well as the influence of gender on self-concept and performance in Mathematics.

2.2 Sample and Sampling Technique

The sample for the study consisted of 320 Senior Secondary School One (SSS1) students (male=160, female=160) selected from 16 schools (urban=8, rural=8) in eight out of the 16 local government areas of Ekiti State. Random sampling technique was used to select the eight local government area, while stratified random sampling technique was used to select the schools and the selected participants. Senior Secondary School One was used, being a foundational class, while mixed schools were also used on the assumption that the students had homogenous characteristics.

2.3 Research Instruments

Two instruments were used for data collection. The first was a 20-item self-report questionnaire titled, "Self-concept towards Mathematics" in which the students were asked to rate how they think, feel, act, value and evaluate themselves in Mathematics on a four-point scale, namely: Strongly Agree=4, Agree=3, Disagree=2 and Strongly Disagree=1 (*see* Annex I).

The face content and construct validity criteria were ensured using experts in Educational Psychology as well as those in Tests and Measurement at the University of Ado-Ekiti, Nigeria who vetted each item and modified some. The reliability coefficient of the instrument was estimated at 0.74 using Cronbach-α (1951). The second instrument was a 30-item multiple choice Mathematics Achievement Test (MAT) drawn from the First Term syllabus of senior secondary school one Mathematics, based on three levels of cognition namely, knowledge, understanding and application (*see* sample items in Annex II). The difficulty indices of the items ranged from 0.42 to 0.91 using 27% upper and lower total score (Tetrachronic-α) while the reliability coefficient was estimated at 0.83 using Kuder-Richardson-21 (1937).

2.4 Administration of Instruments and Data Analysis

The instruments were administered using trained research assistants. They were postgraduate students in Tests and Measurement in the Faculty of Education, University of Ado-Ekiti, whose part of course works included Test construction and administration. The respondents were adequately informed of the purpose of the research and the need to respond objectively. The self-concept questionnaire was first administered to determine whether the respondents' self-concept towards Mathematics would match their subsequent performance in Mathematics. After retrieving the first instrument, the MAT was then administered and retrieved after the expiration of 45 minutes allowed. The respondents' responses in the two instruments were scored and collated for analysis. The maximum score for the self-concept questionnaire was 80 and minimum score was 20 while each correct item in MAT attracted 1 mark and incorrect option attracted zero (0). Data were analysed using Pearson product moment correlation coefficient and t-test statistics tested at 0.05 level of significance.

3. Results

HO_1: Self-concept and performance in Mathematics are not significantly related

Data were analysed using Pearson product moment correlation coefficient as presented in table 1.

Table 1 shows that r-calculated was 0.569 while its corresponding table value at 0.05 level of significance was 0.195. Since $r_{cal} > r_{tab}$, it implies that significant relationship existed between self-concept and performance in Mathematics.

HO_2: Gender has no significant influence on self-concept of students towards Mathematics

Data were analysed using t-test statistics as presented in table 2.

Table 2 shows that the mean scores of male and female students in self-concept towards Mathematics were 67.9 (84.9%) and 66.7 (83.4%) with standard deviations of 8.18 and 8.30 respectively while the t-test calculated was 1.30 and its corresponding table value at 0.05 level of significance was 1.96. By comparison, t-calculated was less than the t-table. Hence the hypothesis of no significant influence of gender on self-concept was accepted.

HO_3: Gender has no significant influence on performance of students in Mathematics

Data were analysed using t-test statistics as presented in table 3.

Table 3 shows that the mean scores of male and female students in Mathematics were 13.7 and 14.1 with standard deviations of 4.72 and 3.85 respectively while t-calculated was -0.831 and its corresponding table value at 0.05 level of significance was 1.96. By comparison, t-calculated was less than the t-table. Hence, the hypothesis of no significant gender influence on performance in Mathematics was accepted.

4. Discussion

In this study, the relationship between self-concept and performance in Mathematics as well as the influence of gender on self-concept towards Mathematics and performance in Mathematics were investigated. The result in table 1 showed a positive and moderate significant relationship between self-concept and performance in Mathematics with a correlation coefficient of 0.569 (0.57). This result is in line with the previous findings of Muijs (1997) who obtained a correlation coefficient of 0.55 and Kamba (2009) who obtained a correlation of 0.695 (0.70) between Mathematics self-concept and Mathematics grades. The moderate correlation between self-concept and performance in Mathematics in the present study is an indication that the way the students thought of, felt about, acted towards, valued and evaluated themselves in Mathematics moderately related to their performance in Mathematics. This finding also supports the view of Valentine, Dubois & Cooper (2004) that self-concept is an important linkage to academic achievement. The result in table 2 showed no significant gender influence on self-concept towards Mathematics as the difference in the mean scores was not significant. This result is at variance with the findings of Funk & Bachman (1996), Manger & Eikeland (1998) who found that boys seem to have a more positive self-concept than girls in a number of dimensions including Mathematics. The lack of gender influence in self-concept is not surprising because the sample for the study was selected from co-educational schools with similar learning environment and common quest for academic achievement.

The result in table 3 also showed no significant gender influence on performance in Mathematics as the t-calculated was less than the t-table. This result replicates the finding of Fisher (2008) who found no gender difference in Mathematics performance but at variance with the findings of Mullis, Martin &Foy (2008) who found that males continue to outperform females on standardised tools measuring Mathematics performance. However, a re-examination of tables 3 indicated that the mean scores of males (13.7) and females (14.1) in Mathematics test were slightly below the average of 15. Sampled opinion on this results showed that the students probably attached little or no importance to the outcome of the test since it neither formed part of their class-based assessment scores nor end-of-term assessment score. Notwithstanding, it is expected, from a theoretical viewpoint, that high and positive self-concept should match high performance in Mathematics which is slightly lacking in this study.

5. Conclusion

Based on the findings of this study, it could be concluded that self-concept moderately related to performance in Mathematics and that gender had no influence on self-concept towards Mathematics and performance in Mathematics.

6. Recommendations

Based on the findings and conclusion of this study, the following recommendations were made:

1) Mathematics teachers should develop in their students' positive self-concept towards Mathematics so as to pay more attention to problem solving skills for better performance in the subject.

2) Students should be encouraged to match positive self-concept towards Mathematics with high performance in Mathematics.

3) Teachers should provide the male and female students the enabling environment to learn and solve mathematical problems cooperatively in order to maintain equity in mathematics performance.

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Table 1. Pearson correlation between students' self-concept and performance in Mathematics

Variables	N	r_{cal}	r_{tab}
Self-concept	320	0.569*	0.195
Mathematics	320		

P<0.05 (significant result)

Table 2. t-test comparison between self-concept of male and female students towards Mathematics

Variables	N	Mean	SD	df	t_{cal}	t_{tab}
Male	160	67.9	8.18	318	1.30	1.96
Female	160	66.7	8.30			

Maximum score=80, P>0.05 (not significant)

Table 3. t-test comparison between performance of male and female students in Mathematics

Variables	N	Mean	SD	df	t_{cal}	t_{tab}
Male	160	13.7	4.72	318	-0.831	1.96
Female	160	14.1	3.85			

Maximum score=30, P>0.05 (not significant)

Annex I

Questionnaire on self-concept of mathematics

Dear Student,

This questionnaire is designed to find out exactly the way you think, feel, act, value and evaluate yourself in Mathematics. This is for a research purpose and it will be highly appreciated if you respond to each item with utmost sincerity.

Thank you.

Section I *(Bio-data)*

1. Name of School:_____
2. Location of School *(Town)*:_____
3. Local Government Area:_____
4. Gender: Male [ ] Female [ ]
5. Age *(Year)*: Below 10 [ ]; 10—14 [ ]; 15—19 [ ]; 20 and above [ ]
6. Class: SS I [ ]
7. Serial Number:_____

Section II

Please, read each of the following statements and indicate (✓) your degree of agreement or disagreement as follows: Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD)

S/N	***Statement***	***SA***	***A***	***D***	***SD***
1.	Mathematics is an easy subject to learn				
2.	Mathematics is an easy subject to pass				
3.	Mathematics helps me find a new way of doing things				
4.	Every question in Mathematics is answerable				
5.	Mathematics lessons give me satisfaction				
6.	Mathematics improves my understanding of other subjects				
7.	Mathematics improves my learning and retention capacities				
8.	I am good at Mathematics as a subject				
9.	I am capable of making a good grade in Mathematics				
10.	I feel delighted when answering Mathematics questions				
11.	Mathematics facilitates my studying independently				
12.	Mathematics is suitable only for the gifted students				
13.	Mathematics encourages me to apply detailed steps to solving my personal problems				
14.	Mathematics makes me think fast				
15.	My present knowledge of Mathematical concepts is high				
16.	Mathematics is worth passing well				
17.	I do extra work to learn Mathematics				
18.	Mathematics is important in my future career				
19.	I am comfortable in Mathematics lessons				
20.	Learning Mathematics gives me meaning to learning activities				

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Annex II

Mathematics Achievement Test

Section A *(Bio-data)*

1. Class: SS I
2. Serial Number: _____
3. Name of School:_____
4. Location of School *(Town)*:_____
5. Local Government Area:_____
6. Gender: Male [ ] Female [ ]
7. Age *(Year)*: Below 10 [ ]; 10—14 [ ]; 15—19 [ ]; 20 and above [ ]

Section B

Answer all the questions. Use pencil throughout. Work fast and as accurately as you can. If you cannot answer any question, do not spend too much time on it, go on to the next question. Select the best option from *a—e* in each item.

1. Which one of the following is a prime number?

(a) 2 (b) 4 (c) 9 (d) 12 (e) 15

2. What is 0.015846 to 3 significant figure?

(a) .0159 (b) 0.159 (c) 0.0158 (d) 0.158 (e) 0.016

3. What is the integer of $\log_{0.04135}$?

(a) -5 (b) -4 (c) -3 (d) -2 (e) 4

4. If the product of two natural numbers greater than one is odd, then their sum is

(a) even and greater than their product (b) even and less than their product

(c) odd and greater than their product (d) odd and less that their product

(e) either even or odd

5. Which of the following numerals represents the largest number?

(a) 2211_{three} (b) 233_{five} (c) 252_{six} (d) 244_{seven} (e) 143_{eight}

6. The sum of the interior angles of a pentagon is

(a) 9 right angles (b) 8 right angles (c) 7 right angles

(d) 6 right angles (e) 5 right angles

7. The average age of 5 children is 3 years, if one of them is taken away, the average age of the remaining children is 2 years 9 months. How odd is the child withdrawn?

(a) 2 years (b) 2¾ years (c) 3 years (d) 4 years (e) 5 years

8. If $p=q^2-r^2$ and $q=999$ while $r=1$. What is the value of p?

(a) 998 (b) 9980(c) 9990(d) 99800 (e) 998000

9. If $log_{10}2=0.3010$ and $log_{10}3=0.4771$, evaluate $log_{10}12^{10}$

(a) 0.6020 (b) 0.7781 (c) 0.9542 (d) 1.0791 (e) 1.552

10. Find x if $16^x=64$

(a) 2/3 (b) 3/2 (c) 3 (d) 4 (e) 6

Note: Items 1—4 Test knowledge (simple recall of facts) Items 5—7 Test understanding/comprehension

Items 8—10 Test application (ability to apply knowledge)