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Research Article

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The Relationship Between Self-Concept and Problem-Solving Skills on Students' Attitude Towards Solving Algebraic Problems

Elizabeth Julius [1]*

[1]Department of Science Education, Faculty of Education, Kebbi State University of Science and Technology, Aliero, Kebbi State, NIGERIA
***Corresponding Author:** mummybaffa2000@gmail.com

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ABSTRACT

This study aimed to determine the relationship between self-concept and problem-solving skills in students' attitudes towards solving algebraic problems. 377 students were utilized in the study. Two instruments were used to gather data: a problem-solving performance test and a questionnaire on self-concept and attitudes towards solving algebraic problems. The instrument was developed through concept analysis and review of literature; validated by subject matter experts. Lawshe's (1975) content validity ratio was used to ascertain the validity of the instrument. Reliability of the instruments was established through the utilization of the most common and the best index of internal consistency known as Cronbach's coefficient alpha. The findings showed based on the three hypotheses tested that there is a significant but negative relationship between self-concept and students' attitude toward solving algebraic problems (ATPS) and also there is a significant positive relationship between problem-solving skills and their ATPS. However, the findings also indicated that there was no significant relationship between students' problem-solving skills and their self-concept. It was concluded that schools in collaboration with the Ministry of Education should organize inter and intra mathematics competitions on algebraic problem-solving skills.

Keywords: self-concept, problem-solving skill, algebra, attitude

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INTRODUCTION

In the Nigerian education system, mathematics is a subject mandatory to be offered from primary (basic) through the junior secondary and senior secondary levels of learning. This significant emphasis given to the subject in the school curriculum is the result of mathematics' role in scientific and technological development in nation-building. The craving for a high level of performance in the subject placed a lot of pressure on (students, teachers, parents, and specifically school) and in general the education system itself. Sokoto state, like most states in Nigeria, mathematics is a compulsory subject from primary through secondary school level. The importance of mathematics in the school curriculum is not compared with any subject in the field of education. This is because mathematics plays a big role in developing human thought; it brings about systematic reasoning processes used in problem-solving and analysis (Phonapichat et al., 2014). The key anticipation of mathematics as a subject is the improvement of problem-solving skills, as stipulated by the National Council of Teachers of Mathematics and the solitary aim of mathematics teaching is to fortify students to solve daily life problems.

Phonapichat et al. (2014) discoursed that mathematics is a gadget that can be employed to train students to be able to solve problems, and also to form their thinking ability that leads to supplementary solving of non-mathematical problems. It is imperative that learning to solve a problem is fundamental in learning mathematics, as problems are part of everyday life. Problem-solving, according to Mayer and Wittrock (2006), is a cognitive procedure directed at achieving a goal when no clarified method is obvious to the problem solver. Their definition consists of four-part: First, problem-solving is cognitive i.e., it occurs within the cognitive system of the problem solver. Secondly, problem-solving is a process i.e., it involves applying a cognitive process to cognitive presentation in the problem solvers cognitive system. Thirdly, it is directed, or it is guided by the problem solver and lastly it is personal, it depends on knowledge and skills of the problem solver.

It is no doubt therefore that the ultimate aim of teaching mathematics at any level is to solve problems (Adeniji & Salman, 2016). Adeniji and Salman (2016) termed it as the backbone of science and technology and an implement inevitable for human survival in everyday life. Secondary school mathematics has many core areas of study such as algebra, mensuration, statistics, number and numeration, geometry, and trigonometry. All cited aspects of mathematics encompass the application of problem-solving skills. Algebra is that branch in mathematics that mostly makes use of alphabets in the place of numbers. An algebraic equation usually represents a scale, what is done on one side of the scale with a number is also done on either side of the scale (Naseer, 2016). Algebra, according to Usman and Musa

(2015), is a facet of mathematics which involves the use of letters and numbers. These letters combined with figures bring a lot of confusion to the students more so, with the letters changing values or one letter replacing another letter at intervals. Thus, all mathematics processes of problem-solving and all problems are resolved into algebraic expressions and equations for possible solutions. This implies that it is only those students who understand, master, and retain knowledge and skills of algebra that are likely to apply them successfully in their mathematics field and in real life. Research revealed that several factors play a vital role in influencing students' understanding of algebraic expressions and performance in mathematical problem-solving. According to Amadi and Charles-Ogan (2015), Salleh and Othman (2014), and Tahar et al. (2010), the factors include students' self-concept, self-efficacy, extrinsic motivation, experience in school, and attitudes.

Attitude is paramount for human existence, it is the feelings individuals experience towards a particular object, event, phenomenon, people, or place. The attitude of an individual to an object, place, event, or another person determines their relation to such object, phenomenon, event, or people at a different point in time (Anwer et al., 2012; Memnun & Akkaya, 2012). It is defined in contemporary social psychology as a relatively general and enduring evaluation of an object or concept in a valence direction ranging from positive to negative. Hogg and Vaughan (2005) in McLeod (2014). Also, attitude is a mental and neural representation organized through experience, exerting a directive or dynamic influence on behavior (Breckler & Wiggins, 1989).

Self-concept also called self-construction, self-identity, and self-perspective or self-structure is a collection of beliefs about oneself (Geertje et al., 2010). According to Lundetrae et al. (2010), self-concept is defined as a person's perceptions of him- or herself. Self-concept in the context of this study is defined as the way an individual thinks, feels, acts, values and evaluates him/herself in relation to his or her problem-solving skills in algebra (mathematics). Research on self-concept is flooded in the field of psychology and other fields of study as well which began so many years ago, as reflected in the proliferation of articles, review chapters and books. It is believed to be associated with a wide range of performance indicators (Peixoto, 2003).

LITERATURE REVIEW

Many studies have been conducted earlier, and these research have indicated that student's attitudes toward mathematics and algebra, in particular, are very much closely related to their attitude toward solving problems in general (Bala & Shaafiu, 2016; Effandi & Normah, 2009; Tezer & Karasel, 2010). Lai et al. (2015) suggest that negative attitudes in students need to be overcome in order to prevent the persistent occurrence of poor algebraic problem-solving skills in future. It is therefore imperative to teach students how to overcome the mathematics representation phase since many difficulties they face are not unconnected to algebraic problem-solving. Hence, students' interest in mathematics and their beliefs in the usefulness of mathematical knowledge in their future career or in their everyday life is determined in a fundamental way by their problem-solving behavior (Marchis, 2013). Other studies show that performance in mathematics may be influenced by attitude toward solving the algebraic problem (Mohd & Mahmood, 2011). For instance, Anwar (2018) conducted a study on the problem-solving ability of secondary school students in relation to their attitudes towards mathematics. It was found that a relationship exists between the problem-solving ability of secondary school students and their attitudes towards mathematics. Furthermore, Anboucarassy (2015) emphasized the problem-solving ability of high secondary students in relation to their learning style and it indicated that the problem-solving ability of higher secondary students is average in nature. It was found that problem-solving ability had a positive relationship with learning.

However, Angga (2014) carried out a research on mathematics self-concept and anxiety with different achievements in calculus problem-solving using three students in qualitative research, the study classified students as high, standard and low, which showed that those with high self-concept had high achievement to accomplish test in any level, those with low self-concept accomplish test in standard level and low achievers achieve at low level feel nervous, unsteadiness and could not focus their mind. Another study conducted by Veisikahre et al. (2017) on the effectiveness of problem-solving training on the academic self-concept of high school students in Holillan Kahreh a quasi-experimental study, using first-grade high school students in Holillan of Ilam, revealed that problem-solving caused increased self-concept.

Consequently, in another study that examined problem-solving in mathematics self-concept and cognitive empathy, the result shows that collaborative problem-solving was positively influenced by average mathematics self-concept of talented students while zero or positive influence on average students in 7th grade. Elliott et al. (2001) also conducted a study on the effect of an interdisciplinary algebra/science course on students' problem-solving skills, critical thinking skills and attitude toward mathematics. They discovered that there was no difference in problem-solving skills between students in the interdisciplinary course and students in college. Thus, students' success in achieving their goals in algebra, encourages them to develop a positive attitude towards it and other problem-solving activities (Ismail, 2011). Therefore, algebraic problem-solving in mathematics is of vital importance (Yildizlar, 2001). Problem-solving ability in students increases their confidence in self which directly affects the way they see and evaluate themselves in learning mathematics.

CONCEPTUAL FRAMEWORK

A conceptual framework is a description of the main independent and dependent variables in a study and the relationship among them. Independent variables are conditions or characteristics that are manipulated to ascertain the relationship and observed phenomenon, while the dependent variables are conditions that appear to change as the independent variables are introduced or removed. This study's conceptual framework is constructed based on the current literature, as well as upon the opinions of several previous researchers. Research has shown that students' attitudes toward mathematics are closely related to their attitudes toward problem-solving, which implies that students' attitude toward solving an algebraic problem is somewhat related to their attitude toward problem-solving. According to O'Connell (2000), it is paramount for students to have a positive attitude towards problem-solving if they are to succeed in general.

The problem-solving skills test in this study is based on the (Polya, 1973) model for problem-solving, which involves four segments: understanding a problem, devising a plan to solve the problem, solving the problem, and looking back. In the first segment, which understands

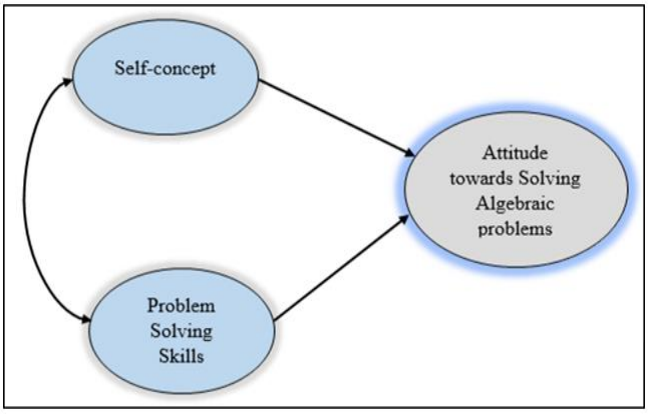


Figure 1. Conceptual framework of the study

the problem, the problem-solver converts the statements of the problem into a mental model that represents the problem-solver's interpretation of the problem. In the second segment, that is, devising a plan to solve the problem, the different pieces of this interpretation are pooled into an articulated structure that will support the problem-solving plan. In the third segment, solving the problem, the problem-solver here formulates a step-by-step plan to solve the problem. Finally, in the fourth segment, the problem-solver looks back at the procedure he/she has applied in solving a problem to be sure he/she is on the right track. **Figure 1** is the conceptual framework of the study.

Theoretical Framework

The theoretical framework of any research work relates to the philosophical basis on which the research is built as well as forming the link between theoretical and practical components that are being investigated. In view of this, the present study is interested in studying the algebraic problem-solving attitude of students in relation to their self-concept and problem-solving skills. Hence, after extensive review of literature on previous studies, the researcher outlines the following theories and models to underpin the current study. The theories are ABC model (Eagly & Chaiken, 1998), ability model (Mayer et al., 2000), and theory of reasoned action (TRA) (Ajzen & Fishbein, 1976).

Objectives of the Study

1. To determine the influence of self-concept on attitude towards solving algebraic problems (ATPS) among secondary school students in Sokoto State.
2. To determine the influence of problem-solving skills on ATPS among secondary school students in Sokoto State.
3. To examine the relationship among self-concept, attitudes towards solving algebraic problems, and problem-solving skills of secondary school students in Sokoto State.

Research Questions

1. What is the influence of self-concept on attitude towards solving algebraic problem among secondary school students in Sokoto State?
2. What is the influence of problem-solving skills on attitude towards solving algebraic problem among secondary school students in Sokoto State?
3. Does any relationship exist among self-concept, ATPS, and problem-solving skills?

METHODOLOGY

The methodology is the body of methods, rules, and postulates employed by a discipline, which explains a particular procedure or set of procedures employed in conducting research. The methodology employed in research is essential to its success or otherwise. The current study explains the procedures involved in carrying out the study, as presented in the sections below.

Research Design

Research design is the process that a researcher follows in planning and noting the pathways of activities (Muhammad, 2015). The design used for this study was a quantitative design. The study is in the form of survey research design. According to Graziano & Raulin (2000), survey method is often used to study people's feeling and thinking about specific issues. Attitudes and self-concept cannot be directly observed, so to measure them one can simply ask the person or use indirect methods of inferring cues to measure implicit behaviors. However, selecting an appropriate research pattern is vital for any researcher who intends to conduct any type of research (Creswell & Plano-Clark, 2011).

Population and Sample

Research population can be described as the totality of events, objects, or individuals that the research is concerned (Creswell, 2013; Mathew & Ross, 2010). According to Ladico et al. (2006), research population is a wide group of people on whom the research is being conducted. The population of the current research was all the senior secondary school students of Sokoto State with a total of 21,839 students and the target population was limited to senior secondary school two (SSII) students of Sokoto State with a total of 8,361.

The selection of a sample in research is a very important step in any research project because studying the entire population is somewhat not practical, possible, efficient, or ethical. However, the sample utilized in the study was retrieved from eight secondary schools out of the entire population of secondary school students in Sokoto, Nigeria. Attention was specifically focused on the target population, which are SSII students. The sample comprised 377 participants who are within the age bracket of 11-17 years. The selection of the number of the respondents was based on table of determining sample size, which suggested that a sample of 367 respondents is appropriate from a population of 8,361 (Krejcie & Morgan, 1970).

Research Instrument

The instruments used to collect data in this research are a questionnaire on self-concept and ATPS and a performance test on problem-solving skills (**Appendix A**). There are some existing measures of self-concept and attitude, but they do not appear to be suitable for secondary school students in Sokoto, due to differences in culture, environment, and location (Duatepe & Cilesiz, 1999; Dubey, 2008; Heppner & Krauskopf, 1982; Marchis, 2013; Nasir & Hashim, 2013; Saraswat, 1984; Serin et al., 2010).

It is not clear whether these measures will be applicable to students in Sokoto. Thus, it was necessary to develop a workable self-concept measure and algebraic problem-solving attitude scale for students in Sokoto. To develop a usable self-concept and algebraic problem-solving attitude scale measure for Sokoto students, a concept analysis was carried out. The fundamental idea for the concept analysis is to define the concept of the variable under investigation and all its elements or

domain, so as to enable the generation of items. Furthermore, literature related to the variable under study was also reviewed to gather additional data on the constructs. Hence, this was done in other to complement the concept analysis. Based on the reviewed literature and the concept analysis the researcher develops the items for the measurement of the self-concept and algebraic problem-solving attitude scale. It was validated by subject matter experts (SME), after which the result of their comments was calculated using the content validity ratio (CVR) (Lawshe, 1975). The instrument was modified after the content validation and some of the items were dropped as a result. The self-concept and algebraic problem-solving attitude scales were both measured on a five-point Linkert. The instrument was used to measure students' self-concept and algebraic problem-solving attitudes all in relation to solving algebraic problems.

The problem-solving performance test was used to measure students' problem-solving skills. The test has ten items that reflect the content of the secondary school syllabus based on secondary school mathematics textbooks and the WAEC past questions (**Appendix B**). The problem-solving skills test was assessed using the Rubric assessment grading technique. The research adopts a 3-scale rubric grading point, with 1-students solve the problems completely incorrect, 2-students partially solve the problem but incorrect and 3-students solve the problem complete and correct. Each item has a difficulty index between 0.27 and 0.54. Loon (2007) states that a difficulty index of 0.20 to 0.80 can be used as the basis to qualify a test item for inclusion in a study. All the items were found to have a positive discrimination index of 0.21 to 0.37. An item that has a discrimination index of more than 0.25 can be considered a good item (Khan et al., 2015).

Data Analysis

Data analysis in research entails important processes involved in translating raw data into useful information. Raw data are yet to be refined materials collected by the research from a survey exercise conducted at a particular time (Bodgan & Biklen, 2003). It can also be defined as a sequence of interrelated activities aimed at harvesting useful information in order to answer the already raised question in a research study (Creswell, 2012). Data collected were analyzed using descriptive and inferential statistical tools. The descriptive aspect was analyzed with the use of percentage and the inferential analysis aided with the use of SEM-PLS was employed. SEM-PLS is a multivariate statistical technique employed to examine direct and indirect relationships between one or more independent latent variables and one or more dependent latent variables (Gefen et al., 2000). Herman Wold, an econometrician, initiated PLS in the '60s and '70s (Chin, 1998; Hair et al., 2011; Vinzi et al., 2010). PLS is a family of alternating least squares algorithms, which extend principal component and canonical correlation analysis (Henseler et al., 2009). The researcher considered using SEM-PLS because, it offers superior advantages over the using first-generation analysis techniques because it allows flexibility for researchers to the interplay between theory and data (Chin, 1998). For instance, it allows the researchers to model relationships among multiple predictors and criterion variables construct unobservable latent variables, model errors in measurement for observed variables and statistically test prior theoretical and measurement assumptions against empirical data.

Table 1. Exploratory factor analysis outcome

Items	Rotated component matrix[a]							
	Component							
	1	2	3	4	5	6	7	8
SW1	.516							
SW2	.670							
SW3	.751							
SW4	.794							
SW5	.810							
SW6	.805							
SW7	.709							
SI1				.710				
SI2				.814				
SI4				.817				
SI5				.864				
SI6				.786				
SI7				.825				
IS1					.794			
IS3					.744			
IS4					.840			
IS5					.810			
IS6					.757			
ATD1						.506		
ATD2						.680		
ATD9						.645		
ATD13						.606		
ATD16						.597		
ATD23						.528		
ATD5							.496	
ATD12							.492	
ATD19							.652	
ATD20							.539	
ATD21							.596	
ATD3								.688
ATD4								.644
ATD7								.558
ATD8								.557
ATD10								.657
ATD15								.647
ATD22								.617
PS1		.885						
PS2		.935						
PS6		.968						
PS7		.906						
PS9		.970						

Exploratory Factor Analysis

Exploratory factor analysis (EFA) constitutes one of the approaches used in factor analysis to analyze the individual influence of all the items that make up a construct (Awang, 2014). He suggested that the use of EFA should be employed by a researcher for items of an instrument that were developed by the researcher or for items gotten from the literature. The present study conducted an EFA helps to identify the dimensionality of items so that items with low factor loading as well as redundant items can be dropped from the questionnaire (**Table 1**).

A total of 18 items were retained in the self-concept construct, 23 items retained in the attitude construct and five items retained from problem-solving skills. All items with factor loading below 0.5 were dropped.

Table 2. KMO and Barlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		.896
Barlett's test of sphericity	Approximate Chi-square	13,079.697
	df	2,762
	Sig.	.000

Table 2 shows the Kaiser-Meyer-Olkin (KMO) and Barlett's test, where principal component analysis was used as extraction method while varimax with Kaiser mormalization was used as rotation method.

Validity and Reliability

The validity and reliability of research instruments are very important to ensure the dependability and consistency of results. Therefore, the instrument validity was checked by SME and mathematics teachers with more than five years of working experience. The reliability of the instrument was established through the utilization of the most common and the best index of internal consistency known as Cronbach's coefficient alpha with an index of .879 and .878 for the self-concept and ATPS instrument. Cronbach's alpha with an index of .684 alongside item analysis was calculated for the reliability of the problem-solving skills test.

RESULTS

Profile of the Respondents

There were 377 students involved in the study, the results indicated that 210, 55.7% of respondents were males and 167, 44.3% of the respondents were females. This implies that there are more boys than there are girls in secondary schools in Sokoto, Nigeria. This is presented in **Figure 2**.

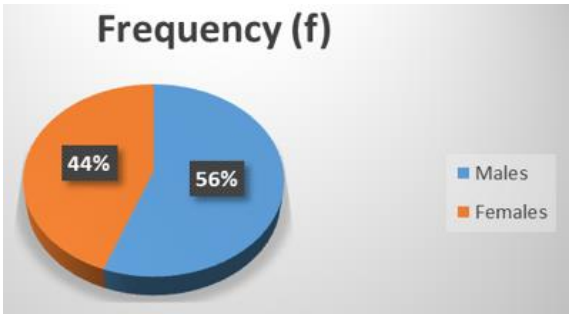


Figure 2. Profile of the respondents

Evaluation of Measurement Models

There are two types of measurement models, which are reflective and formative constructs. A reflective measurement model is a type of measurement model in which the direction of the arrow is from the construct to the indicator, signifying the assumption that the construct causes the measurement model of the indicator variables (Hair et al., 2014). Reflective measurement models are usually assessed based on their reliability and validity. Construct reliability assessment mainly emphasizes' composite reliability as an estimate of a construct's internal consistency in PLS-SEM, which prioritizes indicators according to their reliability during model estimation. Composite reliability values above 0.60 indicate adequate reliability in exploratory research. Then, the next consideration is the indicator reliability, any value below .5 should be eliminated. Furthermore, validity evaluation concentrates on convergent validity and discriminant validity. For convergent validity, the average variance extracted (AVE) is examined. An AVE value of 0.50 and higher indicates a sufficient degree of convergent validity, meaning that the latent variable explains more than half of its indicators' variance while the discriminant validity can be assessed with the use of the HTMT method as suggested by (Henseler et al., 2015). In the case of the current study, the researcher employed the various stages explained above to assess its models.

Table 3 shows the validity and the reliability of the constructs. It is established that after the evaluation of all the constructs, they all have achieved an adequate level of reliability and validity. Factor loading, which is indicator reliability are all >0.50, the composite reliability is all >0.60, the AVE value was also all >0.50 and finally, the discriminant validity was all < 0.80. Thus, making all the constructs valid and reliable for onward analysis.

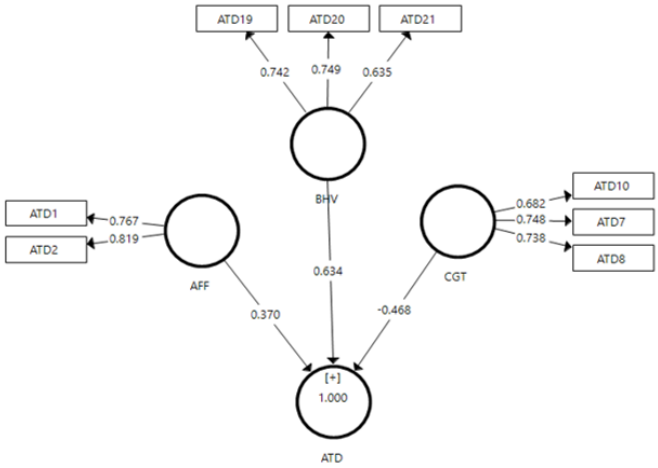
Findings

The data were analyzed and interpreted based on the research objectives. The findings of the study are presented according to the sequence of the research questions and hypotheses.

Research question 1: What is the influence of self-concept on ATPS among secondary school students in Sokoto, Nigeria (**Figure 3**)?

The result of the path analysis shows that self-concept has a significant direct negative influence on the students' ATPS (**Table 4**).

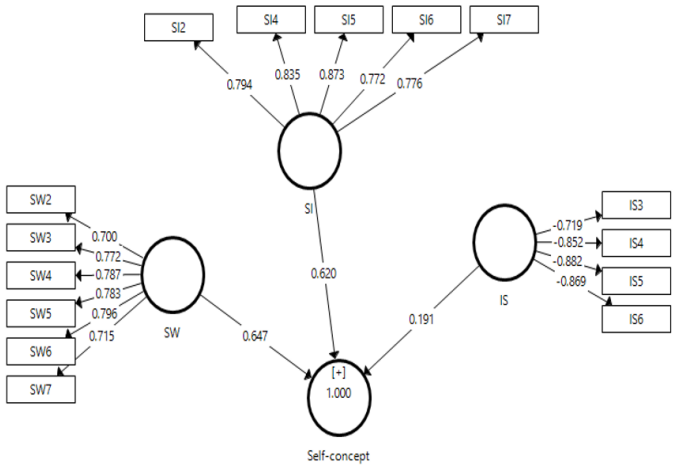
Table 3. Constructs evaluation table



Reliability of the ATSAP construct		
ATSAP	**CR**	**AVE**
FCT1	0.773	0.630
FCT2	0.753	0.505
FCT3	0.767	0.523

Discriminant validity			
	FCT1	**FCT2**	**FCT3**
FCT1			
FCT2	0.614		
FCT3	0.126	0.285	

Table 3 (Continued). Constructs evaluation table

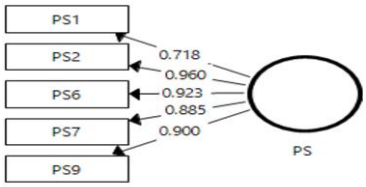


Reliability of the self-concept construct

Self-concept	CR	AVE
SW	0.891	0.577
SI	0.905	0.657
IS	0.900	0.694

Discriminant validity

	SW	SI	IS
SW			
SI	0.158		
IS	0.059	0.180	



Reliability of the problem-solving skills test construct

PSST	CR	AVE
PSST	0.945	0.776

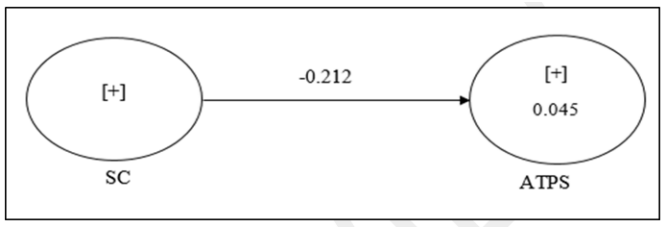


Figure 3. Self-concept based on attitude towards solving algebraic problems

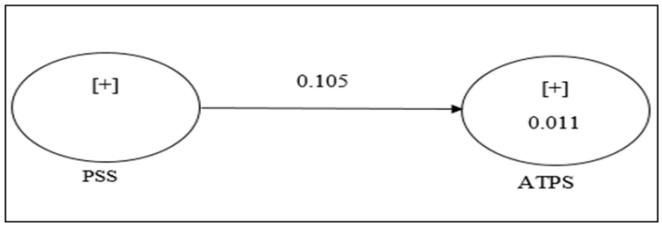


Figure 4. Problem-solving skills on attitude towards solving algebraic problems

Table 4. t-statistics and p-value of self-concept on attitude

	O	M	SD	TS	PV
SC->ATPS	-0.212	-0.212	0.046	4.565	0.000***

Note. O: Original sample; M: Sample mean; SD: Standard deviation; TS: t-statistics (TS=|O/STDEV|); PV: p-value

Table 5. t-statistics and p-value of problem-solving skills on attitude

	O	M	SD	TS	PV
PSS->ATPS	0.105	0.104	0.053	2.002	0.046**

Note. O: Original sample; M: Sample mean; SD: Standard deviation; TS: t-statistics (TS=|O/STDEV|); PV: p-value

The relationship is negative with a path coefficient (β=-0.212, t≥±1.96). So, since the t-value is >±1.96, it, therefore, means the influence of self-concept on attitude towards solving problems is significant and self-concept has an influence on students' attitudes towards solving algebraic problems. Thus, hypothesis is not rejected.

Research question 2: What is the influence of problem-solving skills on ATPS among secondary school students in Sokoto State?

Based on the path analysis of **Figure 4**, the result shows that students' problem-solving skills have a direct positive relationship with their ATPS (**Table 5**).

The influence is significant and positive with a path coefficient (β=0.105, t>±1.96). This implies that the student's problem-solving skills influence the attitude of the students towards solving algebraic problems. With a t-value of 2.002 and a p-value of 0.046. Since the t-value is >±1.96, it, thus, implies that problem-solving skills are significantly related to students' ATPS. Thus, the hypothesis is not rejected.

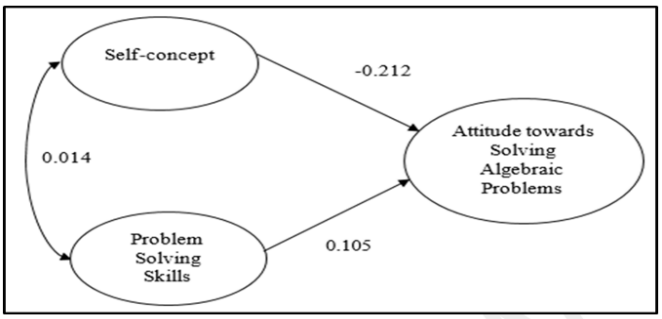


Figure 5. Relationship among SC, PSS, and ATSAP

Research question 3: What is the relationship among self-concept, problem-solving skills, and ATPS?

Figure 5 and **Table 6** show our findings.

Table 6. t-statistics and p-values of SC, PSS, and ATSAP

	O	M	SD	TS	PV
SC->PSS	0.014	0.017	0.046	0.296	0.768
SC->ASAP	-0.212	-0.212	0.046	4.565	0.000
PSS->ATSAP	0.105	0.104	0.053	2.002	0.046

Note. O: Original sample; M: Sample mean; SD: Standard deviation; TS: t-statistics (TS=|O/STDEV|); PV: p-value

DISCUSSION

In this study, self-concept was found to have a negative significant influence on students' attitudes toward solving algebraic problems (β=-0.212, t=4.565, p<0.001). In other words, this means higher self-concept scores lead to a decrease in ATPS. This result is consistent with previous studies. For instance, Olagoke (2016) examined attitude, self-concept and achievement in basic science using 360 junior secondary two students of Ekiti State in Nigeria and it was discovered that there is a significant correlation between attitude, self-concept, and achievement in basic science.

Also, Wu and Hu (2015) found a significant correlation between skill learning attitudes with vocational self-concept. In a study, they conducted among 270 Taiwanese junior high school students who study in the technical education program. Margareta et al. (2017) also submitted that mathematics self-concept significantly predicts students' attitude toward mathematics in Obio-Akpor Local Government Area of Rivers State. In a study, they conducted using 350 senior secondary students selected through stratified proportionate random sampling. Most of the previous research conducted is in support of the current study by showing a significant influence of self-concept on attitudes towards algebraic problems. It is worthy to note that in the previous studies conducted on self-concept and students' attitudes, there is a significant positive influence, which is in contradiction in the present study, here the influence of self-concept on students' attitudes towards solving algebraic problems is negatively significant. This simply implies that an increase in self-concept will lead to a decrease in ATPS and vice visa. This, the researcher of the present study believe, may be as a result of the culture, belief, and environment of students in the current study.

The present study indicated that students' problem-solving skills have a positive influence on their ATPS (β=0.105, t=2.002, p<0.05). This finding aligned with the previous studies that examined the relationship between students' attitudes towards mathematics and their problem-solving skills where the result showed that there is a strong positive correlation between students' attitude towards mathematics and their problem-solving skills. The findings of this study also are in line with the work of Effandi and Normah (2009), who investigated attitude and problem-solving skills in algebra among Malaysian matriculation college students. The outcome of their findings indicated that there is a moderate relationship between students' attitude and problem-solving skills in algebra, although they also recorded low attitude for some students which they believe may be due to those students' unwillingness to solve problems and also lack the perseverance to solve the problems. Other research conducted earlier also buttress the influence of problem-solving skills on attitude and all found significant relationships between them (Adesoji, 2008; Arslan et al., 2014; Beyazsacli, 2016; James & Adewale, 2015; Nasrazadani et al., 2017; Pimta et al., 2009; Salami & Aremu, 2006). For instance, Nasrazadani et al. (2017) looked at social problem-solving skills and dysfunctional attitudes with risk of drug abuse among dormitory students at Isfahan University of Medical Sciences. In the study, it was found that social problems solving skills have a significant influence on dysfunctional attitudes. Also, a study looking at the relationship between problem-solving skills and academic achievement carried out by (Beyazsacli, 2016), which utilized primary school pupils, discovered in their findings that pupils' problem-solving skills are significantly related to their academic achievement.

Research question 3 specifically focused on eliciting empirical evidence on the relationship that exists between self-concept, problem-solving skills, and ATPS. The purpose of investigating the relationship among the three variables is to empirically demonstrate how they relate to one another. The researcher was interested in also trying to find out if an increase in one of the variables leads to an increase in another and vice visa or if what happened to one variable does not affect the other variable. The result of the relationship between self-concept and problem-solving skills was investigated in the current study. The outcome indicated that the relationship between them is not significant (β=0.014, t=0.296, p>0.05). This finding aligns with the result in the findings of Angga (2014) that found low achievement students' self-concept is not significantly related to their problem-solving ability. Likewise, Yengimolki et al. (2015) found in their study that students' self-concept does not relate to their academic achievement in mathematics. However, contradicting the present study, Kim and Choi (2014) and Veisikahre et al. (2017) in their separate research discovered that both self-concept and student problem-solving ability is positively and significantly related to each other. This, however, may be a result of the different environment or the attitude the students have towards solving problems. A positive attitude towards solving problems will lead to an appreciable level of interest in developing problem-solving skills.

CONCLUSION

Conclusively, it has been unveiled in the current study that students' self-concept has a significant but negative influence on their ATPS. Also, their problem-solving skills have a significant and positive influence on their ATPS. However, it was also discovered that their self-concept and problem-solving skills are not significantly related. In a nutshell, how students view things, how they aspire to achieve and how confident they are in achieving those things determine the attitude they will have towards things. So, therefore, teachers and parents should help inculcate a positive self-concept in their students and children, in order to boost their confidence and interest in solving problems. Thus, when their confidence is build-up, then it will affect the attitude they will display when solving algebraic problems. Also, Schools in collaboration with the Ministry of Education should organize inter and intra mathematics competitions on algebraic problem-solving skills. This will build confidence in these students to face any task given to them on their own.

Limitation and Recommendation

The current study is not without limitations and some recommendations were also put forward. The study is a quantitative survey and not a cross-sectional study, furthermore, the data collected from the study is solely on the students' self-report and performance test skills. Therefore, classroom observations, interviews, and discussion groups might be helpful for a better understanding of these

relations. Consequently, research has shown that the variables considered in the current study have been rarely studied together in a single study across the world. Therefore, it would be stimulating and interesting to carry out a replication of the study in other countries, in other fields or even in another branch of mathematics, and with different levels (grades) of students which may aid the generalizability of the results as well as our understanding of the issue under investigation.

The development of self-concept is to a large extent function of influential others such as parents and role models (teachers). These influential figures can let students know that they are perceived to have the skill, capabilities, and temperament necessary for achieving academically. Also, there is a need to encourage collaboration between counselling psychologists (school counsellors) and mathematics teachers in the cognitive domain field. This will require the establishment of projects and programs of prevention and intervention in difficulties of solving algebraic problems and mathematics learning as a whole. The aim will be to stimulate the attraction and taste for solving algebraic problems and to improve the psychological parameters that students experience when they are solving problems in mathematics generally. Such kind of program will surely lessen the fear of solving problems and will build confidence in students to take on the task given to them.

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APPENDIX A

Table A1. Instrument on self-concept and attitudes towards solving algebraic problems among secondary school students in sokoto state, Nigeria

Measuring scales						
Instruction: Please circle **ONE** response in the column (**Strongly disagree-1; Disagree-2; Neutral-3; Agree-4; & Strongly agree-5**)						
Section B: Responses						
Self-worth						
1	I can solve algebraic problems by myself	1	2	3	4	5
2	I do not know how to start solving any algebraic problem anytime I am confronted with it	1	2	3	4	5
3	I am not good at solving algebraic problem	1	2	3	4	5
4	Working very hard, will enable me to solve algebraic problem	1	2	3	4	5
5	It is sometimes unpleasant for me to think of solving any algebraic problem	1	2	3	4	5
6	I sometimes perform poorly in solving algebraic problems	1	2	3	4	5
7	I feel I have a number of good quality to solve algebraic problems	1	2	3	4	5
Self- image						
1	I am a failure when it comes to solving algebraic problems	1	2	3	4	5
2	I am never good at solving algebraic problems	1	2	3	4	5
3	I will always fail to solve algebraic problems correctly	1	2	3	4	5
4	I am good in some areas of algebraic problem solving	1	2	3	4	5
5	I am the best algebraic problem solver in my class	1	2	3	4	5
6	I am better than others in solving problem in algebra in my class	1	2	3	4	5
7	I am the worse students in my class in terms of solving algebraic problem	1	2	3	4	5
8	I am one of the least performing student in algebra in my class	1	2	3	4	5
Ideal self						
1	I wished I can solve any algebraic problem given to me	1	2	3	4	5
2	I will learn how to solve algebraic problem in the future	1	2	3	4	5
3	I will be the best algebraic problem solver in my class	1	2	3	4	5
4	I will succeed in any given task of solving problems in algebra	1	2	3	4	5
5	I will assist my classmate in solving algebraic problems	1	2	3	4	5
6	I will learn how to solve algebra from my classmates	1	2	3	4	5
7	I will want to become a mathematics teacher in the future because of algebraic aspect of mathematics	1	2	3	4	5
Attitude						
1	I like solving algebraic problems	1	2	3	4	5
2	I enjoy solving problems in algebra	1	2	3	4	5
3	Algebra is not a good topic in mathematics	1	2	3	4	5
4	I can solve algebraic problems on my own	1	2	3	4	5
5	Solving algebraic problems amounted to waste of time	1	2	3	4	5
6	Solving algebraic problems help in developing a good reasoning ability in me	1	2	3	4	5
7	Algebra should be removed as a branch of mathematics topics	1	2	3	4	5
8	Algebra will benefit only the brighter students'	1	2	3	4	5
9	I feel excited whenever I have to solve algebraic problems	1	2	3	4	5
10	I detest algebraic problems and avoid it all the time	1	2	3	4	5
11	I do not like being introduced to new algebraic content	1	2	3	4	5
12	I enjoy the struggle to solve an algebraic problem	1	2	3	4	5
13	I do not like solving algebraic problems	1	2	3	4	5
14	I struggled with many letter in solving algebraic problems	1	2	3	4	5
15	I would like to develop my algebraic skill	1	2	3	4	5
16	Solving algebraic problems makes me feel uncomfortable and nervous	1	2	3	4	5
17	I usually comprehended mathematics content well and seldom got lost	1	2	3	4	5
18	Algebraic problem is boring	1	2	3	4	5
19	I do not like to solve more of algebraic problems of the same type	1	2	3	4	5
20	I like to explain my algebraic solutions to others	1	2	3	4	5
21	For some reason even though I study, solving algebraic problems seems unusually hard for me	1	2	3	4	5
22	I have a lot of self-confidence when it comes to solving algebraic problems	1	2	3	4	5
23	I am usually at ease when solving algebraic problems	1	2	3	4	5

APPENDIX B

Problem-Solving Skills Performance Test Questions

1. A messenger was paid ₦2.50 an hour during the normal working hours and ₦4.00 an hour during overtime. If he received ₦31.00 for 10 hours work, how many hours are for overtime?
2. A dealer sold a car to a man and made a profit of 15%. The man then sold it to a woman for ₦120,175.00 at a loss of 5%. How much did the dealer buy the car?
3. Madam Kwakyewaa imported a quantity of frozen fish costing ₦400.00. The goods attract duty of 15% of its cost. She also paid a sale tax of 10% of the total cost of the goods including the import duty and then sold the goods for ₦660.00. Calculate her percentage profit.
4. A shopkeeper allows a discount of 15% on the marked price of a mobile phone. If a customer paid ₦170.00 for a mobile phone, what was the marked price of the phone?
5. A trader bought an engine for $15,000.00 outside Nigeria. If the exchange rate is $0.075 to #1.00, how much did the engine cost in Naira?
6. Every staff in an office owns either a Mercedes and/or a Toyota car. 20 own Mercedes, 15 own Toyota and 5 own both. How many staff are there in the office?
7. A car uses one litre of petrol for every 14km. If one litre of petrol cost ₦63.00 how far can the car go for ₦900.00 worth of petrol?
8. A seller allows 20% discount for cash payment on the market price of his goods. What is the ratio of the cash payment to the market price?
9. ₦140,000 is shared between Abu, Kayode and Uche. Abu has twice as much as Kayode and Kayode has twice as much as Uche. What is Kayode's share?
10. Tom will be 25years old in n years' time. If he is 5 years younger than Bade, find Bade's present age.