ASSESSMENT OF SELECTED PSYCHOLOGICAL VARIABLES AS PREDICTORS OF ACHIEVEMENT IN MATHEMATICS AMONG ADOLESCENTS WITH HEARING IMPAIRMENT IN INCLUSIVE SCHOOLS IN NIGERIA

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Abstract
The academic performance of students in key subjects like Mathematics and English had been a source of concern to stakeholders. Over the years, so many reasons had been adduced to have caused this downward trend, most importantly among students with disabilities considering their peculiar nature. This study investigated psychological variables as predictors of academic achievement in mathematics among adolescents with hearing impairment in inclusive secondary schools in Lagos state, Nigeria. The study employed descriptive survey research design in which quantitative data were collected. The samples for the study were 94 with hearing impairment purposively sampled from inclusive Junior Secondary School in Lagos State. Their ages range between 12 and 21. The instruments for this study were self-efficacy scale, self-regulation scale, motivation scale, mathematics anxiety inventory, decision-making scale and mathematics achievement test The reliabilities of self-efficacy scale, self-regulation scale, motivation scale, mathematics anxiety inventory and decision-making scale were found using the Cronbach Alpha method to be 0.79, 0.75, 0.78, 0.80 and 0.68 respectively; while that of mathematics achievement test was found using the Kuder-Richardson 20 method to be 0.80. Data collected were analysed using descriptive statistics, Pearson product moment correlation and multiple regression. The results revealed that only anxiety related directly and significantly with achievement in mathematics. It was therefore recommended that teachers and school psychologists design programme to reduce anxiety of students with hearing impairment in mathematics so as to improve their performance in the subject.

Keywords: Self-efficacy, self-regulation, motivation, anxiety in mathematics, achievement in Mathematics

Introduction

The importance of Mathematics in all facets of lives has made the subject the centre of every developmental agenda (Owolabi & Adeniyi, 2017). The knowledge of it is needed to carry out day to day activities. Mathematics as a subject is made compulsory in elementary and secondary levels of education in Nigeria regardless the future aspirations and specialisations of any student. It is a subject that all students must acquire relevant skill in and pass before gaining admission to any tertiary institution. However, the performance and attitude towards the subject have continue to attract attention of all stakeholders because of the inconsistency and inability to achieve relatively stable and or improved performance in the recent times among secondary school students with and without disabilities.

Generally, the performance of students with hearing impairment inclusive have been very unstable swinging from near average to below average in core subjects in which Mathematics is one of them. The five years analyses of performance of students with at least 5 credits passes

including English language and Mathematics as indicated in Table 1. This result do not give hope that students are making steady progress in these core subjects.

Table 1: Percentage credit passes in WAEC between 2013 to 2017

Year	No of Candidate who sat for the exam	No of Candidate who had at least 5 credit pass	Percentage
2013	1543683	1074065	69.57
2014	1692435	529425	31.28
2015	1593442	616370	38.68
2016	1552758	878040	52.97
2017	1559162	923486	59.22

Source: West Africa Examination Council (2013-2017)

The performance in Mathematics from 2015 to 2017 indicated that in 2015 the percentage pass was 38.68%, 2016 recorded 52.97 % and in 2017, 42.73%. (WAEC, 2015-2017). These performances indicated inconsistency in progressive performance and do not reflect any success in Mathematics. More often than not, children with deafness have difficulty obtaining academic success compared with their hearing peers (Traxler, 2000). Though, poor performance is a recurring academic problem among students with and without hearing impairment.

The problem of hearing loss present additional burden that impede academic success among students with hearing impairment. Research findings have revealed considerable effects of hearing impairment on the total development of person with hearing loss with its attendant impact on social, psychological and cognitive disposition of the affected (Adeniyi & Kuku, 2016). Many special educators have devised several methods to teach some basic concepts in mathematics to students with hearing impairment with the aim to improve their performance in subject like mathematics. However, their inputs have not yielded the expected result as performance had been on the downward trend. This then calls for more investigation into the causes of such performance beyond the product or performance outcome which had been subject of discourse in many forums.

Several factors aside teaching methodologies and cognitive capability have been adduced to be the possible causes of students' success or failure. These factors range from students' self-efficacy (Hodges & Kim, 2010), self-regulations (Hartley & Bendixen,2001; Wihipp & Chiarelli,2004; Horges, 2005; Van Gog, Ericsson, Rikern & Paas, 2005), motivation to learn (Mousoulides & Philipou, 2005; Vásquez-Calina, Gonzalez-DeHass & Furner, 2014), mathematics anxiety (Bekdemir, 2010; Mutodi & Ngrirade, 2014), school environment, students' interest and experiences (Mutodi & Ngrirade,2014) decision-making, success orientation and other personal social and emotional factors.

Self-efficacy has a long history of importance in academic endeavor and has been linked to successes in different fields of human activities. Bandura (1997) defined self-efficacy as belief in one's capabilities to organize and execute the courses of action to produce given attainment. Thus, self-efficacy beliefs influence the ability to choose a task, expend efforts to achieve a desired end, and the ability to remain committed to a difficult task when the hope of success is very slim. Self-efficacy can be seen as confidence that individuals possess to achieve life success. The relationship between self-efficacy and academic success has been the focus of many researches for some decades and the results from different studies have revealed strong

link between the two variables (Zimmerman & Schunk, 2003;). Hodges and Kim, (2010), Bandura, Barbaranelli, Caprara and Pastorelli (2001) carried out a study on self-efficacy beliefs as shaper of children's aspiration and career trajectories, the result revealed that self-efficacy was a key determinant of their participants' career aspiration. From the result, one could infer that self-efficacy can influence life success especially academic achievement of any student. Also, Hodges and Kim (2010) carried a study on email, self-efficacy, self-regulation and achievement in college online mathematics course, the finding revealed significant relationship between self-efficacy and achievement of the participants.

Furthermore, self-regulation has been investigated by many researchers as important variable that influence life success (Hartley & Bendixen, 2001; Whipp & Chiarelli, 2004; Hodges, 2005). Three components of self-regulation were identified by Zimmerman (1989) as follows: behavioural, environmental and personal. The behavioural aspect involves individual personal observations, judgment, and adjustments to performances made when compared to some perceived standard of performance. Environmental influences arise through the observation of peers models and persuasion and the personal aspect which sees self-efficacy as a component of self-regulation because it directs which task an individual chooses to engage and how long to persist. Self-regulation as a psychological construct has demonstrated important link with academic achievement. Nota, Soresi and Zimmerman, 2004) noted that self-regulation has strong link with mathematics achievement. Self-regulation is a construct that is involved in actual study process which include goal-setting ability of the students, commitment, effort put into the study and persistence (Schoenfeld, 1992; Gollwizer & Brandstätter, 1997; Kuhl & Fuhrman, 1998; Corno, 2001). Self-regulation has been found to be positively correlated to achievement and a highly self-regulated student may be self- motivated, organised and able to self-monitor his academic activities (Pintrich & De Groot, 1990). This determines the extent of life success and promotion of self actualisation.

In addition, one of the keys to success in life is the drive to achieve, which may either come from within and outside an individual. This is regarded as motivation. As an innate phenomenon, motivation is influenced by four factors of context (environmental and stimuli), temper (the internal condition of an organism), goal (goal of behaviour purpose and inclination) and instruments (instruments for achieving the goal) (Amrai, Motlagh, Zalani & Parhon,2011). These four constructs are needed for human being to achieve life goal. Broadly, experts have divided motivation into two major groups; these are internal and external motivation. While individual is influenced by external motivation with an independent goal undertakes a specific activity, the internal motivation provided the sufficient incentive for doing such task (Reev, 2006). Psychologists have advised that motivation should be taken into account because of its effective relationship with new learning abilities, strategies and behaviour (Shahraray, 2007). Motivation is highly essential for academic achievement and has been one of the psychological constraints that educators, researchers and psychologists have studied for decades. Alderman (2004) reported that those students who have optimum motivation have an edge because they have adaptive attitudes and strategies such as maintaining intrinsic interest, goal-setting and self-monitoring. Besides, motivational variables can interact with cognitive, behavioural and contextual factors to upset self-regulation.

Again, one of the effective components that make learning to be meaningful is anxiety. Anxiety can be seeing as disorganized feelings, lack of composure, helplessness and mental disorganization that individuals experience at performing a perceived difficult task. Feeling of

insecurity at doing certain tasks can make achievement difficult. Hembree (1990) noted that Mathematics anxiety affects students' achievement and attitude towards Mathematics. In the same vein Perry (2004) noted that nervousness and insecurity towards Mathematics can affect students' performance. Venkatesh, Kamar and Karimi (2010) in a study on Mathematics anxiety, Mathematics performance among 424 high School students, the result revealed that Mathematics anxiety has relationship with students' performance in Mathematics and academic performance generally.

Achieving academic success is a function of many factors, some which are within the students and classroom while others are external factors (Bell, 2011). One of the factors within the student is his /her involvement ability in a task that can lead to academic success which among other things involves the ability to take decision that can influence his academic achievement. Developing effective decision making skills is one of the vehicles that propel achievement. It explains why individuals who encountered similar situations use different approaches to solve their problems (Baiocco, Laghi D'Alessio, 2009). Kuzgun (1992) noted that individuals use four decision-making strategies while engaging in a very serious thoughtful situation. These are independent decision-making, logical decision-making, indecisive decision-making and impulsive decision-making. While independent decision-making is about the skill of an individual making decision alone, logical decision-making is about collecting relevant information about available alternatives and examining them carefully. Indecisive decision-making is the desire to change decision constantly or frequently because of inability to be contented with one particular decision while impulsive decision-making is about taking decision on the basis of feeling without thinking about possible options available. The four strategies are always employed by different students depending on individual's mental, social and emotional desires. In classroom, it is left to each student to take decision about the process that will influence his achievement either positively or negatively.

Independently, the constructs under investigation have been variously reported to have great influence on students' academic achievement; however, it is necessary to investigate whether the variables can jointly affect academic achievement so far all the constructs reside in individual students. Therefore, this study is on psychological variables as predictors of academic achievement in mathematics among adolescents with hearing impairment in inclusive secondary schools in Lagos state.

Research Questions

(i) Will there be significant influence of independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision-making) on achievement in mathematics among adolescents with hearing impairment in inclusive schools in Lagos state, Nigeria?

(ii) What is the joint influence of the independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) on achievement in mathematics among adolescents with hearing impairment in inclusive schools in Lagos state, Nigeria?

(iii) What is the relative influence of the independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) on achievement in mathematics among adolescents with hearing impairment in inclusive schools in Lagos state, Nigeria?

Methodology

This study employed descriptive survey research design in which quantitative data were collected in line with the variables under investigation. The population for the study included

students with hearing impairment in inclusive Secondary Schools in Lagos State of Nigeria. The samples for the study were ninety four (94) with hearing impairment purposively sampled from inclusive Junior Secondary Schools in Lagos State. Their ages range between 12 and 21. This serves as one of the criteria for selection. Other criteria were that, they were available during the period of this study and indicated they were ready to participate in the study through the consent form filled by the participants. The instruments for this study were self-efficacy scale, Self-regulation scale, motivation scale, mathematics anxiety inventory, decision-making scale and mathematics achievement test. The self-efficacy scale was adapted from the general self-efficacy scale developed by Schwarzer and Jerusalem (1995). The scale was constructed in 4 likert type: Not all true (NAT), Hardly true (HT), Moderately true (MT), Exactly true (ET) of ten items. The reliability of the scale was 0.79 using test re-test method. Self-regulated scale was adapted from Kanfer (1970). Kanfer scale has sixty three items constructed in 5 likert type but `modified in to 4 likert scale ranging from strongly agree (SA), agree (A), disagree (D) to strongly disagree (SD) with ten items. The reliability of the scale was 0.75 using cronbach alpha. Also, academic motivation scale was adapted from Alivernini and Lucidi (2008). Academic motivation scale was modified and constructed in 4 likert of 10 items ranging from strongly agree (AD), agree (A), disagree (D) and strongly disagree (SD) with reliability of 0.78 using cronbach alpha. Mathematics anxiety scale was adapted from May (2010). This scale was constructed in 4 likert scale from strongly agree (SA), agree (A), disagree (D), strongly disagree (SD). The reliability was 0.80 using cronbach alpha. Decision-making scale was also adapted from French, West, Elander and Wilding (1993). The scale was constructed in 4 likert type ranging from very frequently (VF), frequently (F), quite frequently (QF), not frequently (NT). The reliability was 0.68. Mathematics Achievement Test was adopted from National Examination Council (2016), Basic Education Certificate Examination. 20 items were re-modified and used for this study. The reliability for MAT was 0.80 using Kuder-Richardson 20.

To collect data, the researchers sought the permission of the Principals of the schools used. After the permission had been granted, the researchers met with the students and explain the essence of the study to them with the help of their class teachers. Thereafter, consent forms were given to the students and those who responded positively were asked to respond to the scales and subjected to 50 minutes mathematics test of multiple choice. The researchers waited patiently to monitor the respondents while feeling the questionnaire and attempting the test. The responses were collected after they have been duly attended to. Data collected were coded and analysed using descriptive statistics, Pearson product moment correlation and linear multiple regression.

Results

Research Question One: Will there be significant influence of the independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) and achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria?

To answer research question one, a correlation matrix (Table 1) showing the correlation coefficients between independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) and achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria.

Table 2: Correlation Matrix Showing Relationship between independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) and achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria

	SE	SR	MOT	ANX	DM	ACH
SE	1.000					
	94					
SR	0.597*	1.000				
	0.000					
	94	94				
MOT	0.498*	0.454*	1.000			
	0.000	0.000				
	94	94	94			
ANX	0.283*	0.317*	0.451*	1.000		
	0.006	0.002	0.000			
	94	94	94	94		
DM	0.245*	0.062	0.120	0.210*	1.000	
	0.018	0.551	0.251	0.042		
	94	94	94	94	94	
ACH	0.124	0.035	0.163	0.215*	-0.023	1.000
	0.235	0.738	0.116	0.038	0.826	
	94	94	94	94	94	94

KEY: SE = Self Efficacy; SR = Self Regulation; MOT = Motivation; ANX = Anxiety; DM – Decision Making.

*= Correlation is significant at the 0.05 level (2-tailed)

The results showed that four (4) of the independent variables do not relate significantly with achievement in mathematics. Three of the four independent variables related positively but not significantly with achievement. Self-efficacy ($r = 0.124$, $p>0.05$); self-regulation ($r = 0.035$, $p>0.05$) and motivation ($r = 0.163$, $p>0.05$) related positively but not significantly with achievement. Only mathematics anxiety has a weak, positive and significant relationship with achievement ($r = 0.215$, $p<0.05$). Decision making had a weak negative and insignificant relationship with achievement ($r = - 0.023$, $p>0.05$). Therefore it is only mathematics anxiety that has a relationship that is significant with achievement. The relationship is therefore generalisable.

Research Question Two: What is the joint influence of the independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) on achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria?

To answer research question two, a multiple regression table (Table 2) showing the predictive power of independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) and achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria.

Table 3: Multiple Regression of the independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) on achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria

Parameter	Value
Multiple Regression	0.267[a]
R-Square	0.071
Adjusted R-Square	0.018
Standard Error of Estimate	2.413

a. Predictors: (Constant), self-efficacy, self-regulation, motivation, mathematics anxiety and decision making.

Table 2 presents the multiple regression of the independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making**)** and dependent variable (achievement in mathematics) among adolescents with hearing impairment in inclusive schools in Nigeria. The multiple regression coefficient (R) showing the linear relationship between the five independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) and dependent variable (achievement in mathematics) among adolescents with hearing impairment in inclusive schools in Nigeria is 0.267. The adjusted R square value is 0.018; this implies that the variation in achievement in mathematics accounted for by the stated independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) when combined, among students with hearing impairment is 1.8%.

Table 4: Multiple Regression ANOVA for Achievement in Mathematics**.**

Model	Sum of Squares	df	Mean Square	F-ratio	p-value
Regression	39.274	5	7.855	1.349	0.251
Residue	512.343	88	5.822		
Total	551.617	93			

a. Predictors: (Constant), self-efficacy, self-regulation, motivation, mathematics anxiety and decision making
b. Dependent variable: Achievement in Mathematic

Table 3 shows the Multiple Regression ANOVA of the identified independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making). Further verification using multiple regression ANOVA produced F-ratio = 1.349, $p > 0.05$. This implies that there is no significant linear relationship between the identified independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) and achievement in mathematics.

Research Question Three: What is the relative influence of the independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) on achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria?

To answer research question 3, a multiple regression table (Table 4) showing the predictive power of each of the identified independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) on achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria**?**.

Table 5: Coefficients Indicating Relative Effects of the identified independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) and achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria?.

Model	Unstandardized Coefficients B	Std. error	Standardized Coefficient Beta	t	p-value	Remark
Constant	6.322	2.215		2.855	0.005	S
Self-efficacy	0.109	1.114	0.134	0.963	0.338	NS
Self-regulation	-0.098	0.094	-0.140	-1.049	0.297	NS
Motivation	0.042	0.068	0.079	0.611	0.543	NS
Anxiety	0.118	0.068	0.206	1.746	0.084	NS
Decision making	-0.054	0.059	-0.100	-0.921	0.360	NS

a. Dependent variable: Achievement Test
S: significant at 0.05 alpha levels
N.S: Not Significant at 0.05 alpha levels

Table 4 shows the relative effects of the identified independent variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) and achievement in mathematics among adolescents with hearing impairment in inclusive schools in Nigeria as indicated by standardized Beta (B) weights. Anxiety contributed mostly and directly to Achievement in mathematics ($B= 0.206$; $t = 1.746$; $p > 0.05$). The contributions of level of decision making ($r = -0.921$, $p > 0.05$) is negative and high but not significant.

Discussion

The result revealed that out of the five independent variables, only mathematics anxiety has positive significant relationship with achievement in mathematics among adolescents with hearing impairment in inclusive schools in Lagos state, Nigeria. This finding corroborated the finding by Venkatesh, Kamar and Karimi (2010) in a study on Mathematics anxiety, Mathematics performance among 424 high School students, the result revealed that Mathematics anxiety has relationship with students' performance in Mathematics and academic performance generally. This allude to the fact that anxiety demonstrated by students perceiving that mathematics is a difficult subject may be the pre-condition for consistent poor performance in mathematics by students not minding the nature of variance and attribute of students.

The relationship among self-efficacy, self-regulation, motivation and achievement in mathematics are not significant. This finding therefore contradicts the findings of Bandura, Barbaranelli, Caprara and Pastorelli (2001) that reported that self-efficacy was a key determinant of their participants' career aspiration and life successes. It also contradicts the assertion of Nota, Soresi and Zimmerman (2004) that noted that self-regulation has strong link with mathematics achievement. Also, it disagrees with Alderman (2004) who reported that those students who have optimum motivation have an edge because they have adaptive attitudes and strategies such as maintaining intrinsic interest, goal-setting and self-monitoring.

The result also revealed that mathematics anxiety contributed mostly and directly to achievement in mathematics while decision-making made the least contribution to achievement in mathematics among adolescents with hearing impairment. None of the contributions was

statistically significant. This result is in contrast with the findings of Hembree (1990) that noted that Mathematics anxiety affects students' achievement and attitude towards Mathematics and Venkatesh, Kamar and Karimi (2010) in a study on Mathematics anxiety, Mathematics performance among 424 high School students, found that Mathematics anxiety has relationship with students' performance in Mathematics and academic performance generally.

The contradiction in the findings of this study with those from the previous studies could be as a result of the challenges of hearing impairment experienced by the respondents of this study. Therefore, it can be concluded that the hearing impairment of students in inclusive schools is a strong force to reckon with if we would attain high achievement level in mathematics among them. Measures must therefore be in place to aid their hearing in mathematics class. This would afford them equal opportunity in the teaching learning process with their peers that do not have such a challenge.

Conclusion

This study assesses the relationship and the predictive ability of the selected psychological variables (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) on achievement in mathematics among adolescents with hearing impairment in inclusive schools in Lagos, Nigeria. The result revealed that only anxiety related directly and significantly with achievement in mathematics. The joint contribution of the predictors (self-efficacy, self-regulation, motivation, mathematics anxiety and decision making) to the variation in achievement in mathematics was also found to be low and non-significant. The contributions of each of the predictors to variations in achievement in mathematics was also not significant.

Recommendation

Based on the findings of this study, it is expedient for teachers and school psychologists to find a way of reducing anxiety of students with hearing impairment in mathematics so as to improve their performance in mathematics. For inclusive schools, the hearing impaired students learn in the same classroom and from the same teachers with their colleagues who do not have such a challenge. The challenge of hearing impairment therefore should not be taken for granted as shown in this study. It is therefore recommended that hearing aids be provided for them. Besides, since the focus of a good teaching procedure is to take cognizance of the peculiarities of each student with the aim of making the delivery relevant to every student; teachers of inclusive schools should be given in-service training in order to make their teachings relevant to students with hearing impairments who are in their classes.

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