Indicators of Improved Achievement of Students' in Mathematics

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ABSTRACT

The study focused on examining predictive indicators of improved achievement of students' in Mathematics in Kontagora Metropolis of Niger State, Nigeria. Three research questions and hypotheses were formulated to guide the study. The study adopted the correlational design with a population of 3,789 senior secondary school two (SS2) students in seven (7) selected secondary schools in Kontagora Metropolis. Purposive sampling techniques was used to select 789 senior secondary two (SS2) students who were preparing to take West African Examination Council (WAEC) from 2018/2019 academic session. The research instrument for this study was a researchers' design questionnaire tagged "Improved Achievement in Mathematics Questionnaire (IAMQ)." Face, content and construct validity were adopted to validate the instrument by three experts, two in Test and Measurement and one in Mathematics Education and the reliability of the instrument was established with split-half reliability method. The reliability coefficient obtained ranged from 0.78 to 0.86 which depict that the instrument was a valid measure of the construct. The data collected were subjected to descriptive and inferential statistical analysis. Findings revealed that adequate concentration, time management and persistent concentration significantly predict students' academic achievement in mathematics. It was recommended among others that workshops, quiz programs and competitions on time management in relationship with the study of mathematics should be held by different schools on the need to invest and manage time properly.

Keywords:
Predictive, indicators, improved achievement, mathematics, Kontagora metropolis

INTRODUCTION

Mathematics is a methodical application of numerical values to solve complex task. To this end its value to individual and societal development cannot be underestimated. As a compulsory subject learn at primary, secondary and most discipline in tertiary education levels in Nigeria. Certain qualities that are nurtured by mathematics are power of reasoning, creativity, abstraction or spatial thinking, critical thinking, problem solving ability and effective communication skills (Fletcher, 2003). It is a glaring fact that Mathematics as a subject dominates almost in every field of our modern society. It plays a vital role in students' progress in school as well as in their daily life activities. Therefore, this has made the study of Mathematics to be indispensible. Mathematics curriculum prescribed for secondary classes has a wide range of concepts that have to be learnt and mastered by the students in Pakistan. Learning Mathematics is not enjoyable for all but like a nightmare for majority of students who are studying in secondary schools.

Mathematics is the backbone of all subject with which the world cannot move an inch (Eraikhuemen, 2003). Irrespective of the area of discipline, one may not function effectively if the individual does not have some little knowledge of mathematical operations like addition, subtraction, multiplication and division. Anyone can be a mathematician if being exposed to those indictors that can enhance the understanding of the subject matter. These indicators examine by this study are effective adequate concentration, time management and persistency are indicator considered in this study.

Farooq and Shah (2008) noted that for any students to be skillful in the study of mathematics as a subject there is need for adequate concentration during mathematics classes. This is because most mathematical concept are abstract in nature and can only be properly understood if the individual exert high level of concentration during mathematics lesson deliver or during personal study. Obviously, students who develop phobia for mathematics classes are those who shy and do not pay adequate concentration in studying mathematics.

In this regards, Mohammad (2002) informed that most students claimed to have sound command of memorising mathematics' rules without understanding the need and usability of these mathematics' rules are majorly those who study the subject without adequate concentration. This means that students' who develop positive attitude towards the study of mathematics are those who pay adequate attention and

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concentration during the study of the subject in school. Whereas those who developed negative attitude towards Mathematics signifies lost interest towards studying Mathematics. It is the disposition of students' towards liking or disliking the study of Mathematics. Mathematics is an interesting subject as Farooq and Shah (2008) informed that students showed positive attitude towards learning Mathematics only when they concentrate effectively during mathematics class.

In an empirical study by Semira, Raheb and Sheida (2013) on factors contributing to improve concentration and quality of Mathematics Education among upper high school students' in Malaysia. Two research questions and hypothesis were posed with a descriptive cross-sectional study; a population of 7891 respondents, using simple random sampling, a sample of all students from 2018-2019 academic year, numbering 768 students were drawn for the study. A valid and reliable researchers' developed questionnaire, including demographic data and variables associated with concentration as perceived by students, was used for data gathering. Items were rated by 5 points scale (scored as 0-4). Data were analyzed using descriptive and analytical statistics. The finding revealed that 180 students completed the questionnaires. 59.3% were female. Among the student-related factors, fatigue and sleepiness (mean 3.66±0.66) in class was recognized as the most remarkable factor interfering concentration. Meanwhile, studying teacher-related factors, teacher skills in applied demonstration of learning material (mean 3.47±0.80) was proved to be the main interfering factor. Among environmental factors, lighting and ventilation (mean 3.07±0.87) were the most significant factors. The most students believed that the highest concentration level was obtained in front seats (58.3%) in the morning sessions within 10-12 o'clock (43.8%). Conclusion: Regarding the fact that concentration is an acquisitive mental process, changing some behavioral patterns among students could lead to improvement in their concentration level. This may include planning for enough rest, paying attention to applied presentation of materials and consequently encouraging students, and providing a convenient learning setting such as physical conditions of the classroom.

Another important predictor of improved achievement in mathematics is proper time management means to take control of their time and work and do not let you steer the affairs of the incident in other words; man is passive in relation to the flow of life he will lose heavily. (khaki, 2002) noted that time management entails the act or process design and development of conscious control on the time spent on specific activities, especially to enhance the effectiveness, efficiency or productivity. Time is a priceless resource and continues to pass by without coming back. Time management as self-management with an explicit focus on time in deciding what to do; on how much time to allocate to activities; on how activities can be done more efficiently and on when the time is right for particular activities.

In the light of this, Amirali and Halai (2010) investigate factors responsible for quality of Mathematics instruction in secondary schools in Pakistan. The authors considered teachers' poor subject knowledge, lacking in pedagogical competence and students' perception about time management. The finding revealed that teachers' poor subject knowledge, lacking in pedagogical competence and students' perception about time management has a significant effect on mathematics achievement in the study area. The Merriam Webster dictionary to "persistent practice" is "to continue to do something or to try to do something even though it is difficult or other people want you to stop." Thinking of persistence in this way illuminates what a struggle it can be to persist and what learning process persistence is in itself. Academic persistence is regarded as the individual ability to direct personal resources towards the achievement of academic tasks and goals, including program completion. In other words, it is a modifiable individual non-cognitive aspect, operationalised as the degree to which students feel compelled to pursue the goals needed to finish their current level of studies, regardless of the difficulties and obstacles they face. Persistence and effort are part of the grit construct, which predicts academic performance (Etsey, 2005).

Study by Ali (2011) on perceived factors responsible for the poor learning outcome in Mathematics among high school students in Gilgit-Baltistan. Three research questions and hypotheses with ex-post facto design and a sample of 564 respondents were drawn from a population of 5,674 using simple and stratified random sampling. The instrument for data collections was a mathematic concentration scale (MCS) validated by experts in the subject area with 0.87 reliability index. The findings revealed that students poor learning Mathematics was as a result of lack of deeper and better concentration and understanding of mathematical concepts. This has led to the overall falling standard of mathematics education in the school.

In another empirical study by Mahanta and Islam (2012) who was interested in studying the influence of persistency of secondary students towards Mathematics and its relationship to achievement in mathematics among senior school students in South-Africa. Using five research question and hypotheses, the study utilized he correlational design with a sample of 214 respondents in the study area. A standadised instrument was used in data collection. The study found that majority of the boys considered mathematics to be a hard subject but they knew that Mathematics is very important to all. It was also revealed that most of the respondent did not consider reading mathematics due to it difficult nature. This means that understanding mathematics requires an individual to be consistent in the study of the subject. It is on the basis of this backdrop that the study intends to is to investigate the predictive indicators of improved achievement of students in Mathematics in Kontagora Metropolis of Niger State, Nigeria: Implication in Test and Measurement**.**

Statement of the problem

The public outcry on the standard of education most especially in Mathematics in Kontagora metropolis has been of serious concern to all and sundry. This is manifested in external examinations like, National Examination Council (NECO), West Africa Examination Council (WAEC). result from 2015-2018 revealed that in 2015 the overall failure stood at 47%, in 2016 it rose to 53% and increased geometrically in 2017 and 2018 to 69% and 81% respectively. This ugly situation has drawn the interest of educationists and they tend to shift the blame on the poor application of indicators (factors) that could enhance achievement in Mathematics.

Poor concentration, lack of time management and unseriousness in terms of lack of persistent practices of mathematical concepts among others were attributed to the indicators of the dwindling poor achievement of students in Mathematics. These have led most students to some unethical practices in both internal and external examination just to pass. Most students who utilises such mischievous mean to pass mathematics end up reading lucrative courses like medicine, pharmacist, nursing in tertiary institution, without having the ethics of such profession. The resultant effect is that most end up not graduating from school. Even which some manage to graduate; they still become quacks in practice, which has further pose a serious challenge in our educational system in-spite of government effort to encourage the teaching of the subject. The problem of this study is: what are the predictive indicators of improved achievement of students in Mathematics in Kontagora Metropolis of Niger State, Nigeria: Implication in Test and Measurement**?**

Purpose of the Study

The main purpose of the study is to investigate the predictive indicators of improved achievement of students in Mathematics in Kontagora Metropolis of Niger State, Nigeria: Implication in Test and Measurement**.** Specifically, the study would examine whether:

1. Students' concentration predicts achievement in Mathematics.
2. Time management predicts students' achievement in Mathematics.
3. persistent practice can predict students' achievement in Mathematics

Research Questions

The following questions are raised to guide the conduct of the study.

1. To what extent does students' concentration predict achievement in Mathematics?
2. How does time management predict students' achievement in Mathematics?
3. To what extent does persistent practice can predict students' achievement in Mathematics

Research Hypotheses

Ho_1. Students' concentration doe not significantly predict achievement in Mathematics.

Ho_2: Time management does no significantly predict students' achievement in Mathematics.

Ho_3 There is no significant predictive relationship between persistent practice and students' achievement in Mathematics.

RESEARCH METHODS

This section focused on the methods and procedure to be employed in carrying out the study under the following subheadings: the research design, sample and sampling techniques, research instrument, validation and reliability of research instrument, procedure for data collection and data analysis techniques.

Research Design

The study adopted the correlational design because it intends to explore the relationship in terms of prediction among variables. Kothari (2005) defined corelational design as a measure the relationship that exit among two or more variables of interest.

Population, Sample and Sampling Techniques

The population comprised of 3,789 senior secondary school two (SS2) students in seven (7) selected secondary schools. Purposive sampling techniques was used to select 789 senior secondary two (SS 2) students who were at the time of the study preparing to take West African Examination Council (WAEC) from 2018/2019 academic session, drawn from Mustapha Comprehensive Secondary School, Day secondary school Ungwan Nassarawa, F.C.E. demonstration school, Muazu Ibrahim Commercial School, Gods Foundation Academy, Perfect Secondary School and Saint Michael International School all in Kontagora metropolis of Niger state, Nigeria.

Research Instrument

The research instrument for this study was a researchers' design questionnaire. tagged Improved Achievement in Mathematics Questionnaire (IAMQ) which contains two sections A and B. section A elicit bio-data and demographic information like name, school, class, sex and age while section B is a four point like- type scale. Students are asked to indicate their opinion by taking any of "Strongly Agreed (SA)" "Agreed (A)" "Disagreed (D)" "Strongly Disagreed (SD)"

Validation and Reliability of the Research Instrument

To ascertain the validity of IAMQ, face, content and construct validity were adopted. The instrument was given for validated to three experts, two in Test and Measurement and one in Mathematics Education who rigorously scrutinized the items in the instruments to ensure adequate face, content and construct validity of the IAMQ and the final draft after all corrections was used in the pilot study. The reliability of the instrument was split half reliability method. The reliability coefficient obtained ranged from 0.78 to 0.86 which depict that the instrument was a valid measure of the construct.

Data Analysis Techniques

The data collected were subjected to descriptive and inferential statistical analysis. The mean and standard deviation were employed to answer the research questions while the simple regression analysis was used to test the stated null hypothesis.

RESULTS

The result of the study is presented hypothesis by hypothesis as shown below

Hypothesis one

Students' level of concentration does not significantly predict achievement in Mathematics. The stated hypothesis was tested with simple regression analysis. This statistical analysis was used because the researcher wanted to explore the predictive relationship between concentration and students academic achievement in Mathematics. The result is presented in Table 1

TABLE 1

Results of simple regressions analysis with students concentration and
academic achievement in Mathematics

Variables	X̄	SD	N
Students concentration	15.9618	3.56563	654
Academic achievement in Mathematics	17.4572	2.85491	654

	Groups		Concentration	Academic achievement in Mathematics
Pearson Correlation	Concentration		1.000	.844
	Academic achievement in Mathematics		.844	1.000
Sig. (2-tailed)	Concentration		.	.000
	Academic achievement in Mathematics		.000	.
N	Concentration		654	654
	Academic achievement in Mathematics		654	654

Model summary	R	R Square	Adjusted R Square	Std. Error of the Estimate	
	.844ª	.712	.553	2.38498	

Model		Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
		B	Std. Error	Beta		
(Constant)		-.256	.578		5.443	.000
Concentration		.929	.033	.844	28.417	.000

*p<.05

Table 1 revealed that the descriptive statistics, correlation statistics and model summary for both the predictive and criterion variables. The means and standard deviation for the dependent variable (academic achievement in Mathematics) is 15.9618 and 3.36563 while for the independent variable (concentration) has a means of 17.4572 and standard deviation of 2.85491. A correlation of .844 ($p < .000$) suggests there is a strong positive relationship between concentration and academic achievement in Mathematics. The Model Summary provides the r^2 = .712 suggests that 71% of the variance in students level of concentration score can be explained by the academic achievement in Mathematics scores (p-value .000<.05). This implies that the extent of academic achievement in Mathematics is predicted by the extent of concentration the students put in the subject Mathematics

Hypothesis two

: Time management does no significantly predict students' achievement in Mathematics. The stated hypothesis was tested with simple regression analysis. This statistical analysis was used because the researcher wanted to explore the predictive validity of concentration on students academic achievement in Mathematics which was measured continuous variable (X and Y) as presented in Table 2.

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TABLE 2

Results of simple regressions analysis with time management and
academic achievement in Mathematics

Variables	$\overline{X}$	SD	N
Academic achievement in Mathematics	15.9801	3.53743	654
Time management	17.1870	2.61420	654

	Groups		Academic achievement in Mathematics	Time management
Pearson Correlation		Academic achievement in Mathematics	1.000	.895
		Time management	.895	1.000
Sig. (2-tailed)		Academic achievement in Mathematics	.	.000
		Time management	.000	.
N		Academic achievement in Mathematics	654	654
		Time management	654	654

Model summary	R	R Square	Adjusted R Square	Std. Error of the Estimate	
	.895a	.810	.810	2.36126	

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
	B	Std. Error	Beta		
(Constant)	-.264	.577		-.457	.001
Time management	.931	.033	.745	28.501	.000

*p<.05

Table 2 revealed that the descriptive statistics, correlation statistics and model summary for both the predictive and criterion variables. The means and standard deviation for the dependent variable (Academic achievement in Mathematics) is 15.9801 and 3.53743 while for the independent variable (time management) has a means of 17.1870 and standard deviation of 2.61420. The correlations table which provides a correlation matrix along with probability values for all variables with a correlation of .895 ($p < .000$) suggests there is a strong positive relationship between Time management and Academic achievement in Mathematics. The Model Summary provides the r^2 = .895 suggests that 81% of the variance in time management score can be explained by the Academic achievement in Mathematics scores (p-value .000<.05). This implies that the extent of Academic achievement in Mathematics is strongly predicted by how successful time management by students.

Hypothesis three

There is no significant predictive relationship between persistent practice and students' achievement in Mathematics. The simple regression analysis was employed to test the stated null hypothesis of the study. This is presented in Table 3

TABLE 3

Results of simple regressions analysis with persistent practice and
academic achievement in mathematics

Variables	$\bar{X}$	SD	N
Academic Achievement in Mathematics	15.9801	3.53743	653
Persistent practice	17.4012	2.72426	653

Groups		Academic Achievement in Mathematics	Persistent practice
Pearson Correlation	Academic Achievement in Mathematics	1.000	.712
	Persistent practice	.712	1.000
Sig. (2-tailed)	Academic Achievement in Mathematics	.	.000
	Persistent practice	.000	.
N	Academic Achievement in Mathematics	653	653
	Persistent practice	653	653

Model summary	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.712ª	.507	.506	2.48551

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t-value	p-value
(Constant)	-.110	.629		-.174	.002
Persistent practice	.925	.036	.712	25.878	.000

*p<.05

Table 3 shows the descriptive Statistics, correlation statistics and model summary for both the predictive and criterion variables. The means and standard deviation for the dependent variable (Academic Achievement in Mathematics) is 15.9801 and 3.53743 while for the independent variable (persistent practice) has a means of 17.4012 and standard deviation of 2.72426. A correlation of .712 ($p < .000$) suggests there is a strong positive relationship between persistent practice and Academic Achievement in Mathematics. The Model Summary provides the r^2 = .507 suggests that 51% of the variance in persistent practice score can be explained by the Academic Achievement in Mathematics scores (p-value .000<.05). This implies that the extent of Achievement in Mathematics is strongly predicted by how successful persistent practice of mathematical concepts by students.

CONCLUSION AND DISCUSSIONS

Mathematics is an all round subject that play a role in virtually all the science discipline. The paper puts it clear that the indispensible nature of mathematics makes the subject very unique in all area of knowledge. Most students shy away from mathematics in class without knowing that mathematics is a very simple subject only if one understands the pre-requisite skills needed for its operations. This paper, using the authors' experience in mathematics teaching pinpoints that effective concentration, proper time management

and persistency in the study of mathematics can facilitate mathematical knowledge among students. The paper has demonstrated that action learning of mathematics goes hand in hand with concept attitude and motivation on the part of the learner. The need for students to show good mastery of the subject was also outline in the study. Therefore mathematics should not be seen as a difficult subject means to be studied by students who are exceptionally good academically. Irrespective of one's background, proper application of effective concentration, proper time management and persistency can foster and improve an individual's understanding of mathematics as a subject for all. The study finding was discussed hypothesis by hypothesis as presented below

Hypothesis one showed that students level of concentration has a significant relationship on the achievement in mathematical. Lack of adequate concentration can deprive a student from understanding mathematics as a concept. The finding agrees with Semira, Raheb and Sheida (2013) whose finding revealed that 180 students completed the questionnaires. 59.3% were female. Among the student-related factors, fatigue and sleepiness (mean 3.66±0.66) in class was recognized as the most remarkable factor interfering concentration. Meanwhile, studying teacher-related factors, teacher skills in applied demonstration of learning material (mean 3.47±0.80) was proved to be the main interfering factor. Among environmental factors, lighting and ventilation (mean 3.07±0.87) were the most significant factors. The most students believed that the highest concentration level was obtained in front seats (58.3%) in the morning sessions within 10-12 o'clock (43.8%). Conclusion: Regarding the fact that concentration is an acquisitive mental process, changing some behavioral patterns among students could lead to improvement in their concentration level. This may include planning for enough rest, paying attention to applied presentation of materials and consequently encouraging students, and providing a convenient learning setting such as physical conditions of the classroom.

Again, hypothesis two revealed that time management was found to predict students academic achievement in Mathematics. Time is a very important variable as if wrongly spent cannot be recovered. The finding agrees with Amirali and Halai (2010) whose finding revealed that teachers' poor subject knowledge, lacking in pedagogical competence and students' perception about time management has a significant effect on mathematics achievement in the study area.

Hypothesis three revealed that there is a significant relationship between persistent practices has significantly predicts students academic achievement in Mathematics. This is in agreement with the notion that practice makes perfect. Thus constant practice is a key to perfection. The present result is in harmony with that by Study by Ali (2011) findings revealed that students poor learning Mathematics was as a result of lack of deeper and better concentration and understanding of mathematical concepts. This has led to the overall falling standard of mathematics education in the school. Also, Mahanta and Islam (2012) found that majority of the boys considered mathematics to be a hard subject but they knew that Mathematics is very important to all. It was also revealed that most of the respondent did not consider reading mathematics due to it difficult nature. This means that understanding mathematics requires an individual to be consistent in the study of the subject

IMPLICATION OF THE STUDY ON TEST AND MEASUREMENT

The result of the finding would have strong implications of teachers who and students who are the primary consumer of test as it will enable students to develop good study habits which could lead to good academic achievement in mathematics. It is also expected that the finding would provide parents with detailed information on the improved way of enhancing mathematics performance for enhanced academic achievement of their children/wards and help them to encourage their children to develop a better understanding of Mathematical skills needed for quality education.

Teachers would see the result of the findings useful especially in discharging their duties in the school. This would be achieved through the accurate information that would be provided in the study that will guide them of the salient skill who assigning numerals to student.

This study would enable test experts to initiate programmes that would facilitate effective study of Mathematics in primary and secondary schools Finally, the result of the finding would pose positive implication by encouraging members of the public to motivate their wards to take their education very important and discourage laziness, examination malpractice and other anti-social vices among students in their communities.

RECOMMENDATIONS

From the outstanding finding of the study, the following recommendations were made:

2.   Teachers should provide friendly atmosphere so that every student can effectively concentrate during mathematical classes. In teaching mathematical concept it should start from known to unknown (simple to complex) so that the learner will develop a natural passion for the subject.

2.   Workshops, quiz programs and competitions on time management in relationship with the study of mathematics should be held by different schools on the need to invest and manage time properly.

5.   Teachers might involve students in learning Mathematics with high level of concentration to enhance their confidence in handling mathematical concepts.

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