



Effect of Constructivist and Demonstration Methods on mathematics Performance in Algebra in Senior Secondary School Students in Sokoto metropolis, Nigeria

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Abstract: The research assessed the effect of constructivist and demonstration methods on mathematics performance in Algebra in senior secondary school students in Sokoto metropolis, Nigeria. Quasi-experimental Research design was adopted for this study. The population of this study consist of 83,738 and sample of 164 Students was selected. Three (3) research questions were formulated and answer using descriptive statistics (mean and standard deviation) and three (3) null hypotheses were also formulated and tested using t-test statistics at 0.05 level of significance. Algebraic Performance Test (APT) was used as instrument for data collection, which was validated and reliability index was found to be 0.902 using Pearson Product Moment Correlation (PPMC). Some of the findings study include: students performed significantly better in Algebra when taught using constructivist method, while the demonstration method had least Mean score. It was also revealed that constructivist method is gender pair. It was recommended that Mathematics teacher should use constructivist method in teaching Algebra since it enhances students' performance, Teachers using demonstration method of teaching should be improved so as to meet the gaps between the two methods.

Keywords: H. Pylori, Ulcer, Duodenal and Gastric.

INTRODUCTION

Education at secondary school level is the bedrock and foundation towards higher knowledge in tertiary institutions. Abdulrahman, (2012) stipulated that secondary education is an instrument for national development. It can be used to achieve a more rapid economic, social, political, technological, scientific and cultural development. The importance of mathematics knowledge in understanding engineering and

technical education studies cannot be over emphasized. The way and manner the knowledge of mathematics is passed from teachers to students is an important factor that influences performance in the subject. Mathematics is made a compulsory subject in senior secondary education in Nigeria.

Mathematics is increasingly important, as it provides a means to create, acquire, organize and apply information. Mathematics plays an important role in communicating ideas through making pictorial, graphical, symbolic, descriptive and analytical representations of numerical and mathematical ideas, and hence lays a strong foundation for students' lifelong learning. Mathematical experiences acquired in schools enable students to become mathematically literate citizens and contribute towards social prosperity (Ojimba, 2012).

Equally, in Nigeria, Mathematics is a core subject in the new senior secondary curriculum and is a continuation of the junior secondary mathematics curriculum. It aims to furnish students with the necessary mathematical knowledge and skills to live successfully in society. Mathematics is also a subject that cuts across primary and secondary school as a compulsory subject.

Constructivist learning is an approach that can enable all the learners to construct valid knowledge and also enable them to transmit it in different context. Learning in the constructivist framework contributes to intellectual, social and psychological development of learners unlike other method of instruction. Constructivist pedagogy in mathematics believes that learners can construct knowledge by active participation rather than acquiring knowledge by watching teacher's demonstration in the classroom and, to learn to speak and act mathematically participating in mathematical discussion and solving new or unfamiliar problems (Richards, 2006).

There are many causes of poor performance in mathematics among students. Lack of well trained teachers, inadequate of teaching facilities, lack of fund to purchase necessary equipment and other factors all hamper the smooth acquisition of mathematics knowledge. The advantage of constructivist in mathematics is that it allows students to develop critical thinking skills. Undue emphasis on the coverage of mathematics syllabus at the expense of meaningful learning of mathematics concepts and inadequate facilities and mathematics laboratories. Mbugua, Kibet, Muthaa and Nkonke, (2012) were of the view that mathematics performance of students can be improved by provision of proper staffing, teaching materials, curriculum, motivation. Constructivist instruction builds on the student's existing knowledge base, extends the individual's repertoire of cognitive and meta-cognitive strategies, and corrects specific learning problems (Gales & Yan, 2008). Much of the current research dedicated to the development of teaching techniques and learning strategies suggest employment of constructivist or discovery learning approaches to promote meaningful learning and student success.

Constructivism is viewed as a meaning-making theory that offers an explanation of the nature of knowledge and how human beings learn. Knowledge, as viewed here, is acquired through an involvement with content rather than imitation or repetition. According to this explanation of learning, "individuals create or construct their own new understandings or knowledge through the interaction of what they already know and believe and the ideas, events, and activities with which they come in contact (Boudourides, 2003). Moreover, a constructivist view of learning holds that the student, in trying to make sense of new events or objects, begins from relevant existing ideas, and tests the extent to which the new phenomena can be explained using these existing ideas. If a prediction based on a related existing idea fits the new observations, then the range of applications of the idea or model is extended; if the evidence does not fit the prediction, however, this may mean that the idea or model has to be modified or rejected in the light of the new evidence. To acquire meaningful learning, the students therefore

require a deliberate effort to relate new knowledge to relevant concepts they already possess. Based on the learning perspectives as described above, one of the instructional approaches, concept mapping, could offer a means for course design, which promotes the development of a structured course within a good pedagogical framework (Christensen, 2003). By means of concept maps, students would foster meaningful learning. Constructivism is recognized as a unique learning theory in itself.

Constructivism suggests that students learn concepts or construct meaning about ideas through their interaction with others, with their world, and through interpretations of that world by actively constructing meaning. Students relate new knowledge to their previous knowledge and experience. A constructivist model of teaching has five characteristic features: (a) active engagement, (b) use and application of knowledge, (c) multiple representations, (d) use of learning communities, and (e) authentic tasks (Siemens, 2005). According to this approach, the mathematics role of a teacher is to tutor students and educate them how to learn mathematics. He or she is a mentor, facilitator, helper, and mediator for learning, not just a "purveyor of knowledge" or "supplier of facts." The teacher must provide a learning environment that allows students to generate their own knowledge by experiencing and interacting with the environment (Hill, 2002).

Peter, Abiodun & Jonathan (2010) investigated the effect of instructional approach based on constructivism teaching on mechanical trade students in Western Nigeria technical colleges. Elements of constructivism assessed include concept mapping, cooperative work skills and cognitive apprenticeship. Pretest-posttest control group design was adopted for the study. A total of 106 students in mechanical related trades of two years were randomly selected from four technical colleges spread across the south western Nigeria States. 46 students were placed in the experimental group while 60 students were placed in the control group. Results showed a significant difference between the students taught through constructivism teaching approach than those in the control group. Experimental group outperformed control group in concept mapping, cooperative work skills and cognitive apprenticeship. Significant difference did not exist between male and female students exposed to the constructivist approach. Constructivism instructional approach was recommended by the researcher.

Paul & Dantani (2012) carried out a study to determine the effect of lecture and demonstration methods on academic achievement of students in Chemistry in the Nassarawa Local Government Area of Kano State. Fifty-eight (58) Chemistry students (boys and girls) in the Senior Secondary School One (SS1) from two randomly selected schools were involved in the study. Necessary data were collected and the validated reliable data were analysed using t-test at a significant level of 0.05. Results obtained revealed that students perform better in Chemistry when taught using the demonstration method as compared to the lecture method. The boys and girls are better in academic achievement when taught using demonstration method than when lecture method was used. The demonstration method shows equality in the performance of boys and girls. Hence the adoption of demonstration methods in the teaching and learning of Chemistry and science in general is hereby recommended.

Nayak (2011) conducted a study to examine the effectiveness of constructivist approach on learning process, achievement in mathematics and mathematical creativity. Primary school children of fifth class were taken as sample of the study in three different urban schools of Odishain India. Pretest-posttest control group quasi-experimental research design was used. Significant difference was found between experimental and control group on learning process, achievement in mathematics and mathematical creativity. Experimental group outperformed control group. Results revealed that

constructivist approach is better than traditional approach to improve learning process, achievement in mathematics and mathematical creativity of primary school students.

Statement of the Problem

Students' performance in Mathematics at all levels of education is not encouraging. Poor academic performance in mathematics and knowledge of mathematics concepts is due to a number of factors, Most of the secondary school mathematics teachers still use the traditional method of teaching the subject, the reason for this situation is because majority of teachers were taught in their school's days by teachers who mainly used the traditional method of teaching and so the teachers of today only copy the way they were taught (Azuka 2013). Conventional or traditional method of teaching are not sufficient in mathematics teaching. Algebraic fraction is one of the important Mathematical concepts that is very vital for student's Mathematical development. Despite all of it relevancy it was found that Secondary School students find it very difficult. This difficulty was attributed to the teacher use of traditional method in teaching the topic that is why most students graduate with memorize information as they are not given chance of problem solving. This study therefore committed to provide empirical data on what will be the effectiveness of Constructivist and Demonstration method on Mathematics performance and retention of senior secondary school two (SS2) students in Sokoto state.

Objectives of the Study.

The objectives of the study are to find out: -

1. Difference in mean performance of Senior Secondary Schools Students taught Algebra using Constructivist and those taught Algebraic fraction using Demonstration method.
2. Difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using Constructivist method.
3. Difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using Demonstration method.

Research Questions.

Based on the above objectives, the following research questions are formulated to guide the study:

1. Is there any difference in mean performance of Senior Secondary Schools Students taught Algebraic fraction using Constructivist and those taught Algebra using Demonstration method?
2. Is there any difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using Constructivist method?
3. Is there any difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using Demonstration method?

Hypotheses.

The following null hypotheses are to guide this study: -

H₀₁. There is no significant difference in mean performance of Senior Secondary Schools Students taught Algebra using constructivist method and those taught Algebra using Demonstration method.

H₀₂. There is no significant difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using Constructivist method

H₀₃. There is no significant difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using Demonstration method.

Method

A quasi experimental design was considered to be the appropriate research design for this study. Pre-test, Post-test. Experimental and control group was used, the experimental group was subjected to the treatment (Teaching Algebra using constructivist approach) while the control group was subjected to the Teaching Algebra using Demonstration method.

Population

The target population of this study comprises all the Senior Secondary School Two (SS2) students in Sokoto State. There are 119 public senior secondary schools with total of **83,738** students from which **56,752** are male and **26,986** are female distributed among 6 Educational Zones. Purposive Sampling technique was used to select two (2) senior secondary schools in Sokoto metropolis, intact classes were selected using convenience sampling. The sample size for the study was 164 students consisting of both male and female students.

Table 1: Sample of Students

S/N	Name of Schools	Group	SS2 Males	SS2 Females	Total
1	G. D. S. S. Arkilla	Experimental	42	37	79
2	G. D. S. S. Minannata	Control	47	38	85
Total			89	75	164

Instrument

The research instrument that were used for this study is Algebraic Performance Test (APT), researcher consist of five items and each was scored 20marks for each correct answer. The lowest possible score is 0 and the highest possible score is 100. The test consists of 5 theory questions on algebraic fraction for the students to be answered all, which was based on the topics covered.

Validity of the Instrument

Validity simply implies a degree or extent to which a test measure what it is expected to measure. For this purpose, the Algebraic Performance Test (APT) was subjected to face validation, the instrument was given to experts, colleagues, lecturers, who are specialist in the field in the Department of Science and Vocational Education, Usmanu Danfodiyo University Sokoto and other teacher from Mathematics Department Usmanu Danfodiyo University Model Secondary School Sokoto, Nigeria for validation. So as to determine how effective it is measuring students' performance and retention. All the comment and suggestion made by the experts were used in modifying the items.

Reliability of the Instrument

The instrument was pilot-tested at Senior Secondary School namely: Shehu Shagari College of Education Staff School. Twenty (20) SS2 students was pilot tested, which were not part of the sample but part of the population of the study. The Mathematics performance test was administered twice to the students using test-retest method with two weeks' interval as

recommended by Tuckman (1975). Data obtained after the test was analyzed using Pearson Product Moment Correlation Co-efficient (PPMCC), which was found to be 0.902 which is reliable.

Data Analysis and Result

This section presents analysis of all the research questions raised in the study and for clear understanding the analysis was done taking the research questions one by one.

Research Question 1: Is there any difference in mean performance of Senior Secondary Schools Students taught Algebra using constructivist and those taught using demonstration method?

Table 2. Mean Difference of Performance of Students Taught Algebra Using Constructivist and Demonstration Methods.

Method	N	Mean	Standard Deviation	Mean difference
Constructivist (EG)	79	84.8	16.1	19.39
Demonstration (CO)	85	65.4	25.2	

Table 2 Results show students taught Algebra using constructivist method performed better than those taught Algebra using demonstration method. There is a mean difference of 19.39 in favour of experimental group over the control group. Results were subjected to hypothesis testing using t-test analysis and are presented here as an empirical study.

Researcher Question 2: Is there any difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using constructivist method?

Table 3. Mean Difference of Algebra Performance Between Male and Female Students Taught Constructivist Method.

Gender	N	Mean	Standard Deviation	Mean Difference
Male (EG)	42	69.6	18.2	17.7
Female (EG)	37	51.9	21.2	

From Table 3 showed the mean performance between male and female Senior Secondary Schools Students taught Algebra using constructivist method, which indicates that mean performance of male students was found to be (69.6), and also mean performance of female students was (51.9). Therefore, there is a mean difference of 17.7 in favour of male experimental students taught Algebraic using constructivist methods

Researcher Question 3: is there any difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using demonstration method?

Table 4 Mean Difference of Algebra Performance Between Male and Female Students Taught Using Demonstration Method.

Method	N	Mean	Standard Deviation	Mean Difference
Demonstration male (CG)	47	37.4	19.4	-12.29
Demonstration female (CG)	38	49.7	17.7	

Table 4 showed difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using demonstration method. The result showed that the mean performance of

male students was 37.4 while the mean performance of the female students was 49.7 and the difference between the samples was -12.29.

Testing the Null Hypotheses

This part presents inferential statistical analysis of all the null hypotheses formulated to guide the study. The null hypotheses were tested one after another at 0.05 level of significance

Null Hypotheses 1 (H_{01}): There is no significant difference in mean performance of Senior Secondary Schools Students taught Algebra using constructivist method and those taught Algebra using demonstration method.

Table 5. Analyses of Mean Performance of Students Taught Algebra Using Constructivist and Demonstration Methods.

Method	N	Mean	SD	DF	T-value	P- value	Decision
Constructivist (EG)	78	84.8	16.1	161	8.71	0.000	Rejected
Demonstration (CO)	85	65.4	25.2				

α - value= 0.05

Table 5 showed that, p-value of 0.000 was less than the α - value of 0.05 ($p < \alpha$) hence the null hypothesis which says (There is no significant difference in mean performance of Senior Secondary Schools Students taught Algebra using constructivist method and those taught Algebra using demonstration method) was rejected this is because the p-value is less than the α - value.

Null Hypotheses 2 (H_{02}): There is no significant difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using constructivist method.

Table 6. Difference in Mean Performance between Male and Female Students Taught Using Constructivist Method

Gender	N	Mean	SD	DF	T-value	P- value	Decision
Experimental male	42	69.6	18.2	77	6.43	0.000	Rejected
Experimental female	37	51.9	21.2				

α - value= 0.05

Table 6 showed that, p-value of 0.000 was less than the α - value of 0.05 ($P < \alpha$) hence the null hypothesis which says (there is no significant difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using constructivist method) was rejected.

Null Hypotheses 3 (H_{03}): There is no significant difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using demonstration method.

Table 7 Difference in Mean Performance between Male and Female Students Taught Using Demonstration Method.

Gender	N	Mean	SD	DF	T-value	P- value	Decision
Control male	47	37.4	19.4	83	-2.79	0.006	Rejected
Control female	38	49.7	17.7				

α - value= 0.05

Table 7 showed that, there was no significant difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using demonstration method. This indicate that p-value of 0.006 was less than the α - value of 0.05 ($P < \alpha$) hence the null hypothesis which says there is no

significant difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using demonstration method was rejected.

Discussion

The result of this study indicated that there was significant difference in mean performance of Senior Secondary Schools Students taught Algebra using constructivist method and those taught using demonstration methods. The result revealed that Students taught Algebra using constructivist method perform better than those Algebra using demonstration method. This finding is in line with the finding Nayak (2011) who conducted a study to examine the effectiveness of constructivist approach on learning process, achievement in mathematics and mathematical creativity. Primary school children of fifth class were taken as sample of the study in three different urban schools of Odishain India. Pretest-posttest control group quasi-experimental research design was used. Significant difference was found between experimental and control group on learning process, achievement in mathematics and mathematical creativity. Experimental group outperformed control group. Results revealed that constructivist approach is better than traditional approach to improve learning process, achievement in mathematics and mathematical creativity of primary school students.

There was significant difference between male and female students taught Algebra using constructivist method. This study disagreed with the findings of Peter, Abiodun & Jonathan (2010) who investigated the effect of instructional approach based on constructivism teaching on mechanical trade students in Western Nigeria technical colleges. Elements of constructivism assessed include concept mapping, cooperative work skills and cognitive apprenticeship. The result shows that significant difference did not exist between male and female students exposed to the constructivist approach.

From the findings of this study it was discovered that, there was significant difference in mean performance between male and female Senior Secondary Schools Students taught Algebra using demonstration method. The study showed that, the female Senior Secondary Schools Students taught Algebra using demonstration method perform better than the male Students. It further agreed with the findings of Paul & Dantani (2012), who carried out a study to determine the effect of lecture and demonstration methods on academic achievement of students in Chemistry in the Nassarawa Local Government Area of Kano State. Results obtained revealed that students perform better in Chemistry when taught using the demonstration method as compared to the lecture method. The boys and girls are better in academic achievement when taught using demonstration method than when lecture method. The demonstration method shows equality in the performance of boys and girls

Conclusion

Constructivist in this study depends on approach of instruction. The students exposed to constructivist method had a superior understanding ability than those exposed to the demonstration method of teaching Mathematics. In general, constructivist method have proved to be effective in promoting meaningful learning and students' academic performance in Mathematics.

Recommendations

1. Mathematics teacher should use constructivist method in teaching senior secondary school mathematics since it enhances students' mathematics performance.
2. Teachers using demonstration method of teaching should be improved so as to meet the gaps between the two (constructivist and demonstration) methods
3. The school authority should allocate more time and tutorials to students and also provide all materials necessary for construction in mathematics.

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