International Journal of Research Publication and Reviews

Effect of Portfolio Assessment on Students' Achievement in Senior Secondary Mathematics in Makurdi Local Government Area of Benue State, Nigeria

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ABSTRACT

The study set out to determine the effect of portfolio assessment method on student's achievement in senior secondary Mathematics in Makurdi Local Government Area of Benue State, Nigeria. The study was guided by two specific objectives, two research questions were raised and answered and four hypotheses were formulated and tested at 0.05 level of significance. The study was delimited to portfolio assessment method and achievement. The study was hinged on Jean Piaget constructivism theory. The study adopted the pre-test post-test non-randomized control group quasi experimental design. The area of the study was Makurdi Local Government Area of Benue State, Nigeria. The population of the study was made up of 1312 Senior Secondary two (SS2) students in the 21 public secondary schools in Makurdi Local Government Area of Benue State Nigeria. The sample for the study consisted of 153 students and was drawn using four intact classes of students. The instruments used for data collection was a Mathematics Achievement Test (MAT). The Mathematics Achievement Test (MAT) yielded a reliability coefficient of 0.80 Data collected were analyzed using descriptive statistic of mean and standard deviation and inferential statistic of ANCOVA. The result of the findings revealed there was a statistical significant difference in the mean achievement score of student's assessed in Mathematics using portfolio assessment method and those assessed using the conventional assessment method. The study also revealed that there is no statistical significant difference in the mean achievement score of male and female students assessed in Mathematics using portfolio assessment method. This implies that, male and female students assessed using portfolio assessment method have similar achievement score in Mathematics.

Introduction

Education is the process of socialization by which men and women learn to adapt to, and where necessary, conquer their environment. It is the process of developing the cognitive, affective and psychomotor domains of people in order to equip them with the knowledge and skills necessary to survive and make progress in the society (Olaniyi and Adams in Adewuyi and Okemakinde, 2013). Education is the bedrock for national development as well as a catalyst for sustainable livelihood. It is a process whereby skills, knowledge, attitude and virtues are inculcated in individuals. According to Offorma (2016) the main purpose of education is to develop the individual so that he can be useful to himself, his family and the society in general. The primary objectives of education is to nurture and promote to the fullest individual self-realization for all people as it is the best legacy a nation can give to her citizen especially the youths who are the future hope of any nation that wants to advance in Science and Technology. The role of education can be seen to provide students with skills that will prepare them mentally, socially and physically to make progress in the society and the world at large therefore, it is pertinent to make use of an assessment method that this congruent with instruction.

Assessment as an integral part of learning process as defined by Adikwu, Aduloju and Agi (2016) is the process of gathering information for the purpose of decision making, it involves the collection of information about individual's knowledge, skills, attitudes, judgment, interpretation and using the data for taking relevant decisions about individuals, instructional process, curriculum or programme. Also, Emaikwu (2015) defined assessment as data-gathering strategies, analysis and reporting processes that provides information that can be used to determine whether or not intended outcome are being achieved. Assessment may be defined as any method used to better understand the current knowledge that a student possesses. Assessment may affect decisions about grades, advancement, placement, instructional needs, and curriculum. Assessment can therefore be considered as the measurement of the degree of behavioral changes that have taken place in a learner. The different types of assessment include; formative, summative, norm-referenced, diagnostic, criterion-referenced, conventional assessment and portfolio assessment Emaikwu (2015). The focus of this study is portfolio assessment.

Portfolio assessment is the purposeful collection of students' work that provides evidence of growth and achievement over time Farr and Tone in Charanjit, Sulaiman & Arshad (2015). Portfolio assessment demands that students continuously collect and reflect on their work. In other words, it places students at the centre of the assessment process. Through self-assessment, self-reflection, group discussion, individual presentation and collaboration with the teacher, portfolio assessment may serve as a vehicle for continued growth in the learning process. Portfolio assessment is defined as a purposeful collection of any aspect of the student's work which is kept in a file, folder, box or any durable and expandable container that tells about the students' improvement, progress and achievement trend (Ozdemir, 2012). According to Moya and O'Malley in Parinaz and Behdokht (2015) a portfolio is a collection of a student's work, experiences, exhibitions, self-ratings (data), while portfolio assessment is the procedure used to plan, collect, and analyze the multiple sources of data existing in the portfolio. The main goals of portfolio assessment are encouraging learners to become more autonomous, take control of their learning, make decisions, participate in the evaluation of their own work and solve problems individually through the use of portfolio assessment and this may encourage students' interest and achievement in senior secondary Mathematics.

Charanjit and Samad (2013) found out that students do not just put materials into the portfolios; instead they have to reflect upon the material, what they have learned from the worksheets and the reasons for compiling the materials into the portfolios. Students take ownership of their learning as they are involved in making choices of what goes into their portfolios. When students are aware that they are evaluating their own strengths and weakness, it also encourages them to take responsibility for their own learning and enhance student-teacher interaction in the teaching and learning process as a result, portfolio assessment provides opportunities to improve self-esteem by allowing students to value their own work as a learner. Portfolio assessment according to Fernstern (2005) emphasizes the following: clarity of goals, explicit criteria for evaluation, work samples tied to those goals, students' involvement in the collection of entries, students' and teachers involvement in the assessment process and self-reflection that displays students meta-cognitive ability that is, their understanding of what functioned for them in the learning process these elements further enhance the learning experience and the self-understanding of the students as a learner.

Moya and O'Malley (1994) developed the portfolio assessment model (PAM) where it consists of six interrelated levels of assessment task or activities such as the following:

Step 1:	Identify the purpose and focus of the portfolio procedure

Step 2: Plan portfolio contents

Step 3: Design portfolio analysis

Step 4: Prepare for instruction

Step 5: Plan verification of procedures

Step 6: Implement the model

The model proposed by Moya and O' Malley (1994) is more feasible as it requires teachers to identify the purpose and focus of the portfolio procedure. Teachers can identify and match the purpose and focus of the portfolio based on learning outcomes. What is missing from this model is the emphasis on learning outcomes which is important to ensure that the assessment tasks are appropriately constructed or selected. As for the second step which is to plan portfolio contents, the model should consider students voice in terms of material compilation for the portfolio. By doing so, teachers allow students autonomy to take place and understand their needs in terms of areas of strengths and weakness in learning.

Students are actively involved in their own assessment and such assessment strengthens the students' ability to reason and analyze, synthesize and apply knowledge acquired; Students' higher level of cognitive skills (from knowledge and comprehension to analysis, synthesis, application, and evaluation) are tapped in multiple ways. Unlike the conventional assessment which is teacher centered that requires students to demonstrate knowledge by selecting response or giving correct answers usually, it tests students' proficiency through paper and pencil as students are asked to choose an answer from a set of questions such as multiple-choice test, objective test, true or false test and matching test to assess student knowledge of what has been taught. Using this kind of assessment, students remain passive in the classroom during teaching and assessment processes unlike in portfolio assessment where students are active and are involved in the teaching and assessment processes.

Assessment at times may be separated from teaching and learning in conventional assessment of the students, as it usually comes after instruction to evaluate if the students have successfully learned the content taught in the classroom such assessment strengthens the students' ability to recall, recognize and comprehend content but, does not reveal the students' true progress of what they can do with the knowledge they acquired, only the students' lower level of thinking skills, (knowledge and comprehension), are tapped and these may lead to students not performing well (Charanjit, Sulaiman & Arshad 2015). Since portfolio assessment creates room for students to engage in practical situation with a view to solving problems this may leads to improvement in all subjects which Mathematics is inclusive.

Mathematics is the science of quantity, size, shape, signs and numerals. It is also the study of numbers, the relationship between these numbers and various operations performed on them. It deals with logical reasoning and quantitative calculation and its development has involved an increasing degree of idealization and abstraction of its subject matter. Since the 17th century, Mathematics has been an indispensable and immeasurably used in Science and Technology and in more recent times it has assumed a similar role in the quantitative aspect of the life sciences. Bajah in Chibabi (2019) maintains that no nation can make any meaningful progress in this information technology age, particularly in economic development without good foundation in Science and Mathematics. Every individual needs some measure of Mathematics for his or her day to day activities. Usefulness of Mathematics in human activities cannot be underestimated because it is the precursor of scientific discoveries and inventions of which any nation that overlooks the study of

Mathematics and does not take interest in it would remain underdeveloped. Stressing the usefulness of Mathematics, Pollak (2006) believed that the most fundamental reason why we place so much emphasis on Mathematics is that it is an integral part of life.

Academic achievement is the outcome of education; the extent to which a student, teacher and institution have achieved their educational goals. Kpolovie, Andy and Okoto (2014) states that, academic achievement of students is the ability of students to study and remember facts and being able to communicate their knowledge in oral or in written form even in an examination condition and transforms the knowledge into practice. Students' academic achievement may differ due to their cognitive abilities in the study of Mathematics in relation to gender

Gender refers to the state of being male or female in relation to the social and cultural roles that are considered appropriate for men and women. Kanno (2008) referred to gender as an analytic concept that describes sociological roles, cultural responsibilities and expectations of men and women in a given society or cultural setting. Ezeh (2013) explains that gender describes the personality traits, attitudes, behaviour, values, relative power, influence, roles and expectation (femininity and masculinity) that society ascribes to the two sexes on a differential basis. Therefore, gender is a psychological term and a cultural construct developed by society to differentiate between the roles, behaviour, mental and emotional attributes of males and females. The influence of gender on students' achievement in Mathematics has remained a controversial and topical issue amongst educationists and psychologists. Freud (2011) suggested that the difference in Mathematics achievement of male and female anatomy has bearing and indeed account for the difference observed between the personalities of men and women. There have been gender differences in the achievement of students in some forms of examinations, test or assessment.

In recent times, gender related issues in Mathematics have continued to receive serious attention judging by the quanta of studies done to that effect. Nwosu (2001) found that students' acquisition of science process skills are not gender specific. In addition to this, in a study carried out by Ogunleye (2002) reveals that science achievement depends on gender. But in a study by Babajide (2010) asserted that core subjects like Mathematics is given a masculine outlook by educational practitioners. Boys due to their more social nature have gained advantage over girls in classroom activities like in the learning of Mathematics. Bryden (2009) note that brain lateralization have been used to explain the cognitive difference that lead to differences which are in favour of boys' achievement in Mathematics as opposed to girls on the effect of portfolio assessment on students interest and achievement in senior secondary Mathematics. Similarly, learners have their unique learning styles referred to as four-mat system. Each type of learners is characterized by certain attributes that lead to compatibility or incompatibility between their preferred thinking which is likely to affect understanding and achievement in Mathematics (Sevinc, 2012).

Type one (innovative) learners: this type of learner enjoys creative and innovative approaches to learning they perceive information concretely and process it reflectively. They prefer talking about their experiences and feelings, asking questions and working in groups. They like to have learning connected to real life problems and ask questions 'why?' They prefer to have reasons for learning. Ideally reasons that connect new information with personal experiences and establish that such information is useful in everyday life. Type two (analytic) learners: this type of learners is knowledge oriented, conceptual and organized. These learners perceive information abstractly and process it reflectively. These logical, abstract thinkers want to work with facts, ideas and details. They prefer to learn by thinking through ideas they ask the question "what" they are interested in acquiring fact in order to deepen their understanding of concepts and processes, they prefer to listen to and think about information, seek facts and think through. Type three (common sense) learners: these learners like active problem solving, learning through discovery, touching, manipulating, constructing and spatial tasks. They perceive information abstractly and process it actively. They like hands on experience when learning something new and really want to use what they learn to apply to new situations they ask the question "how" they are interested on how things work, they want to get it and try it. Type four (dynamic) learners: These learners prefer to learn through self discovery and working independently. They enjoy open-ended tasks that involve risk taking, they perceive information concretely and process it actively, and they want action such as see, hear, touch and feel they ask questions "if" they are interested in self-discovery as the prefer to seek hidden possibilities, explore and learn by trial and error.

These categories of learners when assessed using portfolio assessment method, it may enhance their achievement in Mathematics. Therefore; teachers should adopt assessment method that is congruent with instruction. Further, despite the literatures on portfolio assessment, there abounds limited empirical evidence of studies carried out in Makurdi Local Government Area of Benue State and empirical studies on the effect of portfolio assessment on students' achievement in senior secondary Mathematics.

Portfolio assessment is the collection of students' work which provides evidence of growth and achievement over time. It demands that students continuously collect and reflect on their work, as it places students at the center of the teaching and assessment processes. Through self-assessment, self-reflection, group discussion, individual presentation and collaboration with the teacher it may serves as a vehicle for continued growth in the learning and assessment process. If this is done, it will help in encouraging learners to be autonomous to take control of their learning and solve problems independently, also students will see all the positive growth that is taking place during the learning process thus, enhancing his or her esteem and nurturing further growth, it also presents a practical approach to assembling student's works interpreting evidence of student's achievement and assessing student's achievement relative to instructional objectives.

However, over the years the researcher have observed that, students' records which shows their growth, achievement and progress are not been kept nor readily available for students to reflect upon so as to know their area of strength and weakness in terms of growth, achievement and progress over the course of instruction and this may have been responsible for students poor interest and achievement in Mathematics. This poor performance is evident in the statistics by the West African Examination Council (WAEC) Chief Examiners reports which shows that 32.6% students passed Mathematics during the 2016 Examination, 28.9% in 2017, 40.52% in 2018, 38.15% in 2019 (West African Examination Council Chief Examiners Report: 2016, 2017, 2018, 2019, 2020, 2021 and 2022).

If the right teaching, assessment and proper students record keeping is adopted this may significantly improve students' interest and achievement in Mathematics. From the foregoing analysis, could this poor interest and achievement of students in senior secondary Mathematics in Makurdi Local Government Area of Benue State Nigeria be attributed to lack of record keeping of students' assessment? This is the problem of the study. It is on this basis that this study is necessitated to investigate the effect of Portfolio assessment on students' interest and achievement in Senior Secondary Mathematics in Makurdi Local Government Area of Benue State, Nigeria.

To achieve the aim of this study, two research questions and two hypotheses were formulated

1. What is the mean achievement score of students assessed in Mathematics using Portfolio assessment method and those assessed using conventional assessment method?

2. What is the mean achievement score of male and female students assessed in Mathematics using Portfolio assessment method?

1. There is no significant difference in the mean achievement score of students assessed in Mathematics using Portfolio assessment method and those assessed using conventional assessment method.

2. There is no significant difference in the mean achievement score of male and female students assessed in Mathematics using Portfolio assessment method.

Method

The research design adopted by this study was the quasi-experimental research design specifically; the design was the pre-test post-test non-randomized control group design. The study examined the effect of portfolio assessment on students' interest and achievement in Senior Secondary Mathematics in Makurdi Local Government Area of Benue State. The population of the study was 1312 with a sample size of 153 intact classes of (SS2) students. The simple random sampling was used to select four (4) selected secondary schools in the Local Government Area and the names of all the four schools were written on pieces of paper, rolled and put in a basket. The basket was shaked and the required numbers of schools was picked one after another. Two schools were selected in one out of the selected two schools, one arm of two intact classes was assigned to experimental and control group while in the second school, one arm of two intact classes was assigned to experimental and control group. The instrument titled "Mathematics Achievement Test" (MAT) for data collection was a 50-item questionnaire on Mathematics adapted from West African Examination Council (WAEC) and National Examination Council (NECO). The instrument was trial-tested on 30 (SS2) students outside the study area. A reliability coefficient of 0.80 was obtained via a KR_{21} method. The data obtained were analyzed using descriptive statistic of mean and standard deviation and hypotheses formulated were tested using inferential statistic of Analysis of Covariance (ANCOVA). The two hypotheses were tested at 0.05 alpha level of significance.

Results

Research Question 1: What is the mean achievement score of students assessed in Mathematics using Portfolio assessment method and those assessed using conventional assessment method?

Table 1: Mean Achievement Score and Standard Deviation of Students Assessed in Mathematics Using Portfolio Assessment Method and those Assessed using Conventional Assessment Method.

Groups	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Experimental	79	54.52	6.082	61.71	6.863
Control	74	36.58	6.573	40.01	6.247
Mean Diff.		17.94		21.70	
N Total	**153**				

The result of data presented in Table 1 shows the mean achievement score and standard deviation of students assessed in Mathematics using portfolio assessment method and those assessed using conventional assessment method. It can be observed that students in experimental group had mean score of 54.52 and 61.71 in pre-test and post-test respectively and standard deviation of 6.082 and 6.863 in MAT. Also, students in control group had mean score of 36.58 and 40.01 in pre-test and post-test respectively and standard deviation of 6.573 and 6.247 in MAT. It can also be observed that the mean difference of experimental group (21.70) is greater than the mean difference of the control group (17.94). It implies therefore, that students assessed in Mathematics using portfolio assessment method performed better than those assessed using conventional assessment method.

Hypothesis One

There is no significant difference in the mean achievement score of students assessed in Mathematics using portfolio assessment method and those assessed using conventional assessment method.

Table 2: Analysis of Covariance of the Significant Difference in the Mean Achievement Score of Students Assessed in Mathematics Using Portfolio Assessment Method and those Assessed Using Conventional Assessment Method.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	21144.090ᵃ	2	10572.045	471.434	.000	.863
Intercept	916.939	1	916.939	40.889	.000	.214
Pretest	3159.498	1	3159.498	140.890	.000	.484
Group	**957.405**	**1**	**957.405**	**42.693**	**.000**	**.222**
Error	3363.792	150	22.425			
Total	425834.000	153				
Corrected Total	24507.882	152				

The result of the Analysis of Covariance presented in Table 2 shows that the P-value of 0.000 is less than 0.05 level of significant at 1 degree of freedom. This shows that the test is significant. The result implies that there is a statistical significant difference in the mean achievement score of students' assessed in Mathematics using Portfolio assessment method and those assessed using conventional assessment method. Therefore, the null hypothesis of no significant difference is rejected.

Research Question 2: What is the mean achievement score of male and female student's assessed in Mathematics using portfolio assessment method?

Table 3: Mean Achievement Score and Standard Deviation of Male and Female Students Assessed in Mathematics Using Portfolio Assessment Method

Groups	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Male	47	54.81	5.675	61.36	6.693
Female	32	54.09	6.708	62.22	7.183
Mean Diff.		0.72		0.86	
N Total	**79**				

The result of data presented in Table 3 shows the mean achievement scores and standard deviation ratings of male and female students assessed in Mathematics using portfolio assessment method. It can be observed that male students assessed in Mathematics using portfolio assessment in the experimental group have a mean score of 54.81 and 61.36 in pre-test and post-test MAT respectively and a standard deviation of 5.675 and 6.693. While the female have 54.09 and 62.22 in pre-test and post-test MAT respectively and standard deviation of 6.708 and 7.183. It implies therefore, that both the male and female students in experimental group improved in their performance at seemingly similar rate having been assessed in Mathematics using portfolio assessment method.

Hypothesis Two

There is no significant difference in the mean achievement score of male and female student's assessed using portfolio assessment method.

Table 4: Analysis of Covariance of Significant Difference in the Mean Achievement Score of Male and Female Students Assessed in Mathematics Using Portfolio Assessment Method.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1025.484ᵃ	2	512.742	14.712	.000	.279

Intercept	833.427	1	833.427	23.913	.000	.239
PreTest	1011.500	1	1011.500	29.022	.000	.276
Group	**31.132**	**1**	**31.132**	**.893**	**.348**	**.012**
Error	2648.820	76	34.853			
Total	304505.000	79				
Corrected Total	3674.304	78				

The result of the Analysis of Covariance presented in Table 4 shows that the P-value of 0.348 is greater than 0.05 level of significant at 1 degree of freedom. This shows that the test is not significant. The result implies that there is no statistical significant difference in the mean achievement score of Male and Female students assessed in Mathematics using Portfolio assessment method**.** Therefore, the null hypothesis of no significant difference is not rejected.

Discussion

The findings of the study based on research question one and research hypothesis one revealed that there is a statistical significant difference in the mean achievement score of students assessed in Mathematics using portfolio assessment method and those assessed using conventional assessment method. This implies that, students assessed in Mathematics using portfolio assessment method had a better achievement score than those assessed using conventional assessment method. The finding agrees with that of Ozdemir (2012) who found that students who were taught with portfolio-enriched instruction achieve high in Mathematics than those students who were taught with conventional instruction. The study also reveals that, students who were measured or taught with portfolio assessment method could succeed better in Mathematics since they would make connections between their failures and success. The study further found that using portfolio will foster learning and empowers student's growth. The finding of this study maybe due to the fact that when students were assessed using portfolio assessment method are actively involved in the teaching and learning process as portfolio assessment gives students more autonomy of their work thereby making them more assertive and independent thinkers. The finding of this study also supports earlier finding by Komarudin (2017) who found that portfolio assessment is more effective than traditional assessment to enhance student's academic achievement.

The findings of the study based on research question two and research hypothesis two revealed that there is no statistical significant difference in the mean achievement score of male and female students assessed in Mathematics using portfolio assessment method. This implies that efficient use of portfolio assessment method in assessing students in Mathematics had no gender bias on the mean achievement score on gender as every student's were giving equal opportunities during teaching and learning process. This finding agrees with that of Ugodulunwa and Wakjissa (2015) who found that no significant difference exist between the post-test performances mean scores of male and female students in map sketching and location when taught using portfolio assessment techniques. The finding of the study also support earlier finding by Tanimu (2016) who found that gender have no significant effect on students Mathematics achievement and motivation.

Conclusion

Based on the findings of this study, it is therefore concluded that portfolio assessment improves students' academic achievement in Mathematics and also serves as a feedback mechanism between the teacher and the students

Recommendations

1. Teachers should adopt the use of portfolio assessment method in teaching Mathematics as it has shown in the findings of this study that portfolio assessment improves students' interest and achievement in Mathematics.

2. In the teaching and learning of Mathematics, students should be encouraged to take ownership of their own learning and engage in active reflection of the learning process as this improve student's achievement in Mathematics.

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