



Effect of Montessori Teaching Strategy on Upper Basic II Students' Interest and Achievement in Basic Science and Technology in Benue State, Nigeria

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ABSTRACT

The study examined the effect of Montessori teaching strategy on students' interest and achievement in Basic Science and Technology. Two research questions and two hypotheses guided the study. A pre-test post-test control group, non-equivalent quasi-experimental design was used for the study. The sample of 122 students was drawn from the population of 1,384 Upper Basic II students from the Makurdi Local Government. Intact classes were randomly selected and assigned to experimental and control groups. Basic Science and Technology Interest Inventory (BSTII) and Basic Science and Technology Achievement Test (BSTAT) researcher-design instrument were used for data collection. Both the BSTII and BSTAT items of the instrument were subjected to face and content validation. The reliability of the two instruments was established using Cronbach Alpha and Kuder-Richarson formula 20 (K-R20). The reliability coefficients of the two instruments were found to be 0.78 and 0.79 respectively. Montessori teaching strategy lesson plans were used for classroom instruction in the experimental group while the control group used lesson plans on the conventional method for instruction. The research questions were answered using mean and standard deviation, while the hypotheses were tested at 0.05 alpha level of significance using Analysis of Covariance (ANCOVA). The findings of the study revealed that there was a significant difference in the mean interest scores of students taught Basic Science and Technology using the Montessori teaching strategy and those taught using the conventional method ($F(1,60) = 0.073, p < 0.05$). The findings also revealed that there is a significant difference in the mean achievement scores of students taught Basic science and Technology using the Montessori teaching strategy and their counterparts taught using the conventional method ($F(1,119) = 65.281, p < 0.05$). Based on the findings, it was recommended that Montessori teaching strategy should be used in teaching Basic Science and Technology at Upper Basic Education and science in general.

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INTRODUCTION

The study of science in Nigeria has become significant to the extent that emphasis has been placed on the teaching and learning of science with the major aim of science education. This is because science education is needed to produce technologists, technicians, scientists, craftsmen and skilled artisans who are required to change the economy which would in turn lead to a rapid growth and development necessary for nations to cope with the present-day challenges (Samuel, 2018).

Science education is therefore considered as a drive for growth and productivity for any nation that wants to be recognized scientifically and technologically (Atoo, Adeniran & Atsuwe, 2019). This fact is enshrined in the National Policy on Education of the Federal Republic of Nigeria (FRN, 2014) which states that science education should among other things equip students to live effectively in the modern age of science. The policy also emphasized that science and technology teaching and learning are viable instruments for inculcating necessary



knowledge, skills, competencies and attitudes in various developmental strategies such as World Declaration on Education for All (EFA) are put in place in Nigeria educational system. Other strategies like the National Economic Empowerment Development Strategies (NEEDS) and Sustainable Development Goals (SDGs) were put in place. In order to achievement these goals, the Nigerian Government overhauled its existing science curriculum to cater for the need of the nation as it aspires to be among the twenty top economies in the globe (FRN, 2012).

Basic Science and Technology education has become one of the best opportunities to achieve these goals. This is because Basic Science and Technology is the bedrock of all science subjects (Ochu, Adeniran & Atoo, 2017), provides connection between general science and core science, it also affords rudimentary tools for social change and development in areas such as communication, transportation, energy, information, education, agriculture, medicine, among others (Atoo, Adeniran and Atswu, 2019).

Despite the importance of Basic Science and Technology in pursuit for scientific and technological advancement, yet, there is low achievement in the subject especially in Benue State (Agbidye, Achor & Ogbeba, 2019; Ochu & Haruna, 2015). The low achievement in the foundational subject is reflected in different science tests and in the report of Registrar, Joint Admission and Matriculation Board (2016) who indicated that the achievement of candidates in the University Matriculation Examination (UME) has shown a steady decline over the last three years. According to Okwara, Adejoh & Tafi, 2019; Oloyede & Bandele, 2015, the low achievement in Basic Science and Technology and other science subjects could be related to factors such as ability levels of the students, gender issues, teaching – learning environment, teaching strategies, teachers' ability to use the various strategies and materials provided and students' background among others.

In spite of the number of factors suspected to be responsible for the low achievement in the subject, researchers such as Agbidye and Ogbeba, 2019; Samuel, 2018 and Danjuma, 2015 attest that poor instructional strategies employed in teaching the subjects by teachers contribute to students lack of interest and under achievement.

Interest is the charm that forces or compels a child to respond to a particular stimulus. Ayuba (2015) describes interest as the qualities that arouse concern or the curiosity that holds a child's attention on an object while Godpower-Echie and Ihenko (2017) revealed that interest encompasses the positive and a pleasant feeling an individual has when trying to study a subject matter or activity. Students' interest in a particular subject or activity helps in sustaining concentration, purpose and commitment to learn and co-operation with the teacher in the learning process. It is therefore the duty of the teacher to identify and use appropriate teaching strategies that will make students develop interest and curiosity in learning. The curiosity and interest of the students, according to Danjuma (2015) manifest itself in the achievement of the students.

Achievement is the action of accomplishing an academic task successfully. Ogundukun and Adeyemo (2010) views achievement as the exhibition of knowledge attained or skills developed by students in a subject as determined by test scores of students assigned by teachers. Akani (2017) maintained that the purpose of achievement is to ascertain the level of understanding of students at a given moment. It has to do with testing the knowledge acquired by the student which helps the teacher and the student to evaluate and predict the degree of learning attained. It is also a determinant of the efficacy and efficiency of a given instruction (Kabutu, Oloyede & Bandele, 2015). Hence, the interest and achievement of students in Basic Science and Technology cannot be compromised in Nigeria, because it is necessary factor for dynamic economic sector, for the creation of work force which is scientifically and technologically literate to bring about the required changes for sustainable national development (Okwara & Upu, 2017).

Research by Atadoga and Lakpini (2013) revealed that students' interest and achievement in Basic Science and Technology is jeopardized by the teachers' authoritarian and introverted method of teaching. These methods such as lecture and discussion methods reduce Basic Science and Technology to a series of stories written on the chalkboard that have little or no meaning to the students. In this regard, the researcher advocates the use of innovative strategies as a way of getting students interested in the subject. It is as a result of the quest for change in instructional strategy to enhance



learning that the researcher intends to recommend a shift from the conventional lecture method of teaching to the use of constructivist-based teaching strategy known as Montessori Teaching Strategy (MTS).

Montessori teaching strategy (MTS) is an innovative and activity-based teaching strategy which creates a well-planned and structured environment where student can pursue area of study of their interest. It is a strategy that promotes students learning by encouraging the utilization of physical objects as well nurturing their ability and respect for each other and their natural environment. According to Dahunsi, (2014) MTS provide special set of learning materials relating to the topic that are introduced to the students and each student is allowed to choose whatever material he or she is interested to learn with. This helps to develop the student's power of concentration and self-discipline.

MTS stimulates independent learning and self-discovery and defines the laws of nature as being intricate in the ability for a student to learn at capacity. The teaching strategy strives to control the environment and not the child. The role of teacher in a Montessori strategy is to guide the students on the usage of these materials and not to instruct them unlike the traditional method where the teacher instructs the students on what to do or learn (Donnovan & Bransford, 2013).

According to Dahunsi (2014) MTS is a personalized approach to learning which recognizes each student learning ability with a unique style and pace; and students learn best in a prepared environment which support and respect their individual development. Dhillon (2011) posits that Montessori teaching strategy is based on the premise that the intellectual, physical and social needs of the students which are inseparable and equally important at all times.

Montessori teaching strategy assists students to develop positive attitude about learning, a positive image of themselves as a student and a sense of independence and responsibility. Montessori experience produces self-motivated, independent students with characteristic that benefits them throughout their school years and later in life (Roopnarine, Johnson, 2010). The main aim of Montessori according to kareen (2012) is to help each student reach their full potential in all areas of life, to promote development of social skills, emotional growth and physical coordination as well as cognitive preparation for future intellectual

academic endeavours. The holistic curriculum under the guidance of a specific prepared teacher allows the students to experience the joy of learning, the time to enjoy the process and ensures the development of self-esteem. It provides the experiences from which student create their knowledge (Morrison, 2012).

Salazar (2013) examined the impact of Montessori teaching on academic achievement of elementary school students in central Texas school district. The result from the study revealed that student taught using Montessori teaching method achieve better than those taught with traditional method. In a related study, Shivakumara, Dhiksha & Nagara (2016) investigated the efficacy of Montessori and traditional method of education on interest development of children in Texas. It was found that those exposed to Montessori approach of teaching show more interest in learning compare to their counterpart who were taught with traditional method. Although the potential gains of Montessori teaching strategy to science instruction have been widely articulated in literature, its efficacy in Basic Science and Technology in Benue State is yet in doubt and demands an empirical investigation. It is on this basis that the researcher intends to see whether Montessori teaching strategy would have effect on students' interest and achievement in Basic Science and Technology in Benue State, Nigeria.

Purpose of the Study

The purpose of the study is to determine the effect of Montessori teaching strategy on students' interest and achievement in Basic Science and Technology. The study specifically determines:

1. The mean interest scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method.
2. The mean achievement scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method.

Research Questions

The following research questions were raised to guide the study

1. What is the difference in the mean interest scores of students taught Basic Science and Technology using Montessori teaching



- strategy and those taught using conventional method?
2. What is the difference in the mean achievement scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method?

Hypotheses

The following research hypotheses were formulated and tested at 0.05 alpha level of significance:

- H₀₁:** there is no significant difference in the mean interest scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method.
- H₀₂:** there is no significant difference in the mean achievement scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method.

METHODOLOGY

The study employed a quasi-experimental design of non-randomized pretest post-test control group design. The population for the study comprised 1,384 Upper Basic two students offering Basic Science and Technology in public school in Makurdi local government area of Benue State. The sample of 122 Upper Basic II students was assigned to experimental and control group through intact classes. The instructions for data collection were Basis Science and Technology Interest Inventory (BSTII) and Basic Science and Technology Achievement Test (BSTAT) which was developed by the researcher. The BSTII consist of 20 items scored on a four-point scale of strongly agree (SA) =4 points, Agree (A) =3 points, Disagree (D) =2 points and Strongly

Disagree (DA) = 1 point, for positive and items in the revised manner for the negative items. The BSTAT consist of 20 multiple choice items, drawn from Basic science and Technology of Upper Basic II curriculum. The instruments were validated by three experts, one from Test, Measurement and Evaluation and two from Science Education all from Federal University of Agriculture, Makurdi. The reliability coefficients of BSTII and BSTAT were found to be 0.78 and 0.79, using Cronbach Alpha and Kuder-Richardson formula 20 (K-R20) respectively.

The values showed a positive relationship within the test items which means the instruments were both internally consistent and reliable. Research assistants were employed in order to eliminate bias. Pre-test was administered to experimental and control groups to ascertain the level of interest and achievement before the treatment. The experimental group was taught using Montessori teaching strategy (that is treatment) while the control group was taught using conventional method (that is no treatment). A post-test, which was an equivalent form of the pre-test, was administered determine the level of interest and achievement after the treatment. Mean and standard deviations were used to answer the research questions. The null hypotheses were tested at 0.05 alpha level of significance using Analysis of Covariance (ANCOVA) of the Statistical Package for Social Science, (SPSS).

RESULTS

Research Question 1

What is the difference in the mean interest scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method?

Table 1: Mean Interest Scores and Standard Deviation of Students taught with Montessori Teaching Strategy and Conventional Methods.

Groups	N	Pre-Test		Post-Test		Mean Gain
		Mean	SD	Mean	SD	
Montessori teaching	63	2.43	1.09	3.87	0.05	1.44
Conventional	59	2.48	1.08	2.96	0.25	0.48
Mean Difference		-0.05		0.91		
Total	122					

Table 1 shows that students taught Basic Science and Technology with Montessori

teaching strategy (MTS) had a pre-interest and post –interest mean score of 2.43 and 3.87 with a



standard deviation of 1.09 and 0.05 respectively, while that of the conventional method (CM) had pre-interest and post interest mean scores of 2.48 and 2.96 with a standard deviation of 1.08 and 0.25 respectively. The mean gain in the experimental group was 1.44, while mean gain in the control group was 0.48, with mean difference of 0.96. This indicates that mean interest scores of students taught Basic Science and Technology using Montessori teaching strategy was higher than those taught using conventional method. The

result answers the question of difference in the mean interest scores of students taught Basic Science and Technology using MTS and those taught using CM.

Hypothesis 1

There is no significant difference in the mean interest scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method.

Table 2: Summary of Analysis of Covariance (ANCOVA) of Interest Scores of Students taught Basic Science and Technology with Montessori Teaching Strategy and Conventional Methods.

Source of Variance	Sum of Squares	df	Mean Square	F	Sig
Corrected Model	4088.801 ^a	2	2044.401	33.481	.000
Intercept	12624.991	1	12624.991	206.757	.000
Pretest	95.742	1	95.742	1.568	.212
Group	3986.180	1	3986.180	65.281	.000
Error	14838.065	119	61.062		
Total	1544275.000	122			
Corrected Total	18926.866	121			

Table 2 indicate that the ANCOVA analysis of the data collected from the interest scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional teaching method. From the analysis, F-value of 65.281 significant at 0.000, which is less than the P-value of 0.05. Hence, the null hypothesis was not accepted. This means that there is significant difference between the mean interest scores of students taught Basic Science and Technology using Montessori teaching strategy

and those taught using conventional method. This confirms the observed difference in the mean interest scores of students in Basic Science and Technology interest scale.

Research Question 2

What is the difference in the mean achievement scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method?

Table 3: Mean Achievement Scores and Standard Deviation of Students taught with Montessori Teaching Strategy and Conventional Methods

Groups	N	Pre-Test		Post-Test		Mean Gain
		Mean	SD	Mean	SD	
Montessori teaching	63	53.89	4.20	82.97	6.09	29.08
Conventional	59	52.94	4.76	60.91	9.12	7.97
Mean Difference		0.95		22.06		
Total	122					

Table 3 shows that in pre-test, students taught Basic Science and Technology with Montessori teaching strategy had a mean score of 53.89 with a standard deviation of 4.20, while students taught Basic Science and Technology with conventional method had a

mean score of 52.94 with a standard deviation of 4.74. The results in Table 3 also shows that in the post-test, the Montessori teaching strategy group had a mean achievement score of 82.97 with a standard deviation of 6.09, while the conventional group had a mean



achievement score of 60.91 with a standard deviation of 9.12.

From the pre-test and post-test, the mean gain for the experimental group was found to be 29.08 while the mean gain for the control group was 7.97. The mean difference in pre-test scores between both groups was 0.95 while their mean difference in post-test test was 22.06. This therefore implies that students taught Basic Science and technology using

Montessori teaching strategy recorded higher improvement in their achievement scores than their counterparts in the control group.

Hypothesis 2

There is no significant difference in the mean achievement scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method.

Table 4: Summary of Analysis of Covariance (ANCOVA) of Achievement Scores of Students taught Basic Science with Montessori Teaching Strategy and Conventional Methods

Source of Variance	Sum of Squares	df	Mean Square	F	Sig
Corrected Model	4088.801 ^a	2	2044.401	33.481	.000
Intercept	12624.991	1	12624.991	206.757	.000
Pretest	95.742	1	95.742	1.568	.212
Group	3986.180	1	3986.180	65.281	.000
Error	14838.065	119	61.062		
Total	1544275.000	122			
Corrected Total	18926.866	121			

Table 4 shows the ANCOVA analysis of the data collected from the achievement scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional teaching method. From the analysis, $F(1, 119) = 65.281$, $p < 0.05$. Hence, the null hypothesis was rejected. This means that there is significant difference in the mean achievement scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method.

THE SUMMARY OF MAJOR FINDINGS

There is a significant difference in the mean interest scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method.

There is a significant difference in the mean achievement scores of students taught Basic Science and Technology using Montessori teaching strategy and those taught using conventional method

DISCUSSION

The purpose of this study was to find out whether the use of Montessori teaching

strategy was effective in improving the interest and achievement of students in Basic Science and Technology. Before treatment commenced, pre-test was given to determine the level of interest and achievement of students in Basic Science and Technology. Therefore, the observed differences in the results are because of the treatment given to students in the experimental group. The results of the analysis of data on research questions and the null hypotheses were thereby discussed based on the objectives of the study.

The result of this study indicated that the mean interest of students taught Basic Science and Technology using Montessori teaching strategy was higher than their counterpart taught using conventional method. This was confirmed by testing hypotheses 1, which showed a significant different in the mean interest scores of the students taught Basic Science and Technology using Montessori teaching strategy and conventional method. The finding is in consonant with the findings of Shivakumara, Dhiksha & Nagara (2016) who in their study reported that there is a significant difference in the mean interest scores of students taught with MTS and those taught with conventional methods.



The result also revealed that the students taught Basic Science and Technology using Montessori teaching strategy achieved higher than those taught using conventional method. The result was further supported by the testing of hypotheses 2 which revealed a significant difference in the mean achievement scores of students in the experimental and control groups. This finding is in agreement with that of Salazar (2013) whose result indicated that students taught using Montessori teaching strategy scored higher in their post-test mean achievement scores than students taught using conventional teaching method. This implies that if Montessori teaching strategy is implemented in Nigerian schools, it will enhance students' achievement in Basic Science and Technology and science general in general.

CONCLUSION

Based on the findings of this study, the research concluded that MTS enhances

students' interest and achievement in Basic Science and Technology. Therefore, it is an effect instructional approach of teaching science and Basic Science and Technology other science subjects.

RECOMMENDATIONS

Based on the results of the study, the following recommendations were made: Seminars, conferences and workshops should be organized by government and relevant professional bodies such Nigerian Educational Research and Development Council and Science Teacher Association of Nigeria (STAN) to educate and sensitize science teachers on the effect use of MTS in teaching of Basic Science and Technology Science and other Science subjects.

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