Influence of two modes of instructional methods on students’ academic achievement in senior secondary school mathematics in Afijio Local Government Area of Oyo

B. A. Jonah¹ and O. P. Ogundile²*
¹Department of Mathematics, Bethel American International School, Fiditi, Oyo State.
²Department of Mathematics, Covenant University Ota, Nigeria
*Corresponding Author: opeyemi.ogundile@covenantuniversity.edu.ng

Abstract. The increase in the failure rate of students sitting for final year exams, for example, West Africa Senior School Certificate Examination (WASSCE) in mathematics, is a serious concern to both students, teachers, and parents. A review of the WASSCE results statistics by the National Bureau of Statistics (2016-2018) indicated that the achievement of learners in mathematics knowledge, especially in Oyo State in private senior secondary schools, continued to reduce. For example, the percentage of students who have 5% credits and above, including Mathematics is 24% in 2016, the performance reduced to 16.8% in 2017 while in 2018 the result remained at 17.2% [1]. Also, a review of the Chief Examiner's comment on students' weaknesses in general mathematics paper two from (2009-2018) shows that students' weaknesses are primarily expressed in the areas of circle geometry and its application, word problems, and interpretation of graphs [2]. In dealing with these weaknesses, the Chief Examiner suggested that teachers should use instructional aids in teaching and learning processes, teachers should give more worked examples during class lessons and a more appropriate teaching method be employed. Therefore, this research work was carried out to examine if a change in teaching method will influence students' academic performance in Mathematics. In this research, the two methods adopted by the researcher are the Traditional (chalk and talk) method and the Montessori (self-discovery) method. The tools used for data collection were Mathematics Achievement Test (M.A.T), interview, and field observation. Analysis of the results gathered revealed that students that were taught using the Montessori method had a cumulative 57.1% pass. In comparison, their counterparts who used the traditional way had an overall 49.6% pass. These findings revealed that participants from the experimental group performed better than students in the control group.

1. Introduction
Mathematics as a component of research is crucial in analyzing results and making valid conclusions. One of the significant differences between industrialized and underdeveloped nations is their application of mathematical knowledge and concepts [3]. In Nigeria, for example, to attain our national goals on science and technology, mathematics is a necessary tool that must be developed. Countries that include STEM in their curriculum help their students to be innovative and self-reliant [4]. Mathematical knowledge also encourages its leaners a life-long skill even outside the four walls of the classroom—skills such as numeracy, constructive arguments, deductions, and logical thinking.
The learning of mathematics helps the mind think critically and arrange confusing tasks and problems into a step-by-step procedure to provide solutions and answers [7]. Therefore, it is imperative to every Nigerian citizen that students at all levels of learning get a quality mathematics education [8]. However, students’ performance in this subject is discouraging, especially in the Senior School Certificate Examination. The figures below give credibility to this statement.

**Table 1: Students Performance in May/June SSCE Mathematics (WAEC) 2009-2019**

| Years | No. of candidates | Number of candidates with A1-C6 | Percentage number of candidates with A1-C6 |
|-------|------------------|--------------------------------|------------------------------------------|
| 2009  | 1,369,142        | 779,863                        | 56.96                                    |
| 2010  | 1,373,009        | 622,384                        | 45.33                                    |
| 2011  | 1,351,557        | 560,976                        | 41.51                                    |
| 2012  | 1,540,250        | 587,630                        | 38.15                                    |
| 2013  | 1,023,102        | 383,955                        | 37.53                                    |
| 2014  | 1,054,853        | 402,982                        | 38.20                                    |
| 2015  | 1,181,515        | 482,123                        | 41.73                                    |
| 2016  | 1,275,330        | 598,129                        | 46.90                                    |
| 2017  | 1,543,974        | 807,780                        | 52.3                                     |
| 2018  | 1,558,452        | 881,039                        | 56.53                                    |
| 2019  | 1,571,536        | 756,726                        | 48.15                                    |

Efforts had been made by the government and other stakeholders to improve the performance of students in the subject. However, from Table 1, it is evident that these efforts have not yielded the desired results. It serves as a warning that there are still problems yet unresolved. One significant problem, yet undecided is the delivery of the content to the students [9]. Most teachers teaching students in this technological age are still using the traditional method of teaching. Research carried out on mathematics achievement, and the failing students’ performance in mathematics demonstrates the failure of this delivery system. Maria Montessori introduced the Montessori method of teaching in 1977. Dr. Maria Montessori stated that completing tasks for students takes away their ability to complete tasks independently. The method has since been used as a method of teaching in the advanced countries of the world, like the United States of America, Europe, and France. For example, [9] researched students’ performance from a private Montessori school from 2nd through 8th grade on annual standardized achievement tests in the United States of America [10]. The students’ 2nd-grade pretest indicated that the students’ performance reduced when the study began. The post-test results provided quantitative evidence that the Montessori method of teaching improved the students’ academic performance [10][11].

However, this method that has been proven effective and efficient in the advanced countries has not been fully used as a method of teaching in many Nigerian secondary schools. Given the high value placed on mathematics at the Nigerian Senior Secondary School Curriculum and the nature of the subject, teaching it effectively through an effective method is indisputable [12]. Therefore, the main problem of this research is to find out if a change in the teaching methods employed by mathematics teachers in Afijio Local Government will improve the performance of students in mathematics. Other related work on student learning can be found in [11-12].

2. Methodology

In this research work, the researcher adopts the quasi-experimental design. The quasi-experimental design involves two different treatments (Montessori and ‘Traditional) on two different groups. It measures students’ academic performance that received the Montessori method of teaching and those
that received the traditional method of teaching. There are many kinds of quasi-experimental design; examples are nonequivalent group design, pretest-posttest design, interrupted time series design, combination design. However, in this research work, the researcher will make use of pretest-posttest design.

2.1 Pretest-Posttest Design

In a pretest-posttest design, the dependent variable (academic performance) is measured once before the treatment (teaching method) is implemented. The dependent variable is measured again after the treatment has been implemented. If the average posttest score is better than the average pretest score, then it makes sense to conclude that the treatment (method of instruction) might be responsible for the improvement.

2.2 Sampling and Sampling Procedure

A review of the released WASSCE results statistics by the National Bureau of Statistics (2016-2018) revealed that the grades of students in mathematics, especially private senior secondary schools in Oyo State, continued to reduce. For example, the percentage of students who had 5% credits and above including Mathematics is 24% in 2016, the performance reduced drastically to 16.8% in 2017 while in 2018 the result increased slightly to 17%.

Presently, Oyo State has 2,004 public schools, 971 private nursery/primary schools, 969 public secondary schools, including seven (7) schools of science, and 57 private secondary schools (Google, 2020).

Based on this figure, a simple random sampling technique was used to select two (2) equivalent private senior secondary schools in Afijio Local Government Area of Oyo State, and the high schools are SPED International Secondary School, Oyo, and Bethel American International School, Fiditi. SPED International Secondary School, Oyo was randomly assigned to the control group by using the traditional method as treatment, while Bethel American International School, Fiditi was randomly assigned experimental group using the Montessori method as treatment.

**Table 2:** Number of students in the experimental and control groups.

| S/No | Name of School | Group      | Male | Female | Total |
|------|---------------|------------|------|--------|-------|
| 1    | School 1      | Experimental | 13   | 27     | 40    |
| 2    | School 2      | Control     | 19   | 21     | 40    |

3. Results and Conclusion.

3.1 Control Group

**PRE-TEST**

Test on cycle theorems, graphical interpretations, and word problems was administered on the students. The stimulus aimed to measure the understanding of the students about the topics. After the pretest was administered to the students and results recorded, the students were taught using the traditional method of teaching for one month. The results were recorded in the table below.

**Table 3:** Pass Marks

|                      | Marks | N   | Percentage |
|----------------------|-------|-----|------------|
| Circle Geometry      | 12    | 10  | 25%        |
| Graphical Interpretations | 8   | 12  | 30%        |
| Word Problem         | 10    | 15  | 37.5%      |

**Total: 30.8%**
Fail Marks

|                      | Marks | N   | Pass Percentage |
|----------------------|-------|-----|-----------------|
| Circle Geometry:     | 12    | 30  | 75%             |
| Graphical Interpretations: | 8   | 28  | 70%             |
| Word Problem:        | 10    | 25  | 62.5%           |

Total: 69.2%

3.2 Experimental Group

PRE-TEST

The same Mathematics Achievement Test (M.A.T) was administered to the participants as that given to the students in the control group. Likewise, the goal of the stimulus was to measure their elementary understanding of cycle theorems, graphical interpretations, and word problems. The results are given below.

Table 5: Pass Marks

|                      | Marks | N   | Pass Percentage |
|----------------------|-------|-----|-----------------|
| Circle Geometry:     | 12    | 16  | 40%             |
| Graphical Interpretations: | 8   | 16  | 40%             |
| Word Problem:        | 10    | 9   | 22.5%           |

Total: 34.2%

POST TEST

The experimental group students were taught the same topics (cycle theorems, graphical interpretations, and word problems). However, the teacher in the experimental group used the Montessori method of teaching during the same period. The test scores in the post-test are given below.

Table 4: Pass Marks

|                      | Marks | N   | Pass Percentage |
|----------------------|-------|-----|-----------------|
| Circle Geometry:     | 12    | 25  | 62.5%           |
| Graphical Interpretations: | 8   | 27  | 67.5%           |
| Word Problem:        | 10    | 30  | 75%             |

Total: 68.3%

Fail Marks

|                      | Marks | N   | Pass Percentage |
|----------------------|-------|-----|-----------------|
| Circle Geometry:     | 12    | 15  | 37.5%           |
| Graphical Interpretations: | 8   | 13  | 32.5%           |
| Word Problem:        | 10    | 10  | 25%             |

Total: 31.7%
Table 6: Pass Marks

| Section                | Marks | Pass Percentage |
|------------------------|-------|-----------------|
| Circle Geometry        | 12    | N=34/40 (85%)   |
| Graphical Interpretations | 8    | N=31/40 (77.5%) |
| Word Problem           | 10    | N=31/40 (77.5%) |

Total: 80%

Fail Marks

| Section                | Marks | Pass Percentage |
|------------------------|-------|-----------------|
| Circle Geometry        | 12    | N=6/40 (40%)    |
| Graphical Interpretations | 8    | N=9/40 (22.5%)  |
| Word Problem           | 10    | N=9/40 (22.5%)  |

Total: 20%

3.3 Analysis of the findings of the results

As we can see from the results of the post-test for the experimental group, students that were exposed to the Montessori method of teaching (80% pass, 20% fail) performed better than their peers who were taught using the traditional method of teaching (68.3% pass, 31.7% fail).

Table 7: Comparison between control and experimental groups

|                     | Control Group N = 20 | Experimental Group N = 20 |
|---------------------|----------------------|---------------------------|
| Pre-test            | Post-test            | Pre-test                  | Post-test                |
| 30.8% pass          | 68.3% pass           | 34.2% pass                | 80% pass                 |
| 69.2% fail          | 31.7% fail           | 65.8% fail                | 20% fail                 |

Significant (49.5%) overall pass mark from the traditional method of teaching.

Significant (57.1%) overall pass mark from the Montessori method of teaching.

There was a significant improvement in students' academic performance when the Montessori method of teaching was used because the overall pass mark for the Montessori method was 57.1% pass. In comparison, the overall pass mark for the traditional method was 49.55%. Also, the difference between the pass mark for the control group was 37.5%, while the differences between the pass mark for the experimental group were 45.8%. Hence, the researcher can conclude that the Montessori method of teaching has improved students' academic performance in Mathematics.

4. Conclusion

The findings of this research revealed that the students' cumulative pass mark taught using the Montessori method of teaching is higher than those exposed to the traditional method (control group) of teaching. Based on this, the Montessori method of teaching should be encouraged in our teaching and learning process. Besides the academic benefit of the Montessori method, its tenets, such as respect for individuals and innovative thinking, encourages good character amidst students and teachers. To improve students' achievement in mathematics at both terminal and internal exams, teachers of mathematics should be trained in the use of the Montessori method of teaching, and the old chalk and talk method of education should be abolished.

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