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Montessori Method of Teaching: The Key to Learning and Teaching of Mensuration of Solid Shapes, a Case of a Private School in Zimbabwe

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study sought to find out how efficient the Montessori Method of Teaching, MMT is on Ordinary level ('O' level) pupils' achievement in mensuration. This research was carried out in Zimbabwe, at a private school over a period of four months, using a sample of 32 'O' level pupils. The researchers constructed two Mensuration Achievement Tests (MAT) that were used as data collection instruments. Descriptive statistics such as mean and standard deviation were employed in this study. Findings from this study showed that pupils taught with MMT were advanced in achievement than those taught using Conventional lecture Method, CLM. This was indicated by the major variation between the mean scores of pupils taught mensuration with MMT and those taught with the Conventional in the two tests. From the findings it is recommended that mathematics teachers should be trained on the use of Montessori Method in the teaching and learning of mensuration with a vision to making learning of the concepts important, applicable and motivating.

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1. INTRODUCTION

1.1 Background of Study

Mathematics is a very crucial and essential subject in science, technology and in everyday living. Engineering, computer programming and other technology related jobs require mathematics during training and implementation of such skills. Due to its importance, the government of Zimbabwe has made it compulsory to all 'O' level pupils. However, the pass rate for Ordinary level mathematics has remained low, between 10% and 25% for the past five years. Zimbabwe Schools Examinations Council (ZIMSEC) [1] examiner's report cites that, the questions on mensuration of solid shapes were poorly done and very few pupils attempted them.

Researchers such as Harbour – Peters, [2], noted that the use of inappropriate teaching methods and lack of interest are amongst the factors accountable for such persistent failure in mathematics. According to Akinlade, [3] solid mensuration is one of the topics among the abstract and complex aspects of mathematics to teach without the use of instructional materials. Lavador and Calderon, [4] who also carried a similar research, postulate that learning solid mensuration is not as easy as giving a lecture. They further argue that most pupils are visual learners hence they always appreciate more concrete and realistic problems and solutions. Learning mensuration of solid shapes deals with concrete and tangible forms of mathematical problems (Lavador and Calderon), [4]. It is in this regard of using relevant and concrete objects for instruction that this study wishes to establish if these concrete objects can help to improve pupils' achievement in mensuration of solid shapes.

1.2 Conceptual Clarifications

The Montessori Method of Teaching (MMT) method is an approach to teaching that on stresses on independent learning on the part of the pupils and detached watching on the part of the mathematics educator (Abuul), [5]. The MMT is a pedagogical tool that was created by Maria Montessori in 1907 (Kurumeh and Mahommed), [6]. Kurumeh et al. [6] describe the MMT as a case of autonomous method to the teaching and learning process, an approach that is very encouraging, exciting and significant to the pupils. Pupils are active participants in learning and the teacher is a facilitator. The Conventional lecture Method (CLM) is described as the presentation of the material, which frequently comes straight from the teachers. Pupils are passive; the teacher has a more dominant, central role in class activity.

1.3 Research Question

1. What is the difference in mean scores of pupils taught mensuration of solid shapes using MMT and CLM?

2. RELATED STUDIES

The Montessori Method of Teaching (MMT) makes use of real objects. Pupils make use of instructive resources which are of different classes as practical life, sensorial, language art, mathematics and educational matter and these can consist of rods, cubes, and beads, 2 dimensional and 3 dimensional objects (Kurumeh and Mohammed), [6]. Gimba, [7] and Gambari, [8], in different studies reported that using 3 dimensional instructional models to supplement conventional teaching method produced higher achievement than using the conventional method only.

2.1 The Montessori Method of Teaching (MMT)

MMT is a scientific approach to pedagogy introduced by Maria Montessori in 1907 (Kurumeh and Mahommed), [6]. In an Montessori class pupils are provided with real objects that suit the learning environment. According to Montessori, [9], pupils enjoy using Montessori materials to learn because they are concrete, captivating, catchy and solid. These materials arouse the interest of pupils towards learning. The NTCM, [10] advocated for pedagogical approaches that are realistic, motivating, inspiring, student- oriented, and relevant to the desires of the pupils that may improve their understanding in mathematics in general and mensuration in particular. Also using the MMT, pupils learn at their own pace by manipulating objects. Thus, such self-independence, self-discipline and initiative are essential for learning and motivation. The MMT approaches do not allow direct teacher involvement, but the pupils'

effort is respected towards independent mastery (Crain), [11]. Furthermore, scholars like Pickering, [12] asserts that MMT help pupils to develop attention, order, visual perception, and mathematic skill, fine and gross motor skills.

Kurumeh and Mohammed, [6] carried out a similar research on promoting pupils' interest in mensuration using MMT in Nigeria, with pupils from government schools. The results of this study showed that the MMT improved the pupils' achievement in mensuration.

Glen, [13] conducted a 10 year follow up study of using MMT to ascertain measures of academic achievement including personality characteristics such as self-control, creativity and self-direction. The results indicated that pupils taught using MMT were as successful as others.

The study by Dawson, [14] examined mean grade equivalent scores on the Lowa Test of Basic Skills (LTBS) and the Metropolitan Achievement Test (MAT) for pupils in grade 1 up to 5 against national norms. The results indicated that scores on Montessori were higher at all grade levels comparisons.

More so, Lillard et al. [15] argues that Montessori students reported a significantly better quality of experience in their academic work than did traditional students in solid mensuration. In a nutshell, the Montessori Method of teaching seems to produce positive results in achievement and attitude when compared to conventional teaching methods.

3. METHODOLOGY

3.1 Research Design and Methodology

The positivist paradigm was used in this study. Cohen and Manion, [16] postulate that positivism is associated with quantitative research that involves hypotheses testing to obtain objective truth. The quasi-experimental design was seen to be suitable for this research study because of the need to establish equivalence between the number of male and female pupils. Cohen and Manion [16] argue that group equivalence is established by using pretesting or analysis of prior achievement in quasi-experimental design.

3.2 Data Sources and Sampling Techniques

The sample for this study comprised of 32 'O' level pupils selected from two classes at a private school using stratified random sampling techniques. In each class 16 pupils were drawn at random and distributed into experimental and control groups. The group labeled experimental was taught mensuration with Montessori Method of teaching (MMT) whereas the other group, which was the control was taught the same concepts on mensuration by means of the Conventional lecture method (CLM).

The instruments used in the study were two Mensuration Achievement Tests (MAT), which were both face and content validated by lecturers at the university were the researchers are employed. The validation was done by four experts in science & mathematics education department and four in Physics & mathematics at the university were the researchers are employed. Their advice, comments, recommendations and suggestions were used to modify the two MAT. At the end of validation, 20 out of 40 initial items remained for the study.

The study lasted for two weeks of five periods per week of 45 minutes for each session. MAT was given as post test to all the pupils in the experimental and control groups, soon after the completion of the first five lessons. The results of the MAT were collected and used for the study. This was repeated with the methods changed for the two groups. Length of teaching was equally distributed and each classroom session was supervised by the researchers.

4. RESULTS AND DISCUSSION

Table 1 shows the raw scores of the pupils' achievement in MAT TEST1 and MAT TEST2. The Experimental group performance was outstanding after the administration of both MAT TEST1 and MAT TEST2. Pupils perfomed much better when MMT was used unlike in the CLM.

Table 2 shows the mean scores of pupils taught by MMT as 53.44 and 48.74 while standard deviation was 42.34 and 23.62 also when the mean score of pupils taught through CLM was 38.13 and 39. 06 and the standard deviation was 9.71 and 11.73. This shows that MMT is more efficiency than CLM. These findings confirmed Kurumeh et al. [6] who indicated that MMT improves pupils' achievement. The explanation for this high achievement should be the use of practical and concrete objects.

Table 1. Show the raw data classified into various groups under MAT TEST1 and MAT TEST2

Scores	MAT TEST1		MAT TEST2	
	Experimental	Control	Experimental	Control
0-19	-	1	1	2
20-39	3	5	3	4
40-59	6	11	6	8
60-79	4	-	4	2
80-99	3	-	2	-

Table 2. Mean performance scores and standard deviation of students in the experimental and control group

	MAT TEST1		MAT TEST2	
	Experimental	Control	Experimental	Control
Mean (X)	53.44	38.13	48.74	39.06
Standard deviation	42.34	9.71	23.62	11.73

5. CONCLUSION

This study concludes that MMT is a more efficient approach as compared to the CLM. The MMT approach has the potential to make pupils understand the connections between mathematics in general and mensuration specifically to the environment, day –to-day activities and the cultural activities of them. Pupils' become confident in solving real life mathematical problems.

6. RECOMMENDATION

The researcher came up with the following recommendations;

- MMT was found to be effective as a teaching method for mensuration of solid shapes as compared to the CLM. Therefore teachers should be trained on the use of the MMT to develop pupils' interest for better performance in mensuration of solid shapes.
- Teachers should adopt MMT by using variety and stimulating materials that instils in a learner, confidence, enthusiasm and interest in Mathematics that leads to greater achievement.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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