EVALUATION OF JIGSAW STRATEGY AND MASTERY LEARNING (JSML) MODULE VERSUS CONVENTIONAL INSTRUCTION IN TEACHING MATHEMATICS

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ABSTRACT

Objective – To evaluate the effects of JSML Module versus Conventional Instruction in teaching mathematics.
Design – Non-equivalent control group quasi-experimental design
Sample population – Eighty (80) first-year senior secondary school students in the Gombe – Nigeria. The students were randomly assigned to two groups: Conventional instruction (N = 40) and JSML instruction (N = 40)
Procedure – Before the intervention began, teachers and students were trained by the researcher on how to use the module for one week to enable them to master the skills before embarking on the treatment. The five weeks' study consisted of three phases: (a) Pre-test (b) twelves (12) lesson sessions devoted to studying the four mathematics topics (algebra, simultaneous equations, indices and logarithms) which lasted for three weeks, and (c) Post-testing
Results – Students in the Jigsaw strategy and Mastery learning (JSML) group achieved significantly better on the post-test than conventionally instructed students. After the treatment JSML group stated that the JSML module alone provided them with effective instruction.
Conclusion – JSML learning is an acceptable and effective method of teaching students to learn mathematics

Keywords: Cooperative learning, Jigsaw strategy, mastery learning strategy; achievement; conventional method; mathematics.

INTRODUCTION

Mathematics remains one of the fundamental subjects in school curriculum globally as it is used in day - to - day life (Ahmad, et al 2010). It is the principal subject used for the comprehension of other major fields. To buttress this claim Akinsanya, Ajayi, and Salomi (2011) remarked that mathematics is the queen and servant of all fields of study. Furthermore, Aguele and Usman (2007) described mathematics as an implement available for building theories in science and other areas of endeavour. This is because it is a basic part of human thinking which promotes logical understanding among people. Additionally, it gives an effective way of building mental disciplines, impulses, logical thinking and mental rigor. Mathematics is therefore far more than the ability to calculate, memorize formulae, or solve

equations. Rather, it trains and promotes logical thinking.
Despite, the daily needs and the roles played by mathematics in the society, there has been persistent poor performance in the subject worldwide. In United States of America for example, the Program for International Students' Assessment (PISA), reported that students were graded beneath average in mathematics (Ginsburg, Lei wand, & Pollock, 2009). Also in India, students who sat for the same examination emerged second to last in global rating. In Africa, poor performance has also been registered in Mathematics at all levels of education with South Africa, Ghana, Morocco, and Botswana, students ranked below average in 2010 and 2015 Trends in International Mathematics and Science study.

Due to the significance of mathematics to the society, the Nigerian government enacted a policy which made the study of the subject an obligatory for all levels of education. Consequently, credit pass in mathematics becomes pre - requisite requirement for admission into tertiary institutions in the country. Nigerian Universities Commission (NUC, 2016).

As a mark of commitment, the Federal Government of Nigeria has established National Mathematics Centre (NMC), with the mandate to expand the study of mathematics and science. Despite this laudable effort, improvement is yet to be recorded because the performances of students at the secondary school level in Mathematics remains poor.

In Gombe, a remote city of the North Eastern Nigeria and a town with hundreds of secondary schools, poor performance in Mathematics is apparent. The overall performance of the students is as low as 5.68% (Daily Post, 2014). Similarly, the Chief Examiner's Report on West Africa Examination Council (WAEC) indicated poor performance and be argued that such a result could lower students' interest in mathematics and general examinations.
Narrowing down our discussion to the area of study, Gombe is one of the towns in which students in Nigeria sat for Senior Secondary Examinations - a type of examination handles by WAEC. Below is the table indicating Mathematics performance of the Gombe State students at the Senior Secondary School Examination from 2011 to 2015.

Table 1: The Students' Mathematics Performance in Senior Secondary School Certificate Examinations (SSCE) from 2011 to 2015

Year	2011 %	2012 %	2013 %	2014 %	2015 %
% Pass	30.90 (n= 1230)	38.56 (n=1250)	38.14 (n=1033)	31.22 (n=5830)	29.63. (n=3027)
% Fail	69.10 (n= 1230)	61.44 (n=1250)	61.86 (n=1033)	68.78 (n=5830)	70.37 (n=3027)

Source: *Statistics Office WAEC Lagos, and Guardian News Paper 13/08/2014 retrieved on 27/02/2017.*

Table 1 shows clearly that the performance of students in mathematics is not impressive. The percentage of pass in all the years under review (2011, 2012, 2013, 2014, & 2015) is below 50 which could be translated into 30.90%, 38.56%, 38.14%, 31.22%, and 29.63% respectively. These results pose a serious concern to the government, stakeholders in the education, industries, parents and the society at large.

This perennial problem may be precipitated by the teaching technique in which the teachers still maintain the traditional method despite the emergence of new teaching methods,

strategies, techniques, and approaches. With improved methods of teaching the old practice is detrimental to the comprehension of the subject as indicated in the table (1.1) above.

This predicament could be overcome using a cooperative learning strategy which has been identified as one of the ways teachers may apply to increase academic achievement and attitude (Capar & Tarim, 2015). Cooperative learning strategies involves grouping students into small mixed ability learning groups. It is premised on the fact that students work together cooperatively and interdependently in small groups (Wendy, 2005). In a Jigsaw riddle for example, each bit – each student's part is vital for the conclusion and complete understanding of the final product. If each student's part is important, then each student is important. This aspect is what makes this approach efficient as the students become occupied in their learning - learn many materials quickly, share information with other group members, reduce time of listening and remain individually accountable in their learning (Aronson, 1978). Additionally, Jigsaw increases self-esteem participation and stand-in broad-mindedness among the students. It is based on the relevance of the Jigsaw strategy that the present study is premised.

The Jigsaw strategy was developed by Elliot Aronson and Associates in the early 1970s. In their approach, the teacher is supposed to present a topic and its sub-topics while students are divided into small groups of five to six, which is referred to as Jigsaw groups. In Jigsaw application, the concept of learning is sub-divided into different segments, and each student is assigned to a sub-topic so as to enable him/her specialize. This means all students with similar topic form expert groups. This group of students reconvenes as soon as learning is over, in order to solve self-assessment questions individually. The achievement scores of individual members are added up to give the group aggregate scores which is used as data for the analysis. In other words, the groups' strengths and achievements are realized in their unity. This learning process inspires students to listen and engage in a group setting such that each member of the group plays a vital role in the group. When students relate and discuss freely, there is a high propensity for them to unveil the areas of their learning difficulty which the teacher can utilize in order to improve his classroom teaching.

According to Hollebrands (2004), it is essential for a teacher to adopt various approaches to teaching and learning so as to influence the students' understanding which is paramount in the teaching of mathematics and it is called Mastery Learning Technique. This approach can be applied to all ages and should be well-matched with common teaching approaches (Candler, 2010). Similarly, Candler (2010) argues that mastery learning can be defined as an instruction given to the students which is more than showing mastery of instructional content. Furthermore, mastery learning can be used in almost every subject, but it is more suitable in mathematics instruction since it helps students to develop a solid foundation of mathematical understanding in order to solve mathematical problems which involve a higher-level thinking and reasoning. Hence, its application in cooperative situations will promote a strategy that enhances academic achievement and attitude towards learning mathematics. Therefore, Jigsaw Strategy and Mastery Learning Module is so crucial because it aids in teaching and learning mathematics.

Purpose of the study

The general objective of the study is to evaluate the effects of Cooperative Learning (Jigsaw) Strategy and Mastery Learning (JSML) Module on mathematics students' achievement in Nigerian Schools. The specific objectives of the study are:

1. To determine the significant differences between the post-test mathematics scores of the control and treatment groups;

Questions of the Study

1. What are the significant differences between the Post-test mathematics achievement scores of the Control and Treatment Groups?

Hypothesis of the Study

The study tests the following hypotheses at 0.05 level of Significance;

1. There are no significant differences between the post-test mathematics achievement scores of the Treatment and Control Groups.

LITERATURE REVIEW

Cooperative Learning

Adams & Hamm (1996) define cooperative learning as a social instructional strategy of small teams with students of different level of academic ability. From this inference, cooperative learning is an instructional design that teaches learners together in a small group to interact actively on certain issues required of them under the watch of the teacher (Mohammadjani, and Tonkaboni, 2015). Furthermore, both Vanwyk (2010) see that cooperative learning as an instructional strategy where students come together and work as a team to accomplish a desired objective. In a similar vein, Slavin (1990) Says cooperative learning refers to a research approach to pedagogy in mathematics. Students work collectively and help each other. Studies revealed that learning mathematics in a team has found a strong positive effect when goals are incorporated ito individual accountability (Slavin, Sheard, Elliot, Chambers, & Cheung, 2013). Still in mathematics discipline, (Lavasani & Khandan, 2011) examined the effect of Cooperative Learning on mathematics anxiety and help-seeking behavior. The researchers reported that Cooperative Learning method in comparison with the Traditional Group decreased mathematics anxiety in students significantly and avoidance component ($p>0.05$) but increased their help-seeking behavior. The study utilized 40 students from two schools randomly selected termed an experiment and control groups.

Jigsaw Strategy

In a similar dimension, Mbacho & Githua (2013) found that the learners who were taught using Jigsaw Cooperative Learning Strategy performed well than those who received their lessons using Conventional Learning Method and there was no significant gender difference in the achievement using the same learning model. The research was conducted on mathematics students' achievement in secondary schools in Laikipia East District, Kenya. On the other hand, Wilson, Pegram, Battise & Robinson (2017) also compared the Traditional lecture versus Jigsaw learning method for teaching medication therapy management core elements. The results showed improvement in posttest scores favored the traditional method, again no statistical differences were found between the groups. However, the Jigsaw group does better than the traditional lecture in the problem-solving skills. A similar study was undertaken by Rachmah (2017) examined the effects of Jigsaw learning method on students' self-efficacy and motivation to learn. The results showed Jigsaw technique had significant effects on self-efficacy and motivation to learn. Results from research studies carried out on Jigsaw teaching technique versus traditional teaching technique suggested that Jigsaw teaching technique yields greater interest and positive attitudes than a traditional teaching technique

Mastery learning

Mastery learning has been defined in many ways (Bloom, 1968). It is an instructional process that offers students with numerous chances to exhibit content mastery (Candler, 2010). It is distinctive related to the conventional teaching approach in that the unit of

learning is taught and students' comprehension is assessed using a self- assessment test before they are allowed to change on to the subsequent unit. Students who show mastery on this self-assessment test are assigned more inspiring assignments so as to cover and deepen their content knowledge while those who do not pass this test at a designated level (80%) receive a remedial instruction, followed by another test. Block & Anderson (1975) argue that students who fail the assessment test may go back and repeat the learning until all students achieve the mastery level or the teacher decides to change to the next unit or until the majority of the class masters the unit.

Elaldi (2016) conducted a research on the mastery learning model with medical students. The study used mixed method (Quantitative and Qualitative) research, quantitative used pre-test and post-test control group design while qualitative data were collected through semi-structured interviews with six students from the treatment group. The results of the study indicate significant difference between post-tests scores of the treatment and control groups favoring the treatment group [t (62) = -2, 815; P = .007]. The qualitative findings also showed positive attitudes towards learning in terms of increasing achievement.
Similarly, Kalia (2005) investigated the effectiveness of Mastery Learning Strategy and Inquiry Training Model on pupils' achievement in science. The results showed that treatment group attain significantly higher achievement scores than Control Group. In the same way, Barr & Wessel (2018). Examined blend of mastery learning approaches together with the valuable effects of small class sizes. Results showed that if the careful planning of the course structure, students can have both positive effect and attitude towards mathematics. *The review of the related literature showed that when students are provided with an enabling environment of mastery learning could attain a higher academic achievement. When compared students in mastery learning with group students in traditionally taught the mastery learning group reach advanced levels of achievement and develop greater positive attitudes.*

Conventional Teaching Method
In the context of the present study, the conventional teaching method refers to a lecture technique. This strategy is very much unsuitable, especially for the young learner. Aggarwal (2001) defines lecture method as the oldest teaching method given by philosophy of idealism. The method lays emphasis on the presentation of the content rather than methodology. In teaching mathematics, for instance, the teacher concentrates more on the content but pays little attention to the learner's comprehension. This technique of teaching does not involve the communicative method in which the learner is allowed to share his knowledge along with his/her teammates.

Jigsaw Strategy and Mastery Learning (JSML)
This is the combination of elements of the two strategies Cooperative Learning (Jigsaw) Strategy and Mastery Learning. The treatment of this strategy was carried out in addition to cooperative learning (Jigsaw) strategy using the following process: Formative assessment, Corrective instruction, and Summative test. After the students have been self-assessed, those who mastered the materials by scoring 80% and above were involved in enrichment activities while those students who did not reach the fixed standard level of mastery were required to go over the unit again and take another self-assessment after which they were allowed to move to the next unit. The detailed procedure for conducting Jigsaw Strategy and Mastery Learning (Treatment group one) is shown below.

MATERIALS AND METHODS

Research Design

The study exploited the non-randomized pre-test and post-test control group type of quasi-experimental design, since it was not practically, possible to fulfil the requirements of true experiment. As a result, intact classes were randomly assigned to control and treatment groups, without upsetting the school arrangements.

The groups were organized as follows: Group one received a pre-test, treatment (X_1) and post-test while Group two received a pre-test and post-test. On the other hand, Group three were given a pre-test but not received the treatment (X_2) followed by a post-test as shown in figure 3.1 below. This implied that, in this case, Group one and Group two were taught Jigsaw strategy via mastery learning (JSML) and jigsaw strategy (JS) respectively, while Group three were taught using the conventional method (Control group)

Treatment group 1	O_1	X_1	O_2
Control group	O_1	-	O_2

Figure 1: Non-equivalent Pre-test - Post-test Control Group Design
Where; X_1 = *Jigsaw strategy and mastery learning,* O_1 = *Pre-test,* O_2 = *Post-test.*

Sample

For this investigation the researcher used eighty (80) students of SS1 that were randomly taken from Secondary School of Gombe state in Nigeria. The students were randomly divided into two groups. The students were classified as 54 males and 66 females and their average age of 15 years. A number of 40 students (18 males and 22 females) was identified as Treatment Group one while, 40 students (21 males and 19 females) was considered as a Control Group as presented in Table 2.

Table 2: The Sample of the study

Gender	JSML	CG	Total
Male	18	21	54
Female	22	19	66
Total	40	40	120

Research Instrument

In order to collect data and provide answers to the research questions and hypothesis, Pre-test/Post-test (simultaneous equations, algebra, logarithms, and indices) was applied.

Pre-test/Post-test

A thirty (30) multiple choice items with four options (lettered A-D) was applied, which the students were asked to mark the correct answers from the options provided. It was constructed and developed by researcher based on Senior Secondary School one (SS1) curriculum in line with WAEC questions in Mathematics. The specification table was constructed to guide in the allocation of questions in to the three cognitive domains (Knowledge, Comprehension and Application) as presented in Table 3. The number of

questions that were set on the objectives which are defined by the behaviour specified on the top row and the content listed on the left- hand side. The number of questions for the test was thirty (30) with 8 questions on indices, 7 questions on Logarithms, 8 questions on Algebra, and 7 questions on Simultaneous equations. On the scoring of the multiple-choice items, '1' mark was awarded for each correct answer if the method of solution were correct otherwise "0" marks, and '0' for each wrong answer or that was left blank by the students.

Table 3: Specification Test for mathematics Achievement score

Unit	Topics	Objective (cognitive domain)			TOT	Per (%)
		Know	**Comp**	**Applica**		
1	Indices	1,2,3,4	5,6,7	8	8	27
2	Logarithms	9,10,11,12	13,14	15	7	23
3	Algebra	16,17,18,19	20,21	22,23	8	27
4	Simultaneous Equations	24,25,26	27,28	29,30	7	23
Total Items		15	9	6	30	100%
Percentage (%)		50%	30%	20%	100%	

Validity of the Instrument

The pre-test and post-test prepared were validated by four experts (Three senior lecturers and one associate professor) all were from School of Education and Modern Languages Universiti Utara Malaysia and experts from Nigeria (two Associate professors and two mathematics teachers) from University and Secondary school respectively, to check the grammar used and the content whether or not it reflected the SS 1 syllabus. The experts also helped and guided the researcher in modifying the final draft of the instrument.

Procedure

Before the intervention began, teachers and students were trained by the researcher on how to use the module for one week to enable them to master the skills before embarking on the treatment. The five weeks' study consisted of three phases: (a) Pre-test (b) twelves (12) lesson sessions devoted to studying the four topics, and (c) Post-testing (see Table 3).

First Phases - Pre-testing

The pre-test was administered to all the SS1 students immediately after the training to determine the prevailing knowledge of students before the treatment process. The scored obtained helped in the placement of the students into groups as presented in Table 4;

Second Phases - Treatment

After the implementation of pre-test mathematics achievement, the scored obtained helped in the placement of the students into groups as presented in Table 3. The assigned teacher used the combination of Jigsaw strategy and Mastery learning. The treatment session lasted for three weeks of twelve lesson periods

Table 4: The Distribution of the Home Groups

Group A	**Group B**	**Group C**	**Group D**	**Group E**
A1	B1	C1	D1	E1
A2	B2	C2	D2	E2
A3	B3	C3	D3	E3
A4	B4	C4	D4	E4

Table 4 continued.

Group F	Group G	Group H	Group I	Group J
F1	G1	H1	I1	J1
F2	G2	H2	I2	J2
F3	G3	H3	I3	J3
F4	G4	H4	I4	J4

In home groups, each team member was assigned a number from 1-4 as presented in Table 4 Member of respective home groups with same numbers was given the same subtopic in mathematics to study.

Table 5: The Distribution of the Jigsaw Expert Groups

Topic one	Topic two	Topic three	Topic four
A1	A2	A3	A4
B1	B2	B3	B4
C1	C2	C3	C4
D1	D2	D3	D4
E1	E2	E3	E4

Table 5 continued.

Topic one	Topic two	Topic three	Topic four
F1	F2	F3	F4
G1	G2	G3	G4
H1	H2	H3	H4
I 1	I2	I3	I4
J1	J2	J3	J4

The sub-topics were distributed according to the numbers assigned to the home group members as presented in Table 5. Students with the same number (A1, B1, C1, D1, E1…) form the new group called the expert groups. The expert members studied the task assigned to them. Below Table 6, Table 7, and Table 8 presented the distribution of topics according to groups for each week of the treatment periods.

Table 6: The Distribution of Topics according to students Group for Week One

S/N	Topics	Groups
One	Law of Indices	A1, B1, C1, D1, E1, F1, G1, H1, I1, J1.
Two	Zero Index	A2, B2, C2, D2, E2, F2, G2, H2, I2, J2.
Three	Negative Exponents	A3, B3, C3, D3, E3, F3, G3, H3, I3, J3.
Four	Fractional Indices	A4, B4, C4, D4, E4, F4, G4, H4, I4, J4.

Table 7: The Distribution of Topics according to Students Group for Week Two

S/N	Topics	Groups
One	Exponential Equation	A1, B1, C1, D1, E1, F1, G1, H1, I1, J1.
Two	Change exponential to logarithmic expression	A2, B2, C2, D2, E2, F2, G2, H2, I2, J2.
Three	Change logarithmic expression to exponential	A3, B3, C3, D3, E3, F3, G3, H3, I3, J3.
Four	Use the properties of logarithms	A4, B4, C4, D4, E4,

F4, G4, H4, I4, J4.

Table 8: The distribution of topics according to Students Group for Week Three

S/N	Topics	Groups
One	Algebraic Expression	A1, B1, C1, D1, E1, F1, G1, H1, I1, J1.
Two	Simple Equations	A2, B2, C2, D2, E2, F2, G2, H2, I2, J2.
Three	Simultaneous Equations: (Substitution)	A3, B3, C3, D3, E3, F3, G3, H3, I3, J3.
Four	Simultaneous Equations: (Elimination)	A4, B4, C4, D4, E4, F4, G4, H4, I4, J4.

Upon completion of the learning task in the expert groups, the students (A1, B1, C1, D1, E1, F1, G1, H1, I1, and J1) returned to their home groups to teach their members what they learned in the expert groups. The home groups discussed, debated, brainstormed, their assigned task and individual member attempted all the self-assessment for the week individually prescribed in the modules. The whole process would be repeated two times for each week in line with Jigsaw strategy via Mastery learning (JSML) and Jigsaw strategy (JS) principles. At the end of the self-assessment (formative test).

Third Phases - Post-test

At the conclusion of the treatment, a post-test was given to all the students in the two groups. The scripts of the post-test in the two groups were collected, marked and used for further statistical analysis of the study.

Method of Data Analysis

The data analysis was carried out through, descriptive statistics (means and standard deviations) for Pre-test and Post-test, for the control and treatment groups. Independent t-test was applied with the assistance of statistical package for social sciences (SPSS) version 22.
To examined whether there were any significant differences exist between the post-test mean score of both the treatment and control groups.

Results

Table 1 exhibited that the treatment group gained a mean score of 3.78 with standard deviation of 9.77, while the control group gained a mean score of 4.76 with standard deviation of 9.77. This indicated that the treatment group achieved higher mean scores equated with control group. The mean score difference between the groups was 0.98 with a t-value of 12.31. However, the p-value was 0.000l ($p<.05$) indicating the difference in the mean score of the two groups was significant. This means that the difference in the mean score of both the groups was significant. In short, both the students in the control and experiment group were less alike in abilities before the treatment was administered.

Table 6: The Mean Mathematics Achievement Score of Control and Treatment Groups in Pre-test and Post-test

Group	Mathematics Pre-test Score			Mathematics Post-test Score		
	Mean	**SD**	**n**	**Mean**	**SD**	**n**
Treatment Group One (JSML)	9.750	2.529	40	19.350	3.278	40
Control Group	9.450	2.353	40	14.750	3.160	40
Total	9.150	2.357	120	16.550	3.934	120

To determine whether any significant differences exist between the post-test mean score of both the treatment and control groups, an independent sample t-test was done.

Table 7: The independent sample t-test

Group	n	Mean	Std. Deviation	t	Sig. (2-tailed)
Treatment	40	19.350	3.278	42.78	
Control	40	14.750	3.160		

Table 2 exhibited that the control group gained a mean score of 14.750 with standard deviation of 3.16 while the treatment group gained a mean score of 19.35 with standard deviation of 3.28 respectively. The mean score difference between the groups was 4.60 with a t-value of 42.78. However, the p-value was 0.000l ($p<.05$) indicating the difference in the mean score of the two groups was significant. Hence the hypothesis, "There are no significant differences between the post-test mathematics achievement scores of the Treatment and Control Groups" is rejected. Thus it shows that there is significant difference between the achievement of control group and treatment group. This finding demonstrated that the students in the treatment group achieved better using JSML module than the control group that uses the conventional learning method. The difference between the pre-test and post-test mean scores for students taught using JSML method is (10.60), above the mean gain of (7.40) for students in the conventional method. The difference between the mean post-test scores between the two groups is 2.80 and is in favour of the JSML group. This suggests that the JSML students understand content learnt materials more than their counterpart in the other group did.

DISCUSSION

The JSML module can be used as an enabler in the teaching and learning of Mathematics, and more specifically of algebra, indices, logarithms, and simultaneous equation, as there was a significant increase in students understanding of mathematics in the treatment group as compared to students in the control group. The use of the JSML module not only increased student scores, it was observed that the module allowed realization of a lively classroom where

cooperative and collaborative principles of learning were manifest. This finding is supported by Elaldi (2016), where a study was conducted with two groups using the pre and post mathematics achievement to learn mathematical concepts. The findings also corroborate other studies done to determine the effects of a cooperative and mastery learning on students learning (Capar & Tarim, 2015; Slavin, 1990; Slavin, 2013; Lavasani & Khandan, 2011; Mbacho & Githua, 2013) This improvement can be attributed to the design of the constructivist learning environment anchored on the twin concepts of scaffolds and zone of proximal development. The findings also suggest that cooperative and mastery learning were great motivational tool as students' confidence increased when the JSML module was used to enhance the students' learning process. This was especially beneficial for the lower ability students. Jigsaw strategy of cooperative learning acted as a scaffold which enabled learners to reach their zone of proximal development (Vygotsky, 1978). This finding is supported Barr & Wessel, 2018 study whereby it was observed that cooperative based activities encouraged higher order thinking skills, and had a positive effect in motivating students toward learning.

When students were asked how the JSML module affected them, they had many positive things example: it made them more engaged in the learning and enabled them to think at higher levels. In a similar study, Kalia (2005) investigated the effectiveness of Mastery Learning Strategy and Inquiry Training Model on pupils' achievement in science found that treatment group attain significantly higher achievement scores than Control Group.

CONCLUSION

In this study, the Jigsaw strategy via mastery learning (JSML) module has proven to be an effective tool in enhancing Mathematics teaching and learning, specifically in learning algebra, indices, logarithms, and simultaneous equation. Students were able to experience a hands-on method of learning which had a positive effect in enabling them to understand the concepts better rather than just being passive learners. This encouraged a more interactive teacher-student interactional environment where everyone worked as a team to guide, help and assist one another to reach the required goals. Overall, JSML is an effective tool in assisting the teacher and students in the mathematics classroom to achieve the principles of constructivist learning. This supports the findings of (Rachmah, 2017; Wilson, Pegram, Battise & Robinson, 2017). Based on the findings of the current study, it is highly recommended that teachers be encouraged to use JSML module in teaching Mathematics. This should be coupled with research to establish better findings to conclusively ascertain whether JSML does actually have an effect on learning of broader mathematical concepts and on different levels of students.

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