Journal of Positive School Psychology
2023, Vol. 7, Issue 1
Pp 7-17

Effect of Symbolic Form Model on Senior Secondary School Students’ Self-Efficacy in Logic Content of Mathematics Curriculum

Anulika Mary Okeke
Anthonia Chioma Orga
Jane Ndubumma Chinweike
Department of Science Education, Faculty of Education, University of Nigeria Nsukka, Enugu State, NIGERIA.
Felix Oromena Egara
Department of Mathematics, Natural Sciences and Technology Education, Faculty of Education, University of the Free State, Bloemfontein, SOUTH AFRICA.

Abstract
The study investigated the effect of symbolic form model's effect on senior secondary school students' self-efficacy in logic content of mathematics curriculum. The research was guided by three research questions and three hypotheses. The study used a quasi-experimental design. The population of this research was 2,342 SS 2 learners in Enugu State's Nsukka LGA. The study's subjects were a group of 172 students from four different schools. Four SS 2 classes were randomly assigned to experimental and control groups via balloting. Both the experimental and control groups were subjected to pre- and post-testing. The study's data was collected using the Students' Self-efficacy in Logic Content of Mathematics Curriculum Questionnaire (SSLCMCQ), which has a reliability coefficient of 0.85. SPSS software was used to analyze the data collected. The study questions were reported using the mean and standard deviation, and the hypotheses were tested using analysis of covariance (ANCOVA) at a .05 level of significance. The symbolic form model in teaching significantly boosted students' self-efficacy in logic content of Mathematics curriculum, according to the findings. Furthermore, gender was not significant on students' self-efficacy in logic content of Mathematics curriculum. Recommendations were made.

Keywords:
Mathematics; Symbolic Form Model; Students’ Self-Efficacy; Gender; Logic.

Article History:
Received: 17th Nov. 2022
Accepted: 28th Dec. 2022
Published: 25th Jan. 2023

1. INTRODUCTION

Mathematics is an indispensable tool in most fields of human endeavours and its role in the development of any nation like Nigeria cannot be underestimated. Thus, its teaching and learning from primary to tertiary levels of education need to be taken seriously. Ogundele (2013) stated that Mathematics cannot be neglected in any nation that wishes to develop scientifically, technologically, and even economically. Bot (2017) noted that the knowledge of Mathematics is very imperative in harnessing both human and material resources to promote development in any society. More precisely, the knowledge of Mathematics is highly relevant and applicable in engineering, medicine, architecture, agriculture, economics, marketing, accounting among other disciplines necessary for the nation’s development (Inweregbuh et al., 2020; Okeke et al., 2022a, 2022b). Accordingly, Titrek et al. (2019) asserted that, the knowledge of Mathematics is fundamental in various Sciences such as Pharmacy, Medicine, Computer Studies, Engineering, Aviation, Information and Communication Technology among others. Mathematics also helps individuals in logically establishing relationships between known and required facts which enable them to generate possible solutions to their numerous problems (Egara et al., 2018, 2021; Mosimege & Egara, 2022; Nzeadibe et al., 2019, 2020). It also encourages students to be accurate, to arrange facts in a systematic and orderly manner, and to use logical reasoning to reach valid conclusions. From the foregoing, every individual irrespective of career or profession needs some knowledge of Mathematics especially in this 21st century to function effectively in daily live.

According to the literature, students' achievement in Mathematics in both internal and external examinations in Nigeria is not satisfactory; some studies (Galadima & Yushau, 2007; Agashi, 2014; Agwagah & Utibe, 2015) have revealed that students' academic achievement in Mathematics is fluctuating and poor. From 2014 to 2018, an average of 37.15 percent of the 1,597,711 candidates who enrolled for the examination passed with credit marks and above, according to the West African Examination Council (WAEC) results in Mathematics (Ikwong, 2019; Osakwe, et al., 2022, 2023). This implies that 62.85% of the candidates had either a pass or fail in the subject. Further observations have also shown that students' academic achievement in the subject has been inconsistent in the past few years and falls below average (Egara, 2010, 2021). Interestingly, WAEC Chief Examiner's reports from 2016 to 2019 revealed that candidates demonstrated significant weaknesses in many areas of Mathematics, including logical reasoning and set theory as well as word problems, which also require certain degree of logic, among other topics.

Consequently, since most aspects of Mathematics require logical reasoning, this may likely affect the overall achievement of students in the subject, which therefore calls for considerable attention to the logic content of Mathematics. David-Osuagwu et al. (2011) defined logic as a systematic way of reasoning which sets to arrive at conclusions that are based on valid evidence. This implies that logic deals with evidence-based conclusions. According to Reichertz (2014), logic is one of the fundamental skills of effective thinking to raise certain questions and use them to draw reasonable inferences. This implies that logic involves an individual's ability to express ideas clearly and concisely as well as the ability to argue intelligently.

Logic in Mathematics deals with the study of the relationships between certain numbers, functions, algebra, geometrical figures, and statements of facts among others. Logical statements are either true or false and not both (David-Osuagwu et al., 2011). In other words, a logical statement in Mathematics is either critically thought of to be true or false but not both true and false at the same time. The authors further noted that every true statement has a truth value "True" (T) while every false statement has a false value, "False" (F). Logical statements can take the form of a simple, compound, conjunction, conjunction and disjunction, conditional and bi-conditional statements (Otto, 2015). A simple statement is a sentence that is either true or false but not both. Simple logical statements are usually denoted by p, q or r among other symbols. A combination of two or more simple statements using a conjunction or disjunction forms a compound statement. When two or more simple statements are connected symbolically by "Λ", this implies conjunction whereas when "V" is used as a connective, it denotes disjunction. Logical statements could also be conditional or bi-conditional. Conditional statements are those with one implication while bi-conditional statements have two implications. From the foregoing, it may be understood that symbolic expressions of Mathematical ideas and operations are integrated into the learning of logic content in Mathematics. This can determine how much success students may achieve with their self-efficacy and interest in this aspect of the subject.

Many factors have also been adduced to influence the extent to which students learn and consequently perform in Mathematics. Some researchers (Sarfo et al., 2020, 2022; Eze, 2011; Okafor & Anaduaka, 2013) enumerated such factors to include mathematics anxiety, inadequate teaching materials, lack of qualified teachers, poor school environment and poor use of instructional materials. Studies (Kurumeh, 2007; Yara & Otieno, 2010) have also shown that the use of inappropriate teaching methods is one of the factors accountable for poor achievement in Mathematics. The WAEC Chief Examiners Reports (2015-2018) also attribute poor achievement of students in Mathematics to methods adopted by teachers in teaching the subject. This, therefore, raises concern about the effect of the teaching methods used by teachers in teaching Mathematics, especially the logic content of the subject.

Teaching methods are supposed to vary, depending on the topic of the lesson. Moemeke (2016) noted that a teaching method is an approach adopted by a teacher to help students learn the contents of a particular subject to achieve some predetermined learning objectives. This means that teaching methods are the various ways adopted by teachers in presenting the contents of a given subject matter to students and involve the activities implemented by the teacher to enable the students to learn. The common teaching methods employed by teachers in Nigeria secondary schools are the conventional methods (Egara et al., 2018).

Conventional method of teaching is an instructional process whereby as the session progresses, students' engagement in the teaching and learning process is confined to listening, asking, and answering questions, and copying notes. Ikwong (2019) defined conventional teaching methods as methods that recognize the teacher as an expert who transmits knowledge to the students who listen as a novice. Thus, the methods are regarded as teacher-centred methods. Some of the methods include lecture method, discussion method, active demonstration method, seminar method, assignment method, project method among others (Mkpa, 2009). Though, the methods are said to be very easy to adopt and teacher friendly as well as helping teachers to cover a wide range of topics within a short time. Abiodum et al. (2010) asserted that conventional teaching methods cannot meet the learning needs of students for the desired outcome. In the same vein, Eze (2011) noted that virtually every teacher in the Nigerian school system employs conventional teaching methods in teaching, including those that teach Mathematics despite their understandable weaknesses. Maybe, this is because the methods make learning boring and less interesting to students especially given that they are not actively involved in the lesson.

It is imperative to note that, lack of students' self-efficacy and interest in Mathematics may lead to significant weaknesses in the students' learning outcomes in some aspects of the subject, such as the logic content of Mathematics. Consequently, the search for more effective and innovative teaching methods that may enhance the teaching and learning of this concept of Mathematics has become pertinent considering the importance of logical reasoning to students. One of the innovative teaching methods that seem viable but is yet to be explored with the teaching and learning of logic content of Mathematics is the symbolic form model.

The symbolic form model is a theoretical framework on how students can generate and understand mathematical functions and relationships using symbols (Chirume, 2012). Sherin (2001) asserts that learners or students can combine conceptual schema and symbols template to make sense of learning. The conceptual schema is a knowledge structure that provides the basis for conceptualization of knowledge imbedded in mathematical expressions while the symbols template is concerned with the element of knowledge which gives structure to the mathematical expressions. In essence, for meaningful learning to take place, there is a need to understand the structure of logical-mathematical expressions about relationships between certain numbers, functions, algebra, geometrical figures, as well as statements of facts and how the various parts of a mathematical expression are connected symbolically.

The symbolic model therefore seems to have the potential of helping students understand logical mathematical expressions using symbols. Students only need to be guided by the teacher to use various patterns or order of symbols to express mathematical facts. A study by Chirume (2012) who investigated the influence of mathematical symbols on secondary school students' understanding of mathematical concepts reported that proper understanding and use of mathematical symbols improved students' achievement. Similarly, Ebiendebele and Adetunji (2013) studied symbolic notations and their impact on students' achievement in algebra showed that students exposed to symbolic notations had significantly higher achievement than those not exposed to symbolic form, but both variables were effective. Based on these reports, the use of symbolic form model may possibly promote students' learning of logic content of Mathematics curriculum.

Self-efficacy is an important concept in any learning endeavour. Self-efficacy according to Bandura (2009), is a motivational orientation that stimulates people's confidence in their ability to organise, execute or accomplish a task at a prescribed ability level. Bandura further stated that self-efficacy is a critical factor in whether an individual can achieve in a field of endeavour. In essence, self-efficacy deals with a person's self-conviction about accomplishing a task by self without depending on others' ability or support. It concerns a person's judgment about being able to perform a particular activity successfully. Thus, Worchel et al. (2010) defined self-efficacy as the extent to which individuals believe they have the skills and opportunities necessary to act. It typically explains the confidence underlying an individual's successful completion of some assigned tasks (Chan & Lam, 2010). From the foregoing, self-efficacy can be defined as a person's judgment about self-competence in carrying out designated tasks or assignments successfully. In this study, self-efficacy is defined as a person's belief in his or her capacity to successfully accomplish a task including logic content from the mathematics curriculum. Researchers (Motlagh et al., 2011; Akongfe et al., 2013) have revealed a low level of self-efficacy among students in different school subjects. According to Pajares (2009), students who have a high level of self-efficacy have a greater desire to learn, which has a beneficial impact on their achievement.

Students' self-efficacy in Mathematics may however vary depending on their gender differences. Akani (2009) defined gender as a social and cultural construct that specifies the qualities, behaviour and roles in which different societies ascribe to females and males. These roles differentiate females from males in terms of what they are not expected to do and vice-versa. This means that it is these socially assigned roles and expectations that define the concept of gender. Gender, according to Udousoro (2011), is a cultural construct that distinguishes and categorizes creatures based on reproductive and cultural anticipated roles. These roles may imply people's performance tasks, for instance, those in Mathematics. Udousoro also asserted that girls find Mathematics more difficult than boys. This is somewhat related to their self-efficacy and interest in the subject.

In several research, gender inequalities in student self-efficacy have been discovered, with girls having lower self-efficacy in Mathematics than boys (Watt, 2006; Kurumeh et al., 2012). However, according to several studies (Louis & Mistele, 2012; Huang, 2013), male students have stronger self-efficacy in Mathematics than female students. Contradictions in these findings have continued to attract the interest of researchers, for example, if gender differences exist in students' self-efficacy in the logic content of the mathematics curriculum, particularly when taught using symbolic instructional models.

From the reviewed literature, instructional models seem to provide a good framework for effective teaching and learning. According to Pope (2013), instructional models help the teacher to design and present learning activities in such a way that will meet the diverse needs of learners. As stated by Albarmale County Public Schools (2014), instructional models are meant to assist the teacher to reach some specific goals. Some studies (Agommouh, 2010; Ukozor, 2011; Okafor & Anaduaka, 2013; Kwalia et al., 2016) have been conducted both local and foreign to investigate the effects of different instructional models and methods on students' self-efficacy in Mathematics, but, a significant positive effect is yet to be made on students' learning in Mathematics especially to improving their self-efficacy in logic content of the subject which have shown some weakness according to WAEC and research reports. This, therefore, necessitated this study in determining the effect of symbolic form model on senior secondary school students' self-efficacy in logic content of Mathematics curriculum in Nsukka Education Zone of Enugu State.

2. THEORETICAL BASES

Jerome Brunner proposed the constructivism theory of learning in 1960. Learning is an active process in which learners develop new ideas or concepts (knowledge) based on previous/current experiences, according to the theory's main assumption. In contrast to the passive teacher-centered approach, Bruner views learning as a process in which individuals develop their own knowledge. Learners can use their prior experiences and knowledge to identify facts, relationships, and new truths to be learnt in Bruner's theoretical model. When students are given the opportunity to interact with the actual world by investigating and manipulating objects as well as conducting experiments, they may use their cognitive processes to select and change information, build hypotheses, and make decisions. The information is then given meaning and order by the cognitive structures, schema, or mental models, which allow the individual to proceed beyond the information provided. Learners or students may become more interested in topics and activities discovered on their own because of this approach than in a teacher-centered education strategy.

Bruner's constructivist theory is pertinent to this study because it highlights learners' preparedness, which is evidenced by their curiosity, self-discovery of facts, which is driven by their self-efficacy, and students' centered activities, all of which are explored in this study. For this reason, using symbolic form instructional model, the teaching and learning process becomes more student-centered that enabling students in discovering or constructing more knowledge and facts about certain activities that can boost their self-efficacy in the logic content of the mathematics curriculum.

Research Questions

The following research questions were posed to guide the study

1. What are the mean self-efficacy ratings of students taught logic content of Mathematics curriculum using symbolic form and those thought with conventional method?
2. What is the influence of gender on the mean self-efficacy ratings of students in logic content of Mathematics curriculum?
3. What is the interaction effect of instructional models and gender on the mean self-efficacy ratings of students in logic content of Mathematics curriculum?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference in the mean self-efficacy ratings of students taught logic content of Mathematics curriculum using symbolic form and those taught with conventional method.
2. There is no significant difference in the mean self-efficacy ratings of male and female students in logic content of Mathematics curriculum.
3. There is no significant interaction effect of instructional models and gender on the mean self-efficacy ratings of students in logic content of Mathematics curriculum.

3. METHODS

Study Design and Sample

The quasi-experimental research design was used in this study, notably the non-equivalent group pretest-posttest design type. A quasi-experimental design, according to Nworgu (2015), is one in which intact classes or pre-existing groups are employed as experimental and control groups instead of random sampling and group assignment of individuals. The research was conducted in Enugu State's Nsukka Local Government Area (LGA) Education Zone. In the Nsukka Local Government Area, there are thirty (30) secondary schools. Seven (7) of the thirty secondary schools are single sex, with three (3) males and four (4) females, while twenty-three (23) are co-educational. The population of the study comprised 2,342 (1,121 males and 1,221 females) Senior Secondary School Two (SS 2) students in Nsukka LGA (Source: PPSMB- Post-Primary Schools Management Board, Nsukka, August 2019).

The sample consisted of 172 SS2 students drawn from secondary schools in Nsukka LGA using a multistage sampling procedure. Individual students provided consent before participating in the study. In the first stage, four co-educational secondary schools were purposively sampled. This was because the researchers were only interested in co-educational schools (mixed schools) where male and female students would be in the same class and same school. In the second stage, SS2 intact class was purposively sampled for the study. This is because, SS2 students have covered a wide content area in Mathematics, including the logic content of its curriculum which this study was based on. The four schools selected were randomly assigned by balloting to experimental (symbolic form model) and control (conventional method) groups respectively.

The study's data collection instrument was the Students' Self-efficacy in Logic Content of Mathematics Curriculum Questionnaire (SSLCMCQ), which was created by the researchers. There were two sections to the SSLCMCQ (A and B). Section A featured personal information such as the students' identification number and gender, while Section B contained 26 items eliciting information on students' self-efficacy in the mathematics curriculum's logic content. The SSLCMCQ was created using a four-point Likert scale with response possibilities ranging from Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). The corresponding numerical values for the response options range from 4, 3, 2 to 1 respectively. The SSLCMCQ was subjected to constructed validation approach. The instrument was validated by two specialists in Mathematics Education and one in Measurement and Evaluation from the University of Nigeria, Nsukka's Department of Science Education. Cronbach's Alpha was used to determine the SSLCMCQ's dependability. Statistical Package for Social Sciences was used to calculate the SSLCMCQ's internal consistency, which was found to be 0.85.

Experimental procedure and data analysis

In each of the four sampled schools, a treatment condition was randomly assigned to the SSII intact classes. The researchers used four regular SSII Mathematics teachers in the sampled schools as research assistants. The selection criteria for a research assistant was that the instructor must have a bachelor's degree in mathematics (B.Ed) or an equivalent degree with at least three years of graduate education experience. The researchers trained the research assistants in the following areas: Objective of the study, Instructional methods to use, Lesson presentation and Administration of the instrument.

The actual teaching commenced after the research assistants had been trained for one week, under the supervision of the researchers. The research assistants delivered the pre SSLCMCQ to the students before the start of the teaching to determine their level of self-efficacy in the logic content of the mathematics curriculum. This was to determine the homogeneity of students in terms of self-efficacy in the logic content of the mathematics curriculum. The actual teaching (treatment) commenced a week after the pretest administration. The treatment lasted for four weeks with three lessons per week making a total of twelve lesson periods. The use of three lesson periods per week was due to the schools' timetable for mathematics. The research assistants used these regular periods on the timetable. This was to ensure a normal flow following the timetable of the schools and to ensure that the students were not aware they were used for the experiment. One week after the treatment, the research assistants administered the posttest for SSLCMCQ on the students to determine their level of self-efficacy in the logic content of the mathematics curriculum. Data collected were analyzed using SPSS software version 23.0. The study questions were reported using the mean and standard deviation, while the null hypotheses were tested using the analysis of covariance (ANCOVA) at a .05 level of significance.

Journal of Positive School Psychology
2023, Vol. 7, Issue 1
Pp 7-17

4. RESULTS

The results are presented in line with the research questions and the null hypotheses that guided the study.

Research Question 1

What are the mean self-efficacy ratings of students taught logic content of Mathematics curriculum using symbolic form and those thought with conventional method?

Table 1: Pretest and Post-test Mean Self-Efficacy Ratings of Students taught Logic Content of Mathematics Curriculum

Groups		Pretest		Posttest		
		$\bar{X}$	D	$\bar{X}$	D	Mean Difference
Symbolic Form Model	7	6 1.56	.49	2.20	.14	30.64
Conventional Method	5	6 1.78	.27	4.13	.75	2.35

Note: N = Number of Respondents, $\bar{X}$= Mean, SD = Standard deviation

Result in Table 1 shows the pretest and posttest mean self-efficacy ratings of students taught logic content of Mathematics curriculum using symbolic form model (treatment group) and conventional method (control group). The result shows that students who were taught logic content of Mathematics curriculum using the symbolic form model had a mean self-efficacy rating of ($\bar{X}$= 61.56, SD = 8.49) at pretest and a mean self-efficacy rating of ($\bar{X}$= 92.20, SD = 6.14) at post-test, while those who were taught using the conventional method had mean self-efficacy rating of ($\bar{X}$= 61.78, SD = 7.27) at pretest and a mean self-efficacy rating of ($\bar{X}$= 64.13, SD = 4.75) at posttest. The pretest and posttest mean differences of 30.64 and 2.35 for students taught logic content of Mathematics curriculum using symbolic form model and the conventional method suggests that the symbolic form model is more potent in increasing students' self-efficacy in logic content of Mathematics curriculum, unlike the conventional method.

Hypothesis One

H01: There is no significant difference in the mean self-efficacy ratings of students taught logic content of Mathematics curriculum using symbolic form and the conventional method ($p < 0.05$).

Journal of Positive School Psychology
2023, Vol. 7, Issue 1
Pp 7-17

Table 2: Analysis of Covariance (ANCOVA) of the difference in the mean Self-Efficacy Ratings of Students taught Logic Content of Mathematics Curriculum

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected Model	34302.401[a]	4	8575.600	304.878	.000	.880	
Intercept	12408.866	1	12408.866	441.158	.000	.725	
Pretest Self-Efficacy	324.323	1	324.323	11.530	.001	.065	
Gender	55.588	1	55.588	1.976	.162	.012	NS
Groups	34052.289	1	34052.289	1210.621	.000	.879	Sig
Groups * Gender	92.217	1	92.217	3.278	.072	.019	NS
Error	4697.367	167	28.128				
Total	1094202.000	172					
Corrected Total	38999.767	171					

Note: df= Degree of Freedom, F= F-ratio, Sig.= Significant/probability value, NS = Not Significant

Table 2 displays the ANCOVA of the difference in mean self-efficacy ratings of students who were taught logic subject in the mathematics curriculum using the symbolic form versus the traditional technique. The result reveals an f-ratio of [F(1, 1210.621) =.000, p < .05]. The null hypothesis one (H01), which states that there is no significant difference in the mean self-efficacy ratings of students taught logic content of Mathematics curriculum using the symbolic form and the conventional method, is therefore rejected because the associated probability value of .000 is less than the 0.05 level of significance at which the result is being tested. In other words, the effect of the symbolic form model vs the conventional technique on students' self-efficacy in the logic content of the mathematics curriculum differs significantly.

Research Question Two:

What is the influence of gender on the mean self-efficacy ratings of students in logic content of Mathematics curriculum?

Table 3: Pretest and Post-test Mean Influence of Gender on the Mean Self-Efficacy Ratings of Students in Logic Content of Mathematics Curriculum

Gender		Pretest		Posttest		
	N	$\bar{X}$	SD	$\bar{X}$	SD	Mean Difference
Male	83	61.08	7.38	77.80	15.59	16.72
Female	89	62.21	8.34	78.81	14.70	16.60

Note: N = Number of Respondents, $\bar{X}$= Mean, SD = Standard deviation

The result in Table 3 shows the influence of gender on the mean self-efficacy ratings of students in the logic content of the mathematics curriculum. The result shows that male students had a mean self-efficacy rating of (X = 61.08, SD = 7.38) at the pretest and a mean self-efficacy rating of (X = 77.80, SD = 15.59) at posttest. The mean difference obtained for the male students' self-efficacy rating in logic content of the mathematics curriculum was 16.72. While on the other hand, the female students had a mean self-efficacy rating of (= 62.21, SD = 8.34) at pretest and a mean self-efficacy rating of (X = 78.81, SD = 14.70) at posttest. The mean difference obtained for the female students' self-efficacy rating in the logic content of the mathematics curriculum was 16.6. Summarily, the result shows that male students demonstrate slightly higher self-efficacy in the logic content of the mathematics curriculum than their female counterparts.

Hypothesis Two

H02: There is no significant difference in the mean self-efficacy ratings of male and female students in logic content of Mathematics curriculum.

The ANCOVA analysis of the substantial difference in mean self-efficacy ratings of male and female students in the logic component of the mathematics curriculum is also shown in Table 2. An f-ratio of [F (1, 1.976) =.162, $p > 0.05$] was obtained as a result. The null hypothesis two (H02) that there is no significant difference in the mean self-efficacy ratings of male and female students in logic content of Mathematics curriculum is not rejected because the associated probability value of .162 is greater than the 0.05 level of significance. As a result, the conclusion obtained is that there is no significant difference in male and female students' mean self-efficacy ratings in the logic component of the mathematics curriculum. This means that students' self-efficacy in the logic component of the mathematics curriculum is unaffected by gender.

Research Question Three

What is the interaction effect of instructional methods and gender on the mean self-efficacy ratings of students in logic content of Mathematics curriculum?

Table 4: Pretest and Post-test Mean interaction effect of instructional methods and gender on the mean self-efficacy ratings of students in logic content of Mathematics curriculum

Instructional Models			Pretest		Posttest		
	Gender	N	$\bar{X}$	SD	$\bar{X}$	SD	Mean Difference
Symbolic Form Model	Male	39	60.41	8.12	93.44	5.55	33.03
	Female	48	62.50	8.75	91.19	6.46	28.69
Conventional Method	Male	44	61.68	6.69	63.95	4.31	2.27
	Female	41	61.88	7.92	64.32	5.22	2.44

Note: N = Number of Respondents, $\bar{X}$= Mean, SD = Standard deviation

The result in Table 4 shows the interaction effect of instructional models and gender on the mean self-efficacy ratings of students in the logic content of the mathematics curriculum. The result shows that male students taught logic content of Mathematics curriculum using symbolic form model had mean self-efficacy rating of (X = 60.41, SD = 8.12) at pretest and a mean of (X = 93.44, SD = 5.55) at posttest. The mean difference between pretest and posttest was 33.03. Whereas the female students taught logic content of Mathematics curriculum using symbolic form model had mean self-efficacy rating of (X = 62.50, SD = 8.75) at pretest and a mean of (X = 91.19, SD = 6.46) at posttest. The mean difference between the pretest and posttest was 28.69. Furthermore, the result in Table 4 also shows that male students taught logic content of Mathematics curriculum using the conventional method had a mean self-efficacy rating of (X = 61.68, SD = 6.69) at pretest and a mean of (X = 63.95, SD = 4.31) at posttest. The mean difference between the pretest and posttest was 2.27. While the female students taught logic content of Mathematics curriculum using the conventional method had a mean self-efficacy rating of (X = 61.88, SD = 7.92) at pretest and a mean of (X = 64.32, SD = 5.22) at posttest. The mean difference between the pretest and posttest was 2.44. Summarily, the result shows that male students had a slightly higher self-efficacy in the logic content of the mathematics curriculum than their female counterparts when taught using the symbolic form model, but female students had slightly higher self-efficacy levels when taught using the conventional method.

Hypothesis Three

H03: There is no significant interaction effect of instructional methods and gender on the mean self-efficacy ratings of students in logic content of Mathematics curriculum.

Table 2 also displays an ANCOVA study of the interaction effect of teaching modalities and gender on students' mean self-efficacy ratings in the mathematics curriculum's reasoning content. The result reveals that the f-ratio was reached [F (1, 3.278) = 0.72, p > 0.05]. The null hypothesis three (H03), which states that there is no significant interaction effect of instructional methods and gender on the mean self-efficacy ratings of students in the logic content of the mathematics curriculum, is not rejected because the associated probability value of .72 is greater than 0.05 set as the level of significance. As a result, the inference drawn is that the interaction impact of instructional models and gender on students' mean self-efficacy ratings in the mathematics curriculum's reasoning content is not statistically significant.

5. DISCUSSION

The finding of this study has shown that the symbolic form model is potent in increasing students' self-efficacy in the logic content of the mathematics curriculum, unlike the conventional method. The test of the corresponding hypothesis also revealed that there is a substantial difference in the mean self-efficacy ratings of students taught logic content in the mathematics curriculum in favour of the symbolic form model. The findings of the study could be attributed to the fact that both symbolic form model is student-centered, and so students were allowed to participate actively in the lesson and to generate new knowledge from the learning activities assigned to them while the teacher oversees what they are doing. This is unlike the conventional way of teaching where students' engagement in the teaching and learning process is limited to listening, asking, and answering questions, and copying notes as the session continues. Thus, it may be possible that the adoption of the symbolic form model in teaching can effectively increase students’ self-efficacy in the logic content of the mathematics curriculum.

This finding adds credence to the findings by Chirume (2012) whose study showed that teaching with symbols considerably affects the formation of ideas, understanding and communication of concepts in Mathematics and consequently affect their interest and achievement in the subject. Likewise, the finding is consistent with that of the study by Ebiendele and Adetunji (2013) which showed that there was a significant difference between the performance of students in the achievement test when taught with symbolic notations and without symbolic notations in favour of those taught with symbolic notations. In essence, the use of the symbols model in teaching effectively enhanced teaching and learning to an appreciable extent.

From the finding of this study, it was discovered that male students demonstrate slightly higher self-efficacy in the logic content of the mathematics curriculum than their female counterparts. When this was put to the ANCOVA test, it was discovered that there is no significant difference between male and female students' mean self-efficacy ratings in the logic content of the mathematics curriculum. This demonstrates that gender has no bearing on students' self-efficacy in the logic content of the mathematics curriculum. In other words, in the logic content of the mathematics curriculum, both male and female students reported identical levels of self-efficacy. This finding supports the finding by Albayrak and Unal (2011) whose study showed that there was no significant difference in male and female teachers’ mathematics teaching efficacy beliefs. However, the finding contradicts previous findings from the studies by Louis and Mistele (2012) which revealed that female mathematics students held significantly lower self-efficacy than their male counterparts and Huang (2013) whose study disclosed that there exist gender differences in academic self-efficacy in mathematics in favour of the males than their female counterparts. In other words, it showed that male students had higher self-efficacy in mathematics than their female counterparts.

The finding of this present study however could be true since the studies are based on foreign contexts. Thus, in the Nigerian context and Nsukka education zone in particular such disparities in Mathematics self-efficacy of male and female students may be insignificant. Being a male or female may not be a significant factor in determining students’ self-efficacy in Mathematics. Perhaps this explains why, in this study, there was no significant difference in mean self-efficacy ratings of male and female students in the logic content of the mathematics curriculum.

The finding of this study also showed that male students had a slightly higher self-efficacy in the logic content of the mathematics curriculum than their female counterparts when taught using the symbolic form model, while the female students displayed a slightly higher self-efficacy than the males when taught using the conventional method. However, no significant interaction effect of teaching methods and gender on students' mean self-efficacy ratings in the logic content of the mathematics curriculum was discovered. This implies that male and female students taught using symbolic form model and the conventional method demonstrated similar levels of self-efficacy in the logic content of the mathematics curriculum. In other words, students’ self-efficacy in the logic content of the mathematics curriculum was not influenced by the instructional methods and the students’ gender. This also implies that the instructional methods were not gendered biased with respect to increasing students’ self-efficacy in the logic content of the mathematics curriculum.

The finding is somehow in line with some findings from previous studies. For example, the finding supports Agene (2009), who looked at the effect of the ontological structure model on teaching and learning in senior secondary schools in Cross River State and discovered no significant interaction effect of instructional approaches and gender on students' mean achievement scores. Similarly, Albayrak and Unal (2011) found that there was no interaction effect of teaching methods and gender on teachers' mathematics teaching efficacy beliefs. As a result, the instructional methods used benefited both male and female students equally. As a result, according to this study, there may be no significant interaction effect of teaching methods and gender on students' mean self-efficacy ratings in the logic content of the mathematics curriculum. This is because if both gender of students with a similar self-efficacy level are taught using the same method and under the same learning conditions, they are bound to have a similar level of learning outcomes.

6. CONCLUSIONS

The implementation of the symbolic form model in teaching significantly boosted students' self-efficacy in the logic content of the mathematics curriculum, according to the findings of this study. The symbolic form model, if adopted by Mathematics teachers would have similar effects in terms of enhancing students’ self-efficacy in the logic content of the mathematics curriculum. In the logic content of the mathematics curriculum, gender has no substantial impact on learners' self-efficacy. Finally, in the logic content of the mathematics curriculum, there was no significant interaction effect of instructional approaches and gender on students' self-efficacy.

This research paper is not without limitations. The researchers acknowledge that other factors that were not part of the study such as students' intellectual ability, home and school-related factors may have exerted some influence on the students' self-efficacy in the logical content of the mathematics curriculum which is likely to affect the results. Hence, there is a need to consider this when drawing conclusions based on the findings of this study.

This research recommends the following based on the findings of the study (1) Mathematics teachers should be encouraged to adopt the symbolic form model of instruction when teaching the logic content of the mathematics curriculum to boost the self-efficacy of students. (2) Government, through the ministries of education, should organize seminars and workshops for Mathematics teachers on the use of symbolic form model of instruction in the teaching and learning of logic content of Mathematics curriculum. This will increase access and flexibility for learners mastering the content thereby increasing their level of self-efficacy in this aspect of the subject.

References

1. A. Hariri, A. D. Irawan, and A. Q. Purwo, "Authority Dynamic Law of Central and Regional Governments in Managing Natural Resources," in Proceedings of the 2nd International Conference of Law, Government and Social Justice (ICOLGAS 2020), Dec. 2020, pp. 200–208. doi: 10.2991/assehr.k.201209.286.
2. P. A. Prabowo, B. Supriyono, I. Noor, and M. K. Muluk, "Special autonomy policy evaluation to improve community welfare in Papua province Indonesia," International Journal of Excellence in Government, vol. 2, no. 1, pp. 24–40, Jan. 2021, doi: 10.1108/IJEG-06-2019-0011.
3. A. Febriansyah, "Effectiveness and Contribution of Land and Building Tax to Local Revenue:," presented at the International Conference on Business, Economic, Social Science, and Humanities – Economics, Business and Management Track (ICOBEST-EBM 2019), Bandung, Indonesia, 2020. doi: 10.2991/aebmr.k.200108.047.
4. A. Wardhono, J. A. Arifandi, and Y. Indrawati, Panduan Praktik Kelembagaan Usaha Budidaya Tembakau Besuki Na-Oogst. Pustaka Abadi, 2018.
5. M. M. Bate'e, "Analysis of Collection Procedures and Calculation System for Land and Rural and Urban Buildings Tax in Hilihao Village, Gunungsitoli Sub-District," International Journal of Economics, Business and Accounting Research (IJEBAR), vol. 4, no. 3, pp. 301–312, 2020.
6. E. Indarti, "Bridging the Gaps: A Paradigmatic Insight into Philosophy of Law," Diponegoro Law Rev., vol. 1, no. 1, p. 1, Oct. 2016, doi: 10.14710/dilrev.1.1.2016.1-16.
7. M. Mukrimin, L. Lahaji, and A. Akifah, "Democratisation, Decentralisation and Islam: A Reflection of Two Decades of Indonesia's Local Autonomy," Journal of Islamic Studies, vol. 18, no. 1, pp. 41–63, Jun. 2018, doi: 10.30603/au.v18i1.283.
8. P. Perwitiningsih and R. Simarmata, "The Payment of Inheritance Acquisition Duty of Right on Land and Building in Sleman," JMH, vol. 28, no. 1, pp. 75–89, Jul. 2021, doi: 10.18196/jmh.v28i1.10801.
9. J. Hutagalung, D. Kania, and Z. Muttaqin, "Tax Law Certainty on The Sale of Food and Beverages after The Enactment of Law Number 1 of 2022," Journal of Sosial Science, vol. 3, pp. 767–778, Jul. 2022, doi: 10.46799/jss.v3i4.385.
10. D. Elkins, "Horizontal Equity as a Principle of Tax Theory," Yale Law & Policy Review, vol. 24, no. 1, pp. 43–90, 2006.