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# Effect of symbolic form model on students' interest in logic content of the mathematics curriculum

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**ABSTRACT**

The effect of symbolic form model on students' interest in logic content of the mathematics curriculum was investigated in this study. 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 SS2 learners in Enugu State, Nigeria. A sample of 172 students was used. Data were collected and analyzed using the SILCMCQ and SPSS software respectively. The symbolic form model in teaching significantly boosted students' interest in logic content of the mathematics curriculum, according to the findings. The study provided recommendations, one of which is that mathematics teachers should use the symbolic form model of instruction to increase students' interest when logic content is taught.

**Keywords:** mathematics, symbolic form model, students' interest, gender, logic

## INTRODUCTION

Mathematics is a necessary tool in almost every aspect of human endeavor, and its importance in the growth of a country like Nigeria cannot be overstated. As a result, teaching and learning at all levels of education, from primary to tertiary, must be taken seriously. Mathematics cannot be overlooked by any country wishing to advance scientifically, technologically, or economically (Ogundele, 2013). Bot (2017) posited that mathematical knowledge is critical for harnessing both people and material resources in order to foster growth in every civilization. Mathematics, in particular, is very relevant and applicable in engineering, medicine, architecture, agriculture, economics, marketing, and accounting, as well as other fields critical to the nation's development (Egara, 2021). As a result, Titrek et al. (2019) asserted that mathematical knowledge is essential in a variety of fields, including pharmacy, medicine, computer science, engineering, aviation, and information and communication technology. Mathematics also aids people in logically establishing relationships between known and required facts, allowing them to come up with possible solutions to their many problems (Inweregbuh et al., 2020; Okeke et al., 2022a, 2022b, 2023). It also pushes pupils to be precise, to organize data in a systematic and orderly manner, and to achieve valid conclusions through logical thinking.

As a result of the aforementioned, every individual, regardless of job or profession, requires some knowledge of mathematics in order to function effectively in daily life in the twenty-first century (Egara et al., 2018, 2020, 2021). But it is disheartening to see that students' achievement in mathematics in both internal and external examinations in Nigeria is not satisfactory (Mosimege & Egara, 2022; Osakwe et al., 2023a, 2023b). Some studies (Agashi, 2014; Agwagah & Utibe, 2015; Galadima & Yushau, 2007) have revealed that students' academic achievement in mathematics is fluctuating and poor. From 2014 to 2018, an average of 37.15% 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). 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. 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 (WAEC, 2020). 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 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 (Eze, 2011; Okafor & Anaduaka, 2013) enumerated such factors to include inadequate teaching materials, lack of qualified teachers, mathematics anxiety (Sarfo et al., 2020, 2022), 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 so as 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; Nzeadibe et al., 2019, 2020). 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-centered 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’ 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, Ebiendele 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 did not differ significantly. Based on these reports, the use of symbolic form model may possibly promote students’ interest in learning of logic content of mathematics curriculum.

Interest is defined as the predisposition to engage in certain activities more than others (Egara, 2010; Gardner & Tamir, 2009). This implies that interest influences an individual’s choice of engaging in different activities. Usman and Okeke (2017) also defined interest as a subjective feeling of curiosity or concentration in certain activities or objects. In other words, when an individual has interest in a particular activity, such a person may favorably attend to or give time to that activity. Imoko and Agwagah (2006) noted that interest is a significant factor in students’ learning because an individual is likely to become more deeply involved in the activity he/she is interested in. Likewise, Adedeji (2007) noted that interest increases the chances of individual setting goals that will lead to high task persistent, time investment and more effort to achieve in order to achieve them. Hence, interest is conceptualised in this study as the eagerness of students to engage in or carry out activities/tasks in logic content of mathematics. Many studies (Adaramola, 2012; Imoko & Agwagah, 2006; Kurumeh, 2007; Maduabum & Odili, 2006; Odo, 2017; Okigbo & Okeke, 2011; Takor et al., 2015; Udegbe, 2009) have in their different studies reported low interest of students in mathematics which in turn affects their achievement in the subject. Hence, it is imperative to investigate the effects of symbolic form and ontological structure model on students' interest and interest in logic content of mathematics curriculum. Students' interest in mathematics may however vary depending on their gender differences. Akani (2009) defined gender as a social and cultural construct that specifies the qualities, behavior 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 (2011) also asserted that girls find mathematics more difficult than boys. This is somewhat related to their interest and interest in the subject.

In several research, gender inequalities in student interest have been discovered, with girls having lower interest in mathematics than boys (Kurumeh et al., 2012; Watt, 2006). However, some researchers (Agwagah & Utibe, 2015; Anyaflude, 2006; Ogwuche & Kurumeh, 2011; Udofia, 2008) revealed that girls showed greater interest and achievement in mathematics than boys. Nevertheless, some studies (Agashi, 2014; Nworgu, 2015; Okigbo & Okeke, 2011; Okigbo & Osuafor, 2008) indicated that both male and female students in Nigeria have similar interest in mathematics. Contradictions in these findings have continued to attract the interest of researchers, for instance, if gender differences exist in students' interest 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 Albemarle County Public Schools (2014), instructional models are meant to assist the teacher to reach some specific goals. Some studies (Agomuoh, 2010; Kwalia et al., 2016; Okafor & Anaduaka, 2013; Ukozor, 2011) have been conducted both local and foreign to investigate the effects of different instructional models and methods on students' interest in mathematics, but a significant positive effect is yet to be made on students' learning in mathematics specially to improving their interest in logic content of the subject which have shown some weakness according to WAEC and research reports. This, therefore, necessitated this study on the effect of symbolic form model on senior secondary school students' interest in logic content of mathematics curriculum in Nsukka Education Zone of Enugu State.

### Theoretical Framework

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 as a result 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 interest, and students' centred 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 enables students in discovering or constructing more knowledge and facts about certain activities that can boost their interest in the logic content of the mathematics curriculum.

### Purpose of the Study

The main purpose of this study was to investigate the effect of symbolic form model on senior secondary school students' interest in logic content of mathematics curriculum. The study specifically sought to determine the followings:

1. mean interest ratings of students taught logic content of mathematics curriculum using symbolic form,
2. influence of gender on the mean interest ratings of students in logic content of mathematics curriculum, and
3. interaction effect of instructional methods and gender on the mean interest ratings of students in logic content of mathematics curriculum.

### Research Questions

The following research questions were posed to guide the study:

1. What are the mean interest 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 interest ratings of students in logic content of mathematics curriculum?
3. What is the interaction effect of instructional methods and gender on the mean interest ratings of students in logic content of mathematics curriculum?

### Hypotheses

The following null hypotheses were formulated for the study and were tested at 0.05 level of significance:

1. There is no significant difference in the mean interest 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 interest ratings of male and female students in logic content of mathematics curriculum.
3. There is no significant interaction effect of instructional methods and gender on the mean interest ratings of students in logic content of mathematics curriculum.

## METHODS

### Study Design and Sample

The quasi-experimental research design was used in this study, notably the non-equivalent group pre-/post-test 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 LGA, there are 30 secondary schools. Seven of the 30 secondary schools are single-sex, with three males and four females, while 23 are co-educational. The population of the study comprised 2,342 (1,121 males and 1,221 females) senior secondary school two (SS2) 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' interest in logic content of mathematics curriculum questionnaire (SILCMCQ), which was created by the researchers (**Appendix A**). There were two sections to the SILCMCQ (A and B). Section A featured personal information such as the students' identification number and gender, while section B contained 27 items eliciting information on students' interest in the mathematics curriculum's logic content. The SILCMCQ is modeled on a modified four-point Likert-type scale with response options ranging from strongly agree (SA), agree (A), disagree (D) to strongly disagree (SD). The corresponding numerical values for the response options ranged from 4, 3, 2, to 1, respectively. The SILCMCQ 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 SILCMCQ 's dependability. Statistical package for social sciences was used to calculate the SILCMCQ 's internal consistency, which was found to be 0.87.

### Experimental Procedure and Data Analysis

In each of the four sampled schools, a treatment condition was randomly assigned to the SS2 intact classes. The researchers used four regular SS2 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 (BEd) 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 SILCMCQ to the students before the start of the teaching to determine their level of interest in the logic content of the mathematics curriculum. This was to determine the homogeneity of students in terms of interest in the logic content of the mathematics curriculum. The actual teaching (treatment) commenced a week after the pre-test 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 also to ensure that the students were not aware they were used for the experiment. One week after the treatment, the research assistants administered the post-test for SILCMCQ on the students to determine their level of interest 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.

## RESULTS

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

**Table 1.** Pre- & post-test mean interest ratings of students taught logic content of mathematics curriculum using symbolic form model & conventional method

| Groups | Number of respondents | Pre-test | | Post-test | | Mean difference |
|---|---|---|---|---|---|---|
| | | Mean | Standard deviation | Mean | Standard deviation | |
| Symbolic form model | 87 | 58.22 | 6.61 | 66.46 | 7.85 | 8.24 |
| Conventional method | 85 | 57.34 | 6.49 | 59.80 | 6.56 | 2.46 |

**Table 2.** Analysis of covariance of the difference in the mean interest ratings of students taught logic content of mathematics curriculum using symbolic form & the conventional method

| Source | Type III sum of squares | df | Mean square | F | Sig. | Partial eta squared | Decision |
|---|---|---|---|---|---|---|---|
| Corrected model | 2,648.982[a] | 4 | 662.245 | 13.551 | .000 | .245 | |
| Intercept | 4,509.400 | 1 | 4,509.400 | 92.275 | .000 | .356 | |
| Pre-test interest | 650.857 | 1 | 650.857 | 13.318 | .000 | .074 | |
| Gender | 57.848 | 1 | 57.848 | 1.184 | .278 | .007 | NS |
| Groups | 1,802.818 | 1 | 1,802.818 | 36.891 | .000 | .181 | S |
| Groups×gender | 37.364 | 1 | 37.364 | .765 | .383 | .005 | NS |
| Error | 8,161.129 | 167 | 48.869 | | | | |
| Total | 697,137.000 | 172 | | | | | |
| Corrected total | 10,810.110 | 171 | | | | | |

Note. Df: Degree of freedom; F: F-ratio; Sig.: Significant/probability value; NS: Not significant; & S: Significant

**Table 3.** Pre- & post-test mean influence of gender on mean interest ratings of students in logic content of mathematics curriculum

| Gender | Number of respondents | Pre-test | | Post-test | | Mean difference |
|---|---|---|---|---|---|---|
| | | Mean | Standard deviation | Mean | Standard deviation | |
| Male | 83 | 57.99 | 6.22 | 63.60 | 7.37 | 5.61 |
| Female | 89 | 57.60 | 6.86 | 62.76 | 8.48 | 5.16 |

## Research Question One

The first research question is what are the mean interest ratings of students taught logic content of mathematics curriculum using symbolic form and those thought with conventional method?

Result in **Table 1** shows the pre- and post-test mean interest 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 interest rating of ($\bar{X}$=58.22, SD=6.61) at pre-test and a mean interest rating of ($\bar{X}$=66.46, SD=7.85) at post-test, while those who were taught using the conventional method had mean interest rating of ($\bar{X}$=57.34, SD=6.49) at pre-test and a mean interest rating of ($\bar{X}$=59.80, SD=6.56) at post-test. The pre- and post-test mean differences of 8.24 and 2.46 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' interest in logic content of mathematics curriculum, unlike the conventional method.

## Hypothesis One

Our hypothesis is, as follows: **$H0_1$**-There is no significant difference in the mean interest ratings of students taught logic content of mathematics curriculum using symbolic form and the conventional method.

**Table 2** displays the ANCOVA of the difference in mean interest 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, 36.891]=.000, p<.05). The null hypothesis one (**$H0_1$**), which states that there is no significant difference in the mean interest 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' interest in the logic content of the mathematics curriculum differs significantly.

## Research Question Two

The second research question is what is the influence of gender on the mean interest ratings of students in logic content of mathematics curriculum?

The result in **Table 3** shows the influence of gender on the mean interest ratings of students in the logic content of the mathematics curriculum. The result shows that male students had a mean interest rating of ($\bar{X}$=57.99, SD=6.22) at the pre-test and a mean interest rating of ($\bar{X}$= 63.60, SD=7.37) at post-test. The mean difference obtained for the male students' interest rating in logic content of the mathematics curriculum was 5.61. While on the other hand, the female students had a mean interest rating of ($\bar{X}$=57.60, SD=6.86) at pre-test and a mean interest rating of ($\bar{X}$=62.76, SD=8.48) at post-test. The mean difference obtained for the female students' interest rating in the logic content of the mathematics curriculum was 5.16. Summarily, the result shows that male students demonstrate slightly higher interest in the logic content of the mathematics curriculum than their female counterparts.

**Table 4.** Pre- & post-test mean interaction effect of instructional methods & gender on mean interest ratings of students in logic content of mathematics curriculum

| Instructional models | Gender | Number of respondents | Pre-test | | Post-test | | Mean difference |
|---|---|---|---|---|---|---|---|
| | | | Mean | Standard deviation | Mean | Standard deviation | |
| Symbolic form model | Male | 39 | 57.95 | 6.53 | 67.54 | 5.93 | 9.59 |
| | Female | 48 | 58.44 | 6.73 | 65.58 | 9.08 | 7.14 |
| Conventional method | Male | 44 | 58.02 | 6.01 | 60.11 | 6.79 | 2.09 |
| | Female | 41 | 56.61 | 6.96 | 59.46 | 6.36 | 2.85 |

### Hypothesis Two

Our hypothesis is, as follows: **$H0_2$-**There is no significant difference in the mean interest ratings of male and female students in logic content of mathematics curriculum.

The ANCOVA analysis of the substantial difference in mean interest 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, 1.184]=.278, p>0.05) was obtained as a result. The null hypothesis two (**$H0_2$**) that there is no significant difference in the mean interest ratings of male and female students in logic content of mathematics curriculum is not rejected because the associated probability value of .278 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 interest ratings in the logic component of the mathematics curriculum. This means that students' interest in the logic component of the mathematics curriculum is unaffected by gender.

### Research Question Three

The third research question is what is the interaction effect of instructional methods and gender on the mean interest ratings of students in logic content of mathematics curriculum?

The result in **Table 4** shows the interaction effect of instructional models and gender on the mean interest 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 interest rating of ($\bar{X}$=57.95, SD=6.53) at pre-test and a mean of ($\bar{X}$=67.54, SD=5.93) at post-test. The mean difference between pre- and post-test was 9.59. Whereas the female students taught logic content of mathematics curriculum using symbolic form model had mean interest rating of ($\bar{X}$=58.44, SD=6.73) at pre-test and a mean of ($\bar{X}$=65.58, SD=9.08) at post-test. The mean difference between the pre- and post-test was 7.14. Furthermore, the result in **Table 4** also shows that male students taught logic content of mathematics curriculum using the conventional method had a mean interest rating of ($\bar{X}$=58.02, SD=6.01) at pre-test and a mean of ($\bar{X}$=60.11, SD=6.79) at post-test. The mean difference between the pre- and post-test was 2.09. While the female students taught logic content of mathematics curriculum using the conventional method had a mean interest rating of ($\bar{X}$=56.61, SD=6.96) at pre-test and a mean of ($\bar{X}$=59.46, SD=6.36) at post-test. The mean difference between the pre- and post-test was 2.85. Summarily, the result shows that male students had a slightly higher interest 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 interest levels when taught using the conventional method.

### Hypothesis Three

Our hypothesis is, as follows: **$H0_3$-**There is no significant interaction effect of instructional methods and gender on the mean interest 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 interest ratings in the mathematics curriculum's reasoning content. The result reveals that the f-ratio was reached (F[1, .765]=.383, p>0.05). The null hypothesis three (**$H0_3$**), which states that there is no significant interaction effect of instructional methods and gender on the mean interest ratings of students in the logic content of the mmathematics curriculum, is not rejected because the associated probability value of .383 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 interest ratings in the mathematics curriculum's reasoning content is not statistically significant.

## DISCUSSION

The finding of this study has shown that symbolic form model is effective in increasing students' interest in logic content of mathematics curriculum as compared to the conventional method. Furthermore, finding from the test of the corresponding hypothesis one proved that there was a significant difference in the mean interest ratings of students taught logic content of mathematics curriculum using symbolic form and the conventional method. This implies that the symbolic form is effective in increasing students' interest in logic content of mathematics curriculum. This finding appears true as it corroborates with the findings of some previous studies. For instance, the finding supports the finding by Chirume (2012) who investigated the influences mathematical symbols on understanding of mathematics concepts by secondary school students in Shurugwi District, Zimbabwe, and found that teaching with symbols considerably affects formation of ideas, understanding and communication of concepts in mathematics and consequently affecting their interest in the subject. Furthermore, the finding agrees with the findings of Ugboduma (2017) who found that students taught geometry using ADDIE showed more interest than their counterparts taught geometry using the expository method. From the findings of these aforesaid studies, it could be deduced that the use of symbols in teaching can effectively enhanced students' interest in learning to a considerable extent. The findings of the study could be true because the symbolic form model is student-centred. In essence, students' involvement in the teaching and learning process is not limited to listening, asking and answering questions, and copying of notes as the lesson but active participation in all the learning activities while the teacher only supervises them. For this reason, the adoption of symbolic form model in teaching could effectively increase students' interest in logic content of mathematics curriculum.

The finding of this study also showed that male students demonstrate slightly higher interest in logic content of mathematics curriculum than their female counterparts. Nonetheless, when this was subjected to ANCOVA test, it was revealed that there is no **s**ignificant difference in the mean interest ratings of male and female students in logic content of mathematics curriculum. This portrays that gender is not a significant factor in determining students' interest in logic content of mathematics curriculum. That is to say, both male and female students have equal level of interest in logic content of mathematics curriculum. This no significant difference may be due to the fact that the symbolic form model used in the teaching and learning process is student-centred which enabled the male and female students in constructing more knowledge and facts, and as a result, boosted their interest in the logic content of the mathematics curriculum. The finding adds credence to earlier finding from the study by Adaramola (2012) which showed that students' gender had no significant influence on their interest in mathematics. This implies that, gender is not a significant factor in determining students' interest in mathematics. This present study has shown that there is no **s**ignificant difference in the mean interest ratings of male and female students in logic content of mathematics curriculum. However, this finding is inconsistent with the findings of previous studies by Kurumeh et al. (2012) that showed male students displayed a statistically significantly higher level of academic interest than their female counterparts, and Ugboduma (2017) whose study revealed that male students showed more interest in geometry than their female counterparts.

The study also found that male students had a slightly higher interest in logic content of mathematics curriculum than their female counterparts when taught using both the symbolic form model and the conventional method. Nevertheless, it was further revealed that there is no significant interaction effect of instructional methods and gender on the mean interest ratings of students in logic content of mathematics curriculum. This implies that male and female students taught using symbolic form model and the conventional method exhibited similar levels of interest in logic content of mathematics curriculum. In other words, students' interest in logic content of mathematics curriculum was not influenced by the instructional methods and their gender. This also entails that the instructional methods were not gender biased with respect to increasing students' interest in logic content of mathematics curriculum. The finding somewhat agrees with findings from some previous studies. For instance, the finding is in support of the finding by Agene (2009) whose study disclosed that there was no significant interaction effect of instructional approaches and gender on the mean interest scores of students. Similarly, the finding is in line with the finding by Kurumeh et al. (2012) whose study showed that the interaction effect of instructional approaches and gender on students' interest was not statistically significant. This implies that both male and female students' interest improved alike in the instructional approaches adopted. Thus, there could be no significant interaction effect of instructional methods and gender on the mean interest ratings of students in logic content of mathematics curriculum as depicted by the finding of the study.

## CONCLUSION

The implementation of the symbolic form model in teaching significantly boosted students' interest 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' interest in the logic content of the mathematics curriculum. In the logic content of the mathematics curriculum, gender has no substantial impact on learners' interest. Finally, in the logic content of the mathematics curriculum, there was no significant interaction effect of instructional approaches and gender on students' interest.

### Limitation

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' interest 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.

### Recommendations

From the findings of this study, the following recommendations were made:

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 interest 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 interest in this aspect of the subject.

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**Declaration of interest:** No conflict of interest is declared by authors.

**Data sharing statement:** Data supporting the findings and conclusions are available upon request from the corresponding author.

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# APPENDIX A: STUDENTS' INTEREST IN LOGIC CONTENT OF MATHEMATICS CURRICULUM QUESTIONNAIRE (SILCMCQ)

### Section A: Personal Information of Respondent

Student identification (ID) number: ……………………………………………

Student's gender: Male { } Female { }

### Section B

**Instruction:** In this section, you are to consider each statement carefully and indicate by ticking (√) in the appropriate column your level of agreement or disagreement with each of the statement following the options; strongly agree (SA), agree (A), disagree (D), and strongly disagree (SD). Give only one response to each item.

**Table A1.**

| S/N | Item statement | SA | A | D | SD |
|---|---|---|---|---|---|
| 1 | I am eager to do arguments in logic aspect of mathematics. | | | | |
| 2 | I answer questions frequently in logic lessons. | | | | |
| 3 | I ask questions regarding more examples of logical statements in logic content of mathematics | | | | |
| 4 | I am always eager to identify non-logical statements in logic content of mathematics when am asked to. | | | | |
| 5 | I am always eager to give examples of non-logical statements in logic content of mathematics. | | | | |
| 6 | I enjoy learning logic topics in mathematics. | | | | |
| 7 | I enjoy discussing with examples when it comes to negation of logical statements in mathematics. | | | | |
| 8 | I participate actively when it comes to identifying forms of contradiction in logical statements in mathematics. | | | | |
| 9 | Negation of logical statements is my favourite aspect of logic content in mathematics. | | | | |
| 10 | I prefer discussing conjunction of logical statements in mathematics than any other aspect of the subject. | | | | |
| 11 | I hardly explain disjunction of logical statements in mathematics. | | | | |
| 12 | I enjoy doing logical operations in mathematics. | | | | |
| 13 | I enjoy determining truth values of logical statements in mathematics. | | | | |
| 14 | I always make use of conditional statements in line with logic content of mathematics. | | | | |
| 15 | I always participate actively in logic related activities in class | | | | |
| 16 | I enjoy solving any kind of problems in logic aspect of mathematics. | | | | |
| 17 | I prefer leading tutorials on bi-conditional statements in logic aspect of mathematics. | | | | |
| 18 | I usually ask questions for more clarification on compound logical statements than any other aspect of mathematics. | | | | |
| 19 | I enjoy using truth table in determining the truth value of logical statements in mathematics. | | | | |
| 20 | I enjoy using the truth table in proving equivalent of logical statements in mathematics. | | | | |
| 21 | Simple statements in logic contents of mathematics are fascinating to learn. | | | | |
| 22 | I always help my friends in constructing truth tables involving with all logical operations in mathematics. | | | | |
| 23 | I prefer using symbols to represent each logical operation in mathematics. | | | | |
| 24 | I always apply the laws of the algebra of logical statements in my daily activities. | | | | |
| 25 | I enjoy stating the laws of the algebra of logical statements. | | | | |
| 26 | Finding logical equivalence in logical statements in mathematics is worthwhile. | | | | |
| 27 | I give every assignment on logic content of mathematics my best attention. | | | | |