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Strategy That Suits Students' Retention in Mathematics Curriculum Concepts: Assessment-Supported or Lecture Method

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This study explored the strategy that best suits students' retention of mathematics curriculum concepts: assessment-supported instructional model (ASIM) or the lecture method. The method adopted for this research is the quasi-experimental non-randomized planned variation pretest, posttest, and control group design. In this method, three research questions and three hypotheses were formulated and tested. The sample consisted of 200 Senior Secondary II mathematics scholars selected public schools were used. A simple random sampling technique was employed to determine the sample. The researcher developed the Mathematics Achievement Test on Indices and Logarithms (MATIL) which was used as the research instrument. The scores obtained were collated and analysed applying mean, standard deviation, t-test, and ANCOVA to answer the research questions and hypotheses. The findings of the research showed that there was a considerable variation in the average retention ratings between mathematics learners tutored using ASIM and those tutored with the lecture methods. While the mean score of students taught using ASIM was 56.28, the mean score of students taught using the lecture method was 47.55. There was also a considerable variation in the average retention ratings between male and female mathematics students tutored using ASIM. The mean retention gain for male students was 5.03 and that of the females was 6.42. There was no considerable interaction effect between instruction-(ASIM and Lecture) and sex on students' retention in mathematics. It was recommended, amongst others, that teachers should expose the learners to ASIM to promote effective and active learning among them.

Keywords: assessment-supported instructional model, students' retention, lecturemethod, mathematics curriculum, mathematics curriculum concepts

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INTRODUCTION

Curriculum appears not to have a universally acceptable definition among educators, curriculum experts, or scholars. This may be because the meaning changes from time to time according to the viewpoints of educators, curriculum experts, and scholars. Curriculum is a vehicle through which the school strives to achieve educational ends or purposes. ..;Khatete and Benson (2020) described curriculum in the following ways: Curriculum is all the experiences a child has under the guidance of a school. They further stated that Curriculum is all the courses or subjects that the school offers. In addition, curriculum is seen as the systematic arrangement of subject matter and activities within a course offered by a school (Okoye, 2011). These authors further indicated that Curriculum, in its broadest sense, should include the complete experience of the learners while under the direction and guidance of the teacher or school (Obro, 2023). Defining or documenting what the curriculum intends to accomplish is relatively easy. But how well the documented curriculum is delivered to meet the intended purpose (Oyovwi, 2022) deserves to be considered for effective teaching and learning. Mathematics is among the subject matter (curriculum) taught globally in schools. The mathematics curriculum is the plan for the experiences that learners will encounter as well as the actual experiences they encounter that are designed to help students reach specific mathematics objectives. It is designed to enhance and enrich the students; understanding and enjoyment of the subject by providing a rich, challenging, varied, and personalized program of study. It aims to promote an equal learning experience opportunity throughout all topics within the key stages. To advance mathematical research, the Nigerian government made mathematics instruction mandatory in science-related fields at the primary, secondary, and tertiary education levels (FRN, 2020).

Achieving the aforementioned aims and objectives hinges on effective curriculum delivery (Olanipekun & Agboola, 2023). Olanipekun and Agboola (2023) noted that overlooking the curriculum's significance presents a substantial obstacle to the entire teaching-learning dynamic. Therefore, prioritizing curriculum delivery is imperative within the educational framework. Curriculum delivery serves as a method through which the curriculum facilitates students in attaining their learning objectives. This process encompasses teaching, provision of learning support, guidance, interaction, mentorship, and fostering participative and collaborative learning environments (Obro, 2022). It involves executing the intended curriculum, wherein educators impart content and skills to students. As outlined by Echor and Lohor (2022), it involves the administration of curriculum content to learners and the actual instruction as well as assessment of students. Suleiman and Hammed (2019) and Makondo and Makondo (2020) identify several reasons for students' poor academic performance and retention of mathematics curriculum concepts to include inadequate mathematics teachers, poor teaching methods, ineffective instructional strategies adopted by teachers, lack of teaching experience, low motivation of teachers and attitude of teachers. Researchers, educators, stakeholders, parents, and scholars are concerned about the persistent academic performance gaps in mathematics classes despite the subject's importance (Madaki, 2021). According to Effiom and Abubakar (2021) andOlofinlae and Jimoh(2020), this trend of underperformance has been ascribed to the persistence use of of lecture teaching methods, which have not yielded satisfactory results. According to

Obro and Enayemo(2022), lecture-teaching usually involves introducing the topic or concept by explaining or brainstorming and then giving work examples. This is followed by more explanation, discussion, and answered session (Fasasi &Istifanus, 2022). Oyovwi(2022),highlighted that developing efficient curriculum delivery and implementation strategies in Nigerian schools is the joint responsibility of the education sector, educators, and parents. Even though mathematics is a relatively important subject, it is depressing to see students consistently performing poorly on internal and external exams. Fasasi and Istifanus(2022) study highlighted that students consistently perform worse over time in mathematics, indicating a widespread failure rate. This tendency might be caused by students' difficulties in understanding mathematical ideas, the ability to retain what is learned, how teachers teach, and the students' lack of interest in the subject.

A possible strategy is the Assessment Supported Instructional Model (ASIM), which allows learners to actively monitor, regulate, and control their cognitive processes as well as setting their set learning objectives (Misan-Ruppee, et al, 2023). Thus, whether ASIM adoption can raise students' retention level in secondary school mathematics is the central question at hand. In addition, Aguilar (2021) in his research on analysis of models, elements and strategies in high school mathematics teaching and learning noted that different strategies can be used to determine different levels of achievements in mathematics learning. According to these authors, students can be taught with different models to determine which of them that best suit their retention during teaching and learning even at different levels of sophistication during problem solving in mathematics.

In another study by Owolabi and Faleye (2025), they opined that effective use of ASIM can improve students comprehension, critical thinking and academic achievement in mathematics. These authors also noted that the effective use of assessment-supported instructional models goes a long way to motivate students in the learning of mathematics as this strategy can made abstract concepts to be more concrete and interesting in during teaching and learning as well as reducing boredom and arousing curiosity, which could also lead to effective mastery of the concepts. In this connection, teachers' efficiency in teaching and learning can be determined.

Vale and Barbosa (2023) saw mathematics as an essential nutrient for thought, logic, reasoning, and progress. It is a unifying subject, and students' interest in science cannot be alienated from mathematics. Ijeh (2020) observed that the modern conception of the nature of mathematics results from a long and slow evolution. It contains the skills for problem-solving, organizing, simplifying, interpreting data, and performing calculations necessary in science, business, and industry. Agbata et al. (2024) also stated mathematics studies numbers, systems, symbolic language, sizes, relationships, and shapes. This has earned mathematics the status of the core subject in the school curriculum. This status made it compulsory for any student seeking admission to study any science-related courses in any tertiary institution (Macaso & Dagahoy, 2022). Assessment and instructional strategies are integral parts of teaching and learning mathematics. Assessment-Supported Instructional Model (ASIM) is a model design that primarily aims to use the students' assessment results to improve instruction (Makondo

& Makondo, 2020). This model includes pre-teaching preparation, active teaching, formative assessment administration, scoring, result analysis, goal-setting adjustments, teaching strategy reviews, and formative assessment data recording. It enables the students to assess their learning difficulties and devise an appropriate approach to resolve learning problems. This method, when adopted, may help to enhance the retention of mathematics curriculum concepts.

Retention is the ability to recall what is taught or learned by students or the capacity of students to retain knowledge over time (Palomillo,2022). Retention also refers to the mental process of past information retrieval, which has to do with students being able to respond to what they have learned. The implication is that the instructional strategies employed determine the retention ability of students (Ehsanpur& Razavi, 2020).

The available research has offered significant insights into the effect of Assessment-Supported Instructional Model/ASIM on scholars' retention in mathematics. A notable deficiency is the absence of studies, to the researchers' best knowledge, that specifically examine the effect of Assessment-Supported Instructional Model/ASIM on students' proficiency in mathematics. Prior researches have predominantly occurred in varied geographical areas or educational contexts, necessitating the need to address this gap and assess the efficacy of Assessment-Supported Instructional Model/ASIM on scholars' retention and performance in mathematics within this particular region. A further study gap is the insufficient focus on the effect of Assessment-Supported Instructional Model/ASIM on students' retention and progress in mathematics. Although certain studies have investigated individual factors such as students' interest in mathematics, and curriculum design, it is essential to examine the strategy that best suits students' retention of mathematics curriculum concepts such as assessment-supported instructional model (ASIM) or the lecture method. During this research, the interaction effect of sex that may shape students retention of mathematics concepts may also be determined. This study underscores the discrepancies in research outcomes and the necessity to provide empirical literature on the strategy that best suits students' retention of mathematics curriculum concepts, as well as the deficiencies in the current literature.

The novelty of research on Assessment-Supported Instructional Model/ASIM on students' retention in mathematics is in its emphasis on the integration of assessment techniques into the learning process to enhance student retention, rather than their exclusive usage for grading purposes. ASIM utilises formative assessment to deliver ongoing feedback to students and educators, facilitating modifications in instructional and learning methods/strategies to meet particular needs and resolve gaps in comprehension. This differs from conventional procedures, where evaluation typically takes place at the conclusion of a unit or term, so restricting chances for prompt intervention.

The main objective of this study is to ascertain whether or not the utilisation and application of Assessment-Supported Instructional Model (ASIM) can enhance students' retention in mathematics, and whether or not the variation of sex among students affects the efficacy of Assessment-Supported Instructional Model as teaching

method. Specifically, the objective of the study is to investigate if there is any variation in the average retention rate of mathematics students tutored utilizing Assessment-Supported Instructional Model (ASIM) and those tutored with the conventional lecture method. Further will there be any variation in the average retention ratings of male and female mathematics students tutored utilizing Assessment-Supported Instructional Model (ASIM). Furthermore, the study will also determine if there is any interaction effect between the instructional strategies and sex on student retention in mathematics.

Research Questions

1. Is there any variation in the average retention ratings of mathematics students tutored utilizing Assessment-Supported Instructional Model and those tutored with the conventional lecture method?
2. Is there any variation in the average retention rate between male and female mathematics students tutored using Assessment-Supported Instructional Model (ASIM)?
3. Is there any interaction effect of instructional strategy (ASIM or Lecture method) and sex on students' retention in mathematics?

Research Hypotheses

1. The average retention ratings of mathematics students tutored utilizing the Assessment-Supported Instructional Model, and those tutored using lecture method do not differ considerably.
2. The assessment-supported instructional model does not considerably differ in the average retention ratings of male and female mathematics students.
3. Students' retention in mathematics is not a considerable consequence of the combination of sex and instruction (Assessment Supported Instructional Model and Lecture).

METHOD

Design of the Study

This study uses a pretest-posttest planned variation design, which is a quasi-experimental methodology. In this design, an intact class was used to collect data to minimize disruption of class during data collection. These classes were divided into the experimental and control-groups at random.

Population and Sample

The study's population comprises seven thousand four hundred fifty-two male and female Senior Secondary II mathematics students enrolled in the Delta Central Senatorial District mathematics classes. The sample comprised 200 Senior Secondary II mathematics students and three research assistants selected from Delta Central Senatorial District public schools. Each school contributed one intact class for both the experimental and control-groups. The type of school (mixed and single schools) was the inclusion and exclusion criteria for sample selection in the study. Only mixed schools were selected for the study. This is because students' gender was one of the variables

investigated in this study. Therefore, only students in a mixed school that house boys and girls students were selected for the study.

Data Collection

The research employed the Mathematics Retention Test [MRT] developed by the researcher. MRT consists of 24 multiple-choice items, each with five options, designed to assess students' proficiency in indices and logarithms. Test items were aligned with the SS2 mathematics curriculum.

Data Analysis

Statistical mean and standard deviation were utilized to answer the research questions, while t-test and Analysis of Covariance were used to test the stated hypotheses.

Ethical Considerations

Ethical principles were adhered to during the data collection process. The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

FINDINGS

Research Question One: Is there any variation in the average retention ratings of mathematics students tutored utilizing Assessment-Supported Instructional Model and those tutored with the conventional lecture method?

Table 1
Mean of pretest and posttest retention scores of scholars tutored Mathematics applying ASIM, and those tutored applying lecture-method

		Pretest		Posttest		MeanVariation
Group	N	Mean	SD	Mean	SD	
ASIM (Experimental)	123	21.42	9.05	56.28	11.08	34.86
Lecture (Control)	77	22.02	8.73	47.55	10.97	25.53

Table 1 displays the pretest mean retention scores for two groups of students: those instructed with ASIM and those with traditional lecture methods. The ASIM group had a mean score of 21.42 (SD= 9.05), while the lecture group had a mean score of 22.02 (SD= 8.73). The comparison suggests that both groups had similar retention levels in Mathematics concepts before any intervention at the pretest level. At the posttest, the ASIM group achieved a mean score of 56.28 (SD= 11.08), whereas the lecture group attained a mean score of 47.55 (SD= 10.97). The ASIM group exhibited a higher mean difference of 34.86 compared to the lecture group's mean difference 25.53. This indicates that students taught using ASIM showed more remarkable improvement in Mathematics knowledge retention than those taught using traditional lecture method.

Research Question 2: Is there any variation in the average retention rate between male and female mathematics students tutored using Assessment-Supported Instructional Model (ASIM)?

Table 2
Mean and Std scores of male/female mathematics scholars exposed to ASIM

Variable		Pretest		Posttest		
	N	Mean	SD	Mean	SD	Mean Variation
Male	56	12.19	2.26	17.22	4.11	5.03
Female	67	11.97	3.80	18.39	4.00	6.42

Table 2 displays the Mathematics retention test scores of male and female students at both the pretest and posttest stages. Initially, the pretest mean and standard deviation for male students were 12.19 and 2.26, while for female students, they were 11.97 and 3.80, respectively. Upon implementing ASIM, male students achieved a posttest mean score of 17.22 with a standard deviation of 4.11. In contrast, female students achieved a mean score of 18.39 with a standard deviation 4.00. The mean retention gain for male students was 5.03, and for female students, it was 6.42. The analysis shows that female mathematics students performed significantly better than their male counterparts when exposed to the ASIM teaching strategy.

Research Question 3: Is there any interaction effect of instructional strategy (ASIM or Lecture method) and sex on students' retention in mathematics?

Table 3
Summary of univariate analysis of mathematics retention by teaching strategy and sex

	Male		Female	
Method of Instruction	Mean	SD	Mean	SD
ASIM	17.22	4.11	18.39	4.00
Lecture-method	16.08	3.46	16.35	3.37

Table 3 presents the mean and standard deviation of retention test scores categorized by sex and teaching strategy. Specifically, it indicates that male students exposed to the ASIM teaching method achieved a posttest mean score of 17.22 with a standard deviation of 4.11. Conversely, male students taught through the lecture method retain a pretest mean score of 16.08 with a standard deviation 3.46. Female students exposed to ASIM achieved a mean score of 18.39 with a standard deviation of 4.00, while those taught through the lecture method retained a mean score of 16.35 with a standard deviation of 3.37. Upon analysis, no significant interaction effect between teaching strategies and sex on retention of mathematics by the students.

Hypothesis 1 (Ho_1): The average retention ratings of mathematics students tutored utilizing the Assessment-Supported Instructional Model, and those tutored using lecture method do not differ considerably.

Table 4
t-test comparison of pretest scores of Mathematics scholars tutored using ASIM (experimental) and those tutored with lecture-method (control)

Group	N	$\bar{x}$	SD	Df	t-cal.	Sig. (2-tailed)
ASIM (Experimental)	123	21.42	9.05	198	0.626	0.532
Lecture (Control)	77	22.02	8.73			

Table 4 indicates no statistically considerable disparity in the pretest mean achievement scores between students instructed with ASIM and those taught using traditional lecture methods, as evidenced by the t-test result: t(df) = 0.626, p= 0.532 > 0.05. Therefore, the null hypothesis (Ho1) was evaluated using a t-test.

Table 5
t-test comparison of posttest scores of Mathematics students tutored utilizing ASIM (experimental) and those tutored lecture-method (control)

Group	N	$\bar{x}$	SD	Df	t-cal.	Sig. (2-tailed)
ASIM (Experimental)	123	56.28	11.08	336	7.274	0.000
Lecture (Control)	77	47.55	10.97			

Table 5 shows that the posttest average retention ratings of students tutored ASIM and those tutored with the lecture-method differed considerably (t = 7.274, P(0.000) < 0.05). Therefore, Ho1 is refuted. Because of this, the average retention ratings of scholars tutored mathematics applying the ASIM method and the lecture-method differed considerably, with the ASIM method having a more significant advantage.

Hypothesis 2: The assessment-supported instructional model does not considerably differ in the average retention rate of male and female mathematics students.

Table 6
Summary of t-test of Variations between the mean Retention Test Scores of Male and female Mathematics Students Exposed to ASIM

Variable	N	Mean	SD	Df	t-cal	t-crit
Male	56	17.22	4.11			
Female	67	18.39	4.00	95	2.91	1.180

P < 0.05

Table 6 shows the t-test results comparing the posttest average retention ratings of male and female students exposed to ASIM. The critical t-ratio of 1.180 is exceeded by the computed t-value of 2.91. As a result, hypothesis (Ho3) is disproved. This rejection shows that male and female mathematics scholars who received instruction applying ASIM had considerably different average retention ratings. In the ASIM teaching group, female mathematics students performed noticeably better than male mathematics students, who received a mean score of 17.22. The female students' mean score was 18.39.

Hypothesis 3: Scholars' retention in mathematics is not a considerable consequence of the combination of sex and instruction (Assessment Supported Instructional Model and Lecture).

Table 7
Analysis of Covariance for Mathematics Retention by different Teaching Strategies and sex

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	312.710	6	52.118	5.443	0.00
Intercept	22.964	1	22.964	2.398	0.123
Sex	30.591	1	30.591	3.195	0.075
Group	1.103	2	0.552	0.058	0.944
Pretest	208.253	1	208.253	21.748	0.000
Sex * Group	32.735	2	16.367	1.709	0.183
Error	2221.524	252	9.576		
Total	3614.000	259			
Corrected Total	2534.234	258			

$P > 0.05$

According to the results in Table 7, the calculated F-value of 1.709 is lower than the critical F-ratio of 3.04 ($F_{0.05(2,252)} = 3.04$). As a consequence, the null hypothesis is upheld. This indicates that no noteworthy interaction between instructional strategies and sex concerning student retention in mathematics was observed.

DISCUSSION

The research explored the influences of the Assessment Supported Instructional Model (ASIM) on students' mathematics retention. The findings from Table 1 indicate that students instructed with ASIM retain a posttest mean score of 56.28, with a standard deviation of 11.08, while those taught using the lecture method attained a posttest mean score of 47.55, with a standard deviation of 10.97. Notably, students taught with ASIM exhibited a higher mean retention difference of 34.86 compared to those taught using the lecture method, with a mean difference of 25.53.

The corresponding hypothesis tested in Table 6 affirms a significant difference in the posttest mean retention scores between students taught with ASIM and those taught using the lecture method. Further analysis through multiple comparisons across different groups corroborates these findings, revealing significant differences between students exposed to ASIM and those instructed using the lecture method as indicated in table 7. Consequently, the null hypothesis is refuted. Hence one can deduce from the analysis that a notable distinction exists in the mean retention scores between mathematics students instructed with ASIM and those taught using the lecture method, favouring ASIM instruction strategy. This discovery aligns with the research conducted by Aguilar (2021), marchevska, et al. (2022) as well as Owolabi and Faleye (2025). Their findings revealed that lower-performing students in the experimental groups exhibited the most substantial enhancement in performance when compared to control groups in a video modelling instructional strategy.

Furthermore, this discovery aligns with the findings reported by the Babatimehin et al (2025), which documented a feasibility study conducted on assessment. The outcomes of this study yielded valuable insights, leading to the development and adoption of a continuous assessment manual that has since evolved in Malawi used for teaching and

learning of science. Similarly, Shahzadi and Nasreen (2020) conducted a study on the impact of assessment practices that was used to support the learning of science. The results unveiled that assessment is a superior alternative to one-shot final examinations because it can enhance students' performance during the teaching and learning of Mathematics. Moreover, the findings indicated that the assessment qualities are satisfactory and serve the purposes of diagnostics and motivation in learning. This evidence strongly suggests that the Assessment Supported Instructional Model (ASIM) significantly contributes to student achievement in mathematics Owolabi and Faleye (2025).

On the posttest, male students that were taught using the Assessment Supported Instructional Model (ASIM) achieved a mean score of 17.22, with a standard deviation of 4.11, as presented in Table 7. Conversely, female students attained an average posttest score of 18.39, with a standard deviation 4.00. The mean retention gain for male and female students was reported to be 5.03 and 6.42, respectively.

The analysis revealed that when employing the ASIM teaching strategy, female students significantly outperformed male students in mathematics in retention. The hypothesis tested in this context indicates a notable disparity in the average achievement scores of male and female mathematics students exposed to ASIM. Specifically, female students in the ASIM teaching group exhibited markedly higher retention than their male counterparts, with a mean score of 18.39 compared to 17.22 for males. This finding is consistent with the observations made by Ani, et al (2020) and Owolabi (2025) in their research. They noted that while female science students share similar attitudes with their male counterparts regarding the importance of science, they tend to be more knowledgeable, practical, and articulate in the field of science of which mathematics is a part. It contradicts the findings of Čipková et al. (2020), whose research illustrated that engaging students in science process skills-based learning, which incorporates activities tailored for both genders, leads to more effective learning outcomes, regardless of gender or ability level. Baltikian, et al.(2024) also observed that boys do not surpass girls in educational attainment. However, this discovery contrasts with that of Mukti et al. (2019), whose research on the influence of gender on academic achievement indicated that women perform disproportionately worse in science-related fields and programs.

The results in Table 7 indicated no statistically considerable interaction effect between teaching strategies and sex on mathematics student retention. The hypothesis test revealed no considerable interaction between sex and instructional strategies on students' mathematics retention. The results as indicated on table 7 contradict Mwihia (2020), who found a considerable main effect of sex on students' achievement.

CONCLUSION

The research yielded the following conclusions: students who learned through the lecture-method performed worse than those who learned through the Assessment Supported Instructional Model (ASIM) regarding retention. Male and female scholars performed better academically when applying the Assessment Supported Instructional Model (ASIM) for teaching mathematics in secondary school. Mathematics retention

among students was not a considerable consequence of the combination of sex and the Assessment Supported Instructional Model of mathematics instruction.

This study explored strategy that suits students' retention in mathematics curriculum concepts, looking at the effect of assessment-supported and the lecture method on students' retention in mathematics. Teachers used for this study were not scrutinized on the basis of qualification. This may be a limitation. This study was carried out in only one senatorial district of the three senatorial districts. However, further and in-depth studies may be needed to confirm its findings for proper generalization. There is a need to increase the scope by including the other two senatorial districts in the State and single schools to enable proper generalisation.

RECOMMENDATIONS

1. Educators should implement the Assessment Supported Instructional Model (ASIM) to promote engaged and productive student learning.
2. Teachers and curriculum planners should consider the Assessment Supported Instructional Model (ASIM) as a cutting-edge, student-centred, and outcome-focused method of teaching mathematics in secondary education to enhance students' retention.

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