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The Impact of Instructional Aids on the Academic Performance of Lower Secondary School Students in Mathematics

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Abstract

This research investigates the impact of instructional aids on the academic performance of lower secondary school students in mathematics. Instructional aids are crucial tools in the teaching and learning process, as they help to simplify complex concepts and engage students actively in their learning. This research aims to examine the use of instructional aids in teaching and learning mathematics, assess the perception of lower secondary school students regarding the use of instructional aids in mathematics, and investigate the impact of instructional aids on the academic performance of lower secondary school students in mathematics. This research addresses several key questions: 'What is the use of instructional aids in teaching and learning mathematics in secondary schools?', 'What is the perception of lower secondary school students towards the use of instructional aids in mathematics?' And 'What is the impact of instructional aids on the mathematics academic performance of lower secondary school students?' A quantitative research design was employed, involving a sample of Form 2 students from the Dual Language Programme class at SMK Seksyen 9. Data were collected through tests and questionnaires. The research findings showed that instructional aids significantly enhance students' engagement and understanding of mathematics. Students exposed to a variety of aids reported better comprehension and enjoyment of mathematical concepts, finding them more relevant to real-world situations.They also found instructional aids effective in promoting active learning and practical skill development. These findings underscore the importance of instructional aids in mathematics education, supporting effective teaching methods. The research highlights a positive link between using instructional aids and academic performance, suggesting they can improve learning outcomes and increase student interest in mathematics. Overall, this research provides strong evidence of

instructional aids' positive impact on lower secondary school students' academic performance in mathematics, fostering interactive learning that enhances comprehension and critical thinking.

Keywords: Instructional Aids, Mathematics, Academic Performances, Teaching Method, Interactive Learning

Introduction

Mathematics is essential for daily life and requires effective teaching methods for student success (Li & Schoenfeld, 2019). It develops problem-solving skills vital for real-world issues (Audsley, 2019). As a subject with complex rules and analysis, it demands critical thinking, practice, and perseverance, especially for students with limited understanding. However, declining interest in mathematics may stem from difficulties recalling lessons, likely linked to ineffective teaching methods (Chand & Chaudhary, 2021). Effective learning should enhance cognitive, affective, and psychomotor skills through engaging instruction. Silberman (2009) noted that passive learning reduces curiosity, while active learning fosters exploration, problem-solving, and task completion. Teachers can promote active engagement by using various mathematics instructional aids to make learning meaningful and enjoyable.

Instructional aids are essential tools that assist teachers in delivering effective and engaging lessons (Dar, 2022). They serve as supplementary devices that support, rather than replace, the teaching process. In mathematics education, instructional aids play a vital role in helping students understand abstract concepts by providing concrete representations through visual, auditory, or tactile experiences. Tools such as charts, pictures, models, and digital resources transform complex mathematical ideas into relatable and comprehensible forms. The use of instructional aids enriches the teaching and learning process by promoting active participation and fostering deeper comprehension. Furthermore, they stimulate students' interest and curiosity, encouraging them to explore mathematical relationships more confidently. Therefore, instructional aids are indispensable components of effective pedagogy, ensuring that mathematical learning becomes not only informative but also interactive and meaningful.

The integration of instructional aids in mathematics education significantly enhances students' engagement and understanding. As visual and multimedia tools such as pictures, charts, short video clips, and social media resources are introduced, students are better able to connect theoretical knowledge with real-life situations. These aids help simplify abstract ideas, reduce learning anxiety, and promote independent thinking. Teachers who utilize such materials often observe improved classroom participation and enthusiasm among students. Additionally, the use of diverse aids supports differentiated learning, catering to students' varied learning styles—visual, auditory, and kinesthetic. For instance, a short animation on geometry or algebraic patterns can make lessons more memorable than verbal explanations alone. Therefore, instructional aids not only improve comprehension but also enhance students' motivation, confidence, and retention, making mathematics a more approachable and enjoyable subject.

The effective use of instructional aids also depends on teachers' creativity and professional growth. According to Cicekci (2019), lower secondary students often have shorter attention spans and may easily lose interest in traditional lectures. Hence, teachers

must adopt innovative and adaptive teaching strategies that utilize instructional aids effectively. By incorporating multimedia resources, hands-on manipulatives, and digital learning tools, teachers can sustain students' attention and deepen their conceptual understanding. Moreover, creative teaching encourages collaboration, communication, and critical thinking among students. For teachers, the continuous use of instructional aids contributes to professional development, as it requires them to stay updated with modern pedagogical trends and technological advancements. This not only enhances teaching competence but also strengthens teacher-student relationships, making mathematics learning more interactive, enjoyable, and impactful.

This research aims to examine how instructional aids affect the academic performance of lower secondary students in mathematics. By analyzing the relationship between instructional aids and learning outcomes, the research seeks to identify effective teaching practices that improve mathematical understanding and achievement. The findings are expected to provide valuable insights into how visual and interactive teaching materials can enhance lesson delivery, maintain student engagement, and foster positive learning experiences. Additionally, the research will contribute to curriculum development by highlighting the need for resource-based teaching strategies in mathematics. Ultimately, this research aims to support teachers in refining their instructional methods and improving students' overall performance, thereby strengthening mathematics education at the lower secondary level.

Based on the aim of the research, there are research questions as follows:

a) What is the significant relationship between students' motivation and their academic performance in Mathematics?
b) How does students' self-efficacy relate to their academic performance in Mathematics?
c) To what extent do situational factors influence students' performance in Mathematics?
d) Which aspect of students' readiness most strongly influences their academic performance in Mathematics?

Literature Review

A theoretical framework provides the foundation for understanding relationships between concepts and guiding the development of a research study (Vinz, 2022). This research draws upon Cognitivism and John Dewey's Theory to explain how instructional aids enhance students' mathematical learning and performance. Cognitivism, as described by Morales (2021), focuses on the mental processes involved in learning, emphasizing how information is received, organized, stored, and retrieved. It proposes that knowledge is constructed through active engagement with learning materials, and instructional aids support these mental processes by presenting information visually and concretely. Piaget's concepts of assimilation, accommodation, and equilibrium highlight how learners integrate new knowledge with existing cognitive structures. Instructional aids, such as manipulatives and visual tools, facilitate this process by transforming abstract mathematical ideas into tangible forms. Similarly, Bruner's discovery learning emphasizes the learner's active role in constructing knowledge through exploration. Instructional aids encourage this independence, allowing students to form lasting understanding through hands-on

experiences. Collectively, these cognitive theories support the idea that instructional aids foster long-term retention, problem-solving, and conceptual understanding in mathematics.

John Dewey's theory complements this perspective through its focus on experiential and student-centered learning. Dewey (as cited in Lorina, 2022) emphasized that education should connect directly to experience, enabling students to learn by doing. Teachers, therefore, act as facilitators who create interactive learning environments that stimulate curiosity and reflection. Instructional aids serve as tools that bridge abstract mathematics with real-world experience, making learning more meaningful. Dewey argued that engagement with materials enhances problem-solving, collaboration, and critical thinking. In mathematics, such aids—models, visualizations, and digital tools—help learners interact directly with content, deepening their understanding. Moreover, Dewey's ideas on progressive education emphasize the importance of tailoring instruction to students' readiness and interests. Instructional aids address these variations by accommodating different learning styles and promoting inclusivity. Hence, both Cognitivism and Dewey's theory collectively reinforce that instructional aids are not supplementary but essential instruments that make mathematical learning active, reflective, and effective.

Instructional aids transform mathematics learning from an abstract to a concrete experience, allowing students to engage more meaningfully with the subject. According to Awobodu (2002), the absence of instructional aids is one of the major causes of low achievement in mathematics. Oladejo, Ojebisi, and Isola (2011) further found a positive correlation between instructional aid usage and academic success. Adeoye (2012) emphasized that instructional aids enhance communication between teachers and students, simplifying knowledge transfer. Similarly, Mwangi (2006) noted that instructional aids stimulate interest, enhance retention, and provide firsthand experiences that strengthen understanding. Research by Mustamin Anggo and La Arapu (2018) showed that instructional aids facilitate problem-solving and self-regulated learning by engaging students both mentally and physically. Furthermore, studies by Ordu (2021) and Walters & Bailey (2014) highlight that mathematics education must shift toward student-centered approaches that integrate visuals, short clips, and digital tools to maintain engagement. Therefore, the effective use of instructional aids is not only beneficial but necessary for modern mathematics instruction.

Students' perceptions are critical in determining the success of instructional aid implementation. Positive perceptions foster motivation and improve academic performance. Shabiralyani et al. (2015) found that students' comprehension declines without concrete materials, underscoring the value of hands-on learning. Ruja, Sari, and Utomo (2019) and Isiaka, Ganiyu, & Tajudeen (2013) revealed that most students believe instructional aids improve their learning experience and help them understand difficult mathematical concepts. Yahaya (2019) also noted that students taught with instructional aids exhibited greater enthusiasm, focus, and understanding compared to traditional methods. Although some students express anxiety when using new materials, overall responses indicate strong acceptance and preference for interactive learning. Amadioha (2009) and Amah & Nugroho (2016) further affirmed that instructional aids increase motivation and lead to improved learning outcomes. Barus (2021) concluded that students generally perceive instructional aids as effective tools that enhance engagement and understanding. These findings confirm that

students value instructional aids for making mathematics learning more interesting and accessible.

Empirical studies consistently demonstrate that instructional aids positively influence academic performance in mathematics. Dienes (1973) emphasized that learners develop complex knowledge through active engagement with materials. Similarly, Kablan (2010) and Demirel & Altun (2012) highlighted the importance of instructional aids in achieving curriculum objectives. Kul, Aksu, & Celik (2018) and Sherman & Bisanz (2009) found that instructional aids enhance students' ability to understand and retain abstract concepts. Carbonneau, Marley, & Selig (2013) supported the need for visual models in learning mathematics effectively. The use of instructional aids fosters positive attitudes, critical thinking, and deeper comprehension (Apperson, Laws, & Scepansky, 2006). From the studies, it is also confirmed that a significant correlation between instructional resources and academic performance. These materials motivate learners, improve psychomotor skills, and make learning enjoyable. The conceptual framework of this research positions instructional aids as the independent variable and students' academic performance as the dependent variable. The framework posits that effective use of instructional aids enhances students' perception, engagement, and ultimately, their performance in mathematics.

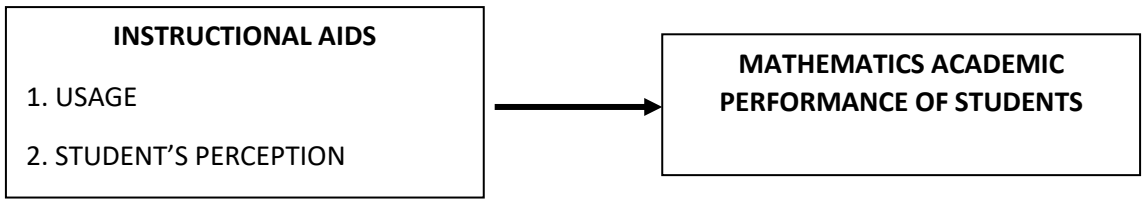

Figure 1 Conceptual Framework of the research

Methodology

The research design provides the necessary framework for the research, serving as its core by integrating the strategy, conceptual model, scope, and data methods (Sileyew, 2019). Research designs are typically classified as quantitative, qualitative, or mixed (Jaiswal, 2023). This research adopted a quantitative design, which involves gathering numerical data to generalize outcomes or explain phenomena (Babbie, 1998). This choice was motivated by the quantitative approach's suitability for large samples (as it often relies on simple surveys) and its capacity to reduce bias, produce accurate findings, and test existing hypotheses. The research therefore utilized these quantitative methods to generate empirical evidence regarding the influence of instructional aids on students' academic performance in mathematics.

While valuable, the quantitative methodology has drawbacks, including producing potentially constrained results that may not fully capture real-world intricacies. The use of surveys and tests with fixed response options can also restrict answers, missing important details. Moreover, this type of research is often costly, time-consuming, and logistically complex, particularly when trying to establish proper controls and randomization (Morgan & Smircich, 1980).

The research specifically uses a quasi-experimental design—one of the key types of quantitative research. This design is akin to an actual experiment but lacks random selection of subjects. It was chosen to investigate how instructional aids affect lower secondary students' academic success in mathematics. The method involved two non-randomly selected Form Two classes being tested before and after the introduction of instructional aids to assess any resulting change in performance.

According to Cristina Canova & Anna Cantarutti (2020), a population is known as a collection of individuals or objects that have similar characteristics to each other. All individuals in a population have the same characteristics, such as age, gender and ethnicity. A population is usually a large collection of a group of individuals or objects that are the main focus of a research study. From the population, a target population must be identified. A target population is a group of individuals that is more specific to the researchers in conducting research and drawing conclusions from it. In the target population, the characteristics depend on the research objectives and questions stated in the research study (Barnsbee, 2018). In this research, a population of 80 lower secondary school students has been selected. Since the test questions are in English, the chosen population comprises all form two students from Sekolah Menengah Kebangsaan Seksyen 9 in the dual language program (DLP), specifically from 2 Solaris and 2 Atria classes. All students in both classes have been selected as the research population without considering gender differences. This population was chosen since they are the closest candidates for the form 3 examination. In addition, this population has also undergone the learning and teaching process at the secondary school level for a year compared to students in form 1. Therefore, form two students are considered the most suitable population to address all research questions and investigate the impact of instructional aids on the academic performance of lower secondary school students in mathematics.

When studying a large group of people, collecting data from each individual can be challenging. Instead, researchers often select a sample. According to McCombes (2022), a sample is a group of individuals who participate in the research. To ensure valid conclusions from the results, researchers must carefully select a sample that represents the entire group, known as the sampling method. Researchers typically employ two main sampling methods: probability and non-probability sampling. In this research, probability sampling has been chosen, specifically using a cluster sampling technique. According to Thomas (2022), cluster sampling is a probability sampling method often used to study large populations, especially those widely dispersed geographically. In cluster sampling, the population is divided into smaller groups, known as clusters. These clusters are then randomly selected to form a sample.

Based on the "Table for Determining Sample Size from A Given Population", since the population for the research is 70 students, a total of 59 samples have been determined to be selected as respondents in the research. Cluster sampling is chosen to help achieve this sample size. With 35 students in each class, both classes are chosen as a group sample for the research, considering the possibility that some students may not be present during data collection. Each class selected includes students with high, medium, and low levels of academic performance. One of the primary reasons for selecting these classes is to examine the impact of instructional aids on mathematics academic performance across diverse

student achievement levels. Accordingly, the performance shown from this sample helps teachers incorporate more instructional aids in the mathematics teaching and learning process to improve student performance in the subject. Therefore, this sampling technique is believed to be the best method to evaluate the impact of instructional materials on the mathematics academic performance of the students.

A research instrument is a tool employed by researchers to obtain data necessary to achieve research objectives (Kenali, 2012). Data itself is the information collected about the subjects or study, including demographic details (age, gender, ethnicity), test scores, or responses from interviews and questionnaires (Idris, 2013). Tools like questionnaires or proportional scales that gather this information are the instruments. In this research, the researchers used two main quantitative instruments which are tests and questionnaires (surveys).

The quantitative tests were designed to measure students' mathematics performance levels before and after the use of instructional aids. The content was based on the Form Two learning standards from Chapter 4 (Polygons) of the Malaysian education system's DSKP (Dokumen Standard Kurikulum Dan Pentaksiran). Test questions were adapted from Third Space Learning (2023). Two tests were administered at different times, allowing the researchers to compare scores and evaluate the instructional aids' impact on academic performance. The quantitative test instrument used in this research consisted of a three-page, six-item multiple-choice quiz focusing on Chapter 4 (Polygons) from Form Two Mathematics. To evaluate the impact of the intervention, respondents were administered the identical test twice: once as a pre-test (before instructional aids were integrated into teaching sessions and activities) and again as a post-test (after the intervention). By comparing the scores obtained on these two administrations, the researchers were able to test the hypothesis and determine whether the use of instructional aids had a positive or negative effect on students' academic performance in mathematics.

The questionnaires were used to gather detailed, numerical quantitative data about the survey topic, which was then analyzed for the research report. These questions formed the core of the survey, focusing on three main areas: the current use of instructional aids in mathematics teaching and learning, students' perceptions toward using these aids, and the impact of the aids on their academic performance. The questionnaires were administered to the respondents after they completed in one day the second quantitative test. The research utilized a questionnaire, titled "The impact of instructional aids on the student's mathematics academic performance," to gather data. This instrument was divided into four sections (A, B, C, and D), designed to collect different types of information from the respondents. The respondents were asked about their demographic background, the use of instructional aids in teaching and learning mathematics, their perception towards the use of instructional aids in mathematics, and the impact of instructional aids on their mathematics academic performance.

The validity and reliability of an instrument used are important in every research (Idris, 2013). The higher the instrument's validity and reliability, the more consistent the resulting data. Consistency is defined when the same item is given to the same individual or group at different times, and the results are the same or almost the same (Ariffin, 2008). Reliability in

research refers to the instrument's ability to acquire the same value when measurements are repeated (Chua, 2016). In order to ensure a test is reliable, each item in a test must be correlated with one another and have consistent results (Singh, Sidhu & Chan, 2009). The reliability of this research instrument is evaluated using Cronbach's alpha reliability coefficient. Cronbach's alpha reliability method was conducted using the SPSS program. SPSS (Statistical Package for the Social Sciences), usually known as IBM SPSS Statistics, is a statistical analysis software package (Contributor, 2018). SPSS was originally used in social sciences but now serves various data markets. SPSS is frequently employed in educational studies. Validity is the ability of a measurement or research instrument to evaluate the genuine value of a concept within a hypothesis (Chua, 2016). To ensure the validity of the test and questionnaire questions, professional lecturers from UiTM were asked to review and verify the research instrument. Lastly, a pilot study was conducted to check the reliability and validity of the research instruments.

In this research, a pilot study was conducted to check the reliability and validity of the research instruments. A pilot study is an initial small-scale study conducted before the main study, serving various purposes such as constructing measuring instruments, enhancing the researcher's skills, estimating study duration, and more. According to Lowe (2019), the primary goal of a pilot study is not to address specific research questions but rather to prevent researchers from initiating a large-scale study without sufficient knowledge of available methodologies. The researchers consider the pilot study a fundamental aspect of every study, as it can render the actual study invalid and unreliable in some cases. Thus, the significance of the pilot study lies in its potential to impact the validity and reliability of the overall study. Additionally, the pilot study aids in ensuring the smooth execution of the actual study.

The pilot study was carried out at SM Sultan Abdul Halim in Jitra, Kedah, involving 30 respondents, including Form Two students. These respondents were selected to complete the questionnaire and quantitative test, aiding in establishing the validity and reliability of the items included in the questionnaires and tests. SM Sultan Abdul Halim was chosen due to its proximity to the residence of the person conducting the study, facilitating the distribution of questionnaires and tests to selected students face-to-face within a short travel time of less than 30 minutes. Additionally, online questions were prepared as an initial precaution in case any obstacles prevented physical access to the respondents. Furthermore, SM Sultan Abdul Halim's status as a boarding school rendered its population suitable for the research, as all students there study mathematics in English.

Each item in the research instrument, including questionnaires and quantitative tests, is analyzed using Cronbach's alpha in SPSS statistics. Frost (2022) stated that Cronbach's alpha is a measure of internal consistency or reliability for a set of questionnaires or quantitative test items. High Cronbach's alpha values indicate consistent respondent responses across questions or test items, suggesting that the measures are reliable and the items may be measuring the same characteristic. Conversely, low Cronbach's alpha values indicate that the items are not adequately measuring the same construct. High responses to one question or test item do not necessarily correspond to high ratings for the other items, indicating the unreliability of the measurements. In this research, Cronbach's alpha target value of 0.7 was set, demonstrating that consistency among the items at this level and above shows the measure's reliability. If any items in the set of questionnaires or test items yield a lower

Cronbach's alpha value than expected, then the instrument must be reviewed, revised, and adjustments made accordingly. Presented below are the findings from the Cronbach Alpha test, which was conducted on the results of a pilot study involving 30 respondents from SM Sultan Abdul Halim.

Table 1
Reliability Statistics: Cronbach's Alpha value for quantitative test.

Cronbach's Alpha	N of Items
0.813	6

Table 1 show Cronbach's Alpha value for quantitative test is calculated to be 0.813. This figure signifies a high level of reliability for the construct being studied. This finding assured that the quantitative test was reliable for assessing the intended construct among the study participants.

Table 2
Reliability Statistics: Cronbach's Alpha value for questionnaires

Cronbach's Alpha	N of Items
0.715	16

Table 2 show Cronbach's Alpha value for 16 questionnaires calculated to be 0.715, which pertains to various aspects, including the use of instructional aids in teaching and learning mathematics, student perceptions toward instructional aids in mathematics, and the impact of instructional aids on students' academic performance in mathematics. With this Cronbach's Alpha value exceeding 0.70, indicating a satisfactory level of reliability for the constructs being assessed through the questionnaires, there is no necessity to eliminate any items from the questionnaires. This outcome underscores the confidence in the reliability of the questionnaire items for capturing the targeted aspects of the study effectively.

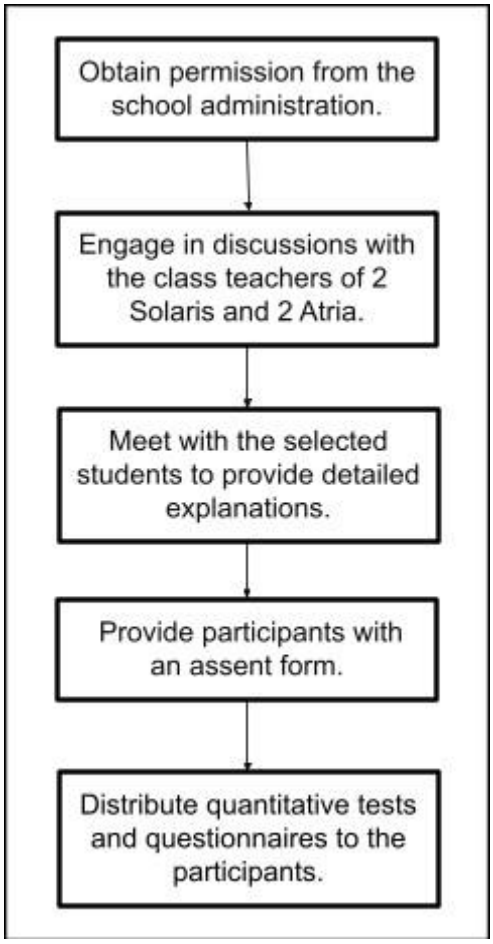

Figure 2 The steps taken to obtain an authorization

Figure 2 show the necessary procedures to obtain an authorization before the quatitiative data collection were employed. As mentioned earlier, DLP Form Two students from SMK Seksyen 9, specifically 2 Solaris and 2 Atria, were selected as the research population. It was essential to obtain permission from the school administration, including the principal. This direct interaction ensured clarity regarding the research goals and fostered trust between the person conducting the study and the school authorities, thereby establishing a solid foundation for ethical conduct throughout the research process. Upon receiving approval from both the principal and the teachers, meetings were held with the selected students to provide detailed explanations of the research purpose, procedures, and their roles as participants. This interaction promoted transparency and ensured that students comprehended the study's significance and their voluntary participation. Additionally, participants were provided with an assent form, emphasizing their independence to choose whether to take part in the research and ensuring their understanding of the research procedure. Finally, a questionnaire related to instructional aids was provided to be answered by the respondents. The purpose of this questionnaire was to obtain the students' opinions and perceptions on using instructional aids during the teaching and learning process in the classroom. The estimated time to answer the questionnaire was 15 minutes. However, for certain reasons, respondents were allowed to take one day to answer it. All respondents were asked to complete the questionnaires and return them a day after they were given. These

data collection methods were considered very relevant and could help in following the research objectives and answering the research questions that had been set.

The data collected will be analyzed using SPSS. Through this research, descriptive and inferential statistics were used to explain the research findings. Descriptive statistics were employed to describe data sets, aiding in understanding the details of the data by summarizing it and identifying patterns from a specific data sample. Methods such as finding the mode, mean, median, and standard deviation were utilized in descriptive statistics. The research was analyzed using the paired-sample t-test, which is suitable for comparing the means of the same subjects under two different conditions, such as before and after an intervention (Bevans, 2022; Kumar, 2023). This test was specifically selected to compare students' mathematics academic performance in the pre- and post-tests given after the use of instructional aids. This statistical approach allowed the researchers to effectively measure the difference in student performance following the intervention. Therefore, the combination of descriptive and inferential statistics was an appropriate choice for the data analysis.

Table 3
Data analyses table

Research objectives	Research questions	Instruments	Analysis
1. To examine the use of instructional aids in teaching and learning mathematics in secondary schools.	1. What is the use of instructional aids in teaching and learning mathematics in secondary schools?	Questionnaire	Descriptive
2. To determine the perception of lower secondary school students towards the use of instructional aids in mathematics.	2. What is the perception of lower secondary school students towards the use of instructional aids in mathematics?	Questionnaire	Descriptive
3. To investigate the impact of instructional aids on the mathematics academic performance of lower secondary school students.	3. What is the impact of instructional aids on the mathematics academic performance of lower secondary school students?	Quantitative test	Inferential: t-test

Table 4
Demographic of Respondents by Class.

	Frequency	Percentage (%)
2 Atria	32	54.2
2 Solaris	27	45.8
Total	59	100

Table 4 shows the distribution of respondents by class who participated in this study. The participation of two classes, namely 2 Atria and 2 Solaris, was observed. In Class 2 Atria, there are a total of 32 students, accounting for 54.2% of the total. In Class 2 Solaris, there are 27 students, constituting 45.8% of the total. Hence, the combined frequency for these two classes is 59 students, representing 100% of the total.

Findings

What is the use of instructional aids in teaching and learning mathematics in secondary schools?

Table 5 shows the Level of agreement for the constructed items related to the use of instructional aids in teaching and learning mathematics in secondary schools.

Table 5
Level of agreement for the constructed items related to the use of instructional aids in teaching and learning mathematics in secondary schools

Items	Level of Agreement					Mean	Std. Deviation
	SD	D	N	A	SA		
Instructional aids have been fully applied in the mathematics classroom teaching and Learning process.	0 0%	0 0%	5 8.5%	42 71.2%	12 20.3%	4.12	0.528
The instructional aids used in teaching and learning mathematics are adequate and appropriate for the learners.	0 0%	0 0%	8 13.6%	30 50.8%	21 35.6	4.22	0.671
Using instructional aids makes learning and teaching mathematics easier, more engaging, concrete, enjoyable, and understandable in	0 0%	0 0%	6 10.2%	26 44.1%	27 45.8%	4.36	0.663

the context of real-world situations.							
Instructional aids produce a more student-centered mathematics lesson in teaching and learning.	0 0%	0 0%	5 8.5%	37 62.7%	17 28.8%	4.20	0.581
Active and effective teaching and learning mathematics has been facilitated by instructional aids.	0 0%	0 0%	5 8.5%	29 49.2%	25 42.4%	4.34	0.633
					Mean Percentage of Agreement		90.18%
					Construct Mean		4.248

The research findings reveal overwhelming agreement among respondents regarding the vital role of instructional aids in secondary mathematics education. The vast majority of participants consistently agreed that these aids make mathematics learning easier, more engaging, concrete, enjoyable, and relatable to real-world situations (53 out of 59 agreed, M=4.36), a perspective supported by existing literature (Umuhoza, 2021). Furthermore, a high consensus affirmed that instructional aids are valuable tools for facilitating active and effective teaching and learning (54 out of 59 agreed, M=4.34), enabling students to grasp complex, abstract concepts through concrete representations and hands-on experiences like manipulatives and visual aids. A significant number of respondents also felt the instructional aids were adequate and appropriate for the learners (51 out of 59 agreed, M=4.22), which is crucial for enhanced academic performance. Additionally, most participants agreed that these aids promote a student-centered learning environment (54 out of 59 agreed, M=4.20), shifting the focus to students' needs and active participation. While agreement was still high, the statement that instructional aids have been fully applied in the classroom received the lowest mean score (M=4.12), suggesting that while their value is recognized, educators are encouraged to more consistently integrate them into instruction to maximize their benefits (Sirajo, 2023).

What is the perception of lower secondary school students towards the use of instructional aids in mathematics?

Table 6 shows the level of agreement for the constructed items related to the perception of lower secondary school students towards the use of instructional aids in mathematics.

Table 6
Level of agreement for the constructed items related to the perception of lower secondary school students towards the use of instructional aids in mathematics.

Items	Level of Agreement					Mean	Std. Deviation
	SD	D	N	A	SA		
Instructional aids are materials that are easy to use for learning mathematics.	0 0%	0 0%	4 6.8%	30 50.8%	25 42.4%	4.36	0.609
Utilizing instructional aids during mathematics learning is crucial.	0 0%	0 0%	13 22%	27 45.8%	19 32.2%	4.10	0.736
Instructional aids provide students with hands-on experiences that help them improve mathematical skills and concepts.	0 0%	1 1.7%	4 6.8%	24 40.7%	30 50.8%	4.41	0.698
Instructional aids are more helpful than traditional methods in grasping mathematics content.	0 0%	0 0%	5 8.5%	24 40.7%	30 50.8%	4.42	0.649
Through the use of instructional aids memorization can be minimized and the student's imagination will be challenged.	0 0%	0 0%	12 20.3%	34 57.6%	13 22%	4.02	0.656
Mean Percentage of Agreement							86.76%
Construct Mean							4.262

The research strongly confirms students' positive perception of instructional aids in mathematics, viewing them as significantly more helpful than traditional, lecture-based methods for grasping content (M=4.42). This is attributed to the aids' ability to actively engage students, make abstract concepts tangible, and cater to diverse learning styles, unlike passive traditional instruction (Miller, 2013). The findings also highlight that instructional aids excel at providing hands-on experiences that directly improve mathematical skills and concepts (M=4.41), a benefit recognized by nearly all respondents and supported by research on active, practical learning (Hosack, 2019). Additionally, students widely agree that these materials are easy to use (M=4.36), fostering a more accessible and supportive learning environment. While most students acknowledged the crucial importance of using instructional aids (M=4.10), and that these aids can minimize memorization and challenge

imagination (M=4.02), these statements received the lowest mean scores, suggesting that educators may need to focus more on fully demonstrating these specific, deeper cognitive benefits to students.

What is the impact of instructional aids on the mathematics academic performance of lower secondary school students?

Table 7 shows the level of agreement for the constructed items related to the impact of instructional aids on the mathematics academic performance of lower secondary school students.

Table 7
Level of agreement for the constructed items related to the impact of instructional aids on the mathematics academic performance of lower secondary school students

Items	Level of Agreement					Mean	Std. Deviation
	SD	D	N	A	SA		
Instructional aids can improve students' understanding of mathematics subjects during the learning and teaching process.	0 0%	0 0%	2 3.4%	34 57.6%	23 39%	4.36	0.550
The utilization of instructional aids can enhance student performance on mathematics tests and examinations.	0 0%	0 0%	4 6.8%	38 64.4%	17 28.8%	4.22	0.559
Instructional aids can change students' attitudes toward maintaining concentration in class.	0 0%	4 6.8%	10 16.9%	17 28.8%	28 47.5%	4.17	0.950
The memorization of a mathematical topic taught in class can be enhanced through instructional aids.	0 0%	0 0%	4 6.8%	35 59.3%	20 33.9%	4.27	0.582
Instructional aids encourage students' interest in learning by enhancing their mathematical skills	0 0%	1 1.7%	6 10.2%	27 45.8%	25 42.4%	4.29	0.720

and ability to think critically.							
Instructional aids positively impact students' academic performance in mathematics.	0 0%	0 0%	6 10.2%	25 42.4%	28 47.5%	4.37	0.667
						Mean Percentage of Agreement	89.57%
						Construct Mean	4.28

The study reveals a strong consensus among lower secondary students that instructional aids have a significant positive impact on their academic performance in mathematics (M=4.37), primarily by improving their understanding of mathematical concepts (M=4.35). These aids transform abstract mathematical ideas into concrete, real-world, and interactive experiences, which not only deepens comprehension and long-term memory retention (M=4.27) but also encourages active learning, critical thinking, and enhanced mathematical skills (M=4.29). Furthermore, students confirm that using instructional aids improves their performance on tests and examinations (M=4.22) and, to a lesser extent, positively changes their attitude toward improving classroom concentration (M=4.17). Overall, the findings, supported by higher post-intervention test scores, consistently validate that instructional aids are crucial tools for fostering greater proficiency and success in mathematics education.

The variable of interest is the Mathematics subject score in two different time periods (before and after the teaching and learning session using instructional aids). The null and alternative hypotheses are defined as follows:
Ho: There is no difference in the mean score between before and after using instructional aids in teaching mathematics.
H1: There is a difference in the mean score between before and after using instructional aids in teaching mathematics.

Table 8
Paired Sample t-test Of Findings for Research Question Three (Quantitative Tests)

Paired Samples Test									
Pair Differences									
					95% Confidence Interval of the Difference				
			Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig (2-tailed)
Pair	Test 1 Marks	Marks – Test 2	-0.983	0.919	0.120	-1.223	-0.744	-8.217	58	0.000

In Table 8, the first column illustrates the actual difference between two means (-0.983), serving as the numerator in the t-test formula. The second column presents the standard deviation of the difference score (0.919), while the third column indicates the standard error of the mean (0.120), functioning as the denominator in the t-test calculation. Moreover, the 95% Confidence Interval outlines the lower and upper limits of the mean difference, with a confidence level of 95%, indicating that the difference between the means falls within the range of -1.223 to -0.744. The obtained p-value from the paired samples test is 0.000, which

falls below the significance level of 0.05, leading to the rejection of the null hypothesis. Additionally, the paired sample t-test reveals a statistically significant difference in test scores before and after using instructional aids in teaching mathematics (t (58) = -8.217, p = 0.000).

Conclusion

a) Instructional aids are overwhelmingly seen as highly effective in teaching high school math. Most people in the study agreed that these tools make learning math easier, more fun, practical, and connected to the real world. Essentially, instructional aids are key to making math lessons better by getting students more involved and helping them truly understand the concepts in a way that matters.
b) Simply put, the research shows that instructional aids are a great way to teach math. Students find them more helpful than old-fashioned lectures because the aids make learning active and work for different learning styles. Even though these tools are very beneficial, teachers need to find better ways to show students that aids can help them stop just memorizing and actually boost their creativity in math. Ultimately, using these aids more effectively will lead to students understanding math much better.
c) Instructional aids are extremely helpful for younger high school students learning math. They boost students' understanding and get them more involved in lessons, which directly results in better grades and success in the subject. Using these aids in teaching is a key strategy for improving math education.

For students, the findings of such research can shape their learning experiences. The findings can help students understand how instructional aids positively affect their academic performances, as well as indirectly help them discover effective learning techniques. When instructional aids are used effectively, they facilitate complex and difficult mathematical concepts. Thus, it makes mathematics more accessible and captivating for students. Such research not only improves students' understanding but also builds their confidence in tackling mathematical problems. For instance, the positive effect of instructional aids on academic performance, as proven by this research findings, can significantly increase student motivation. When students feel that these aids contribute to their understanding and success in mathematics, they will be more likely to participate actively in class discussions and activities that involve the use of these instructional aids. This active involvement fosters a deeper student interest in learning and encourages them to explore and apply mathematical principles outside the classroom.

As is well known, teachers play the most important role in effectively implementing instructional aids in the classroom to improve their students' performance. Such research findings can inform educators about the wider impact that instructional aids have had on student learning outcomes in mathematics. This understanding encourages teachers to make informed decisions about how and when to integrate these aids into their teaching to ensure alignment with curriculum objectives and student needs. Furthermore, research into the impact of instructional aids can boost teachers' efforts to use innovative teaching methods. When teachers discover and understand that specific aids positively impact student performance, they are motivated to use these aids to enrich the learning experience. This can increase teachers' confidence and enthusiasm, encouraging them to continue exploring and refining teaching strategies that benefit their students.

Research on the impact of instructional aids in mathematics education has implications for community and government stakeholders. The positive impacts demonstrated by instructional aids on student performance can strengthen community support for educational initiatives and policies that prioritize resources for effective teaching practices. Government bodies can use such research findings to shape education policy and allocate resources strategically. They can invest in educational programs that promote the use of instructional aids, which can lead to better educational outcomes and better prepare future generations for the demands of the workforce. This alignment between research, policy, and practice ensures that educational investments are evidence-based and aimed at achieving long-term societal benefits.

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References

Adebule, S. O., & Ayoola, O. O. (2015, October 20). Impact of Instructional Materials on Students' Academic Performance in Mathematics in Secondary Schools in Ekiti State, Nigeria. cloudfront.net. Retrieved February 8,2023, from http://www.pearlresearchjournals.org/journals/rjesr/archive/2016/Jan/Pdf/Adebule%20an d%20Ayoola.pdf

Adeoye. (2012). Technology guide for teaching and learning. Nigeria: Eagle Wing Publishing Company, Ibadan, Nigeria.

Amadioha. (2009). The Importance of Instructional Materials in Our School an Overview. New Era Research Journal of Human, Educational and Sustainable Development, 61-63.a

Amah, N., & Nugroho, A. D. (2016). Pengaruh Fasilitas Sekolah Terhadap hasil belajar Akuntansi Dengan lingkungan sosial Sebagai Pemoderasi. Journal of Accounting and Business Education, 2(4). https://doi.org/10.26675/jabe.v2i4.6078

Apperson, Laws & Scepansky. (2006). The impact of presentation graphics on students' experience in the classroom. Computers and Education, 116-126.

Ariffin, S. R. (2008). Inovasi dalam pengukuran & penilaian pendidikan. Bangi: Universiti Kebangsaan Malaysia.

Audsley, S. (2019, August 14). 6 Reasons to Study Mathematics. Retrieved from PHDstudies: https://www.phdstudies.com/articles/6-reasons-to-study-mathematics

Awobodu. (2002). Instructional Materials and Students' Academic Achievement in Science Subjects. Jos: Jos University Press Limited.

Babbie, E. R. (1998). The practice of Social Research. Wadsworth.

Barus, I. R. (2021, November 22). Reading Literacies Through Evieta-Based Learning Material: Students' Perceptions. Journal Of Advanced English Studies, 15-20. Retrieved from https://kims-imio.kz/wp-content/uploads/2021/11/Conf-2021-019.pdf

Bevans, R. (2022, December 19). An introduction to T tests: Definitions, formula and examples. Scribbr. Retrieved February 10, 2023, from https://www.scribbr.com/statistics/t-test/

Capuno, R., & Revalde, H. (2019). Facilitating learning mathematics through the use of instructional media - eric. ERIC. Retrieved January 24, 2023, from https://files.eric.ed.gov/fulltext/EJ1227011.pdf

Chua, Y. P. (2016). Mastering research methods (3rd ed.). McGraw-Hill (Malaysia).

Cicekci. (2019, April 19). Teachers' and Students' Opinions About Students' Attention. Retrieved from Canadian Center of Science and Education: https://files.eric.ed.gov/fulltext/EJ1232893.pdf

Contributor, T. T. (2018, October 11). What is SPSS (statistical package for the Social Sciences)?: Definition from TechTarget. WhatIs.com. Retrieved February 7, 2023, from https://www.techtarget.com/whatis/definition/SPSS-Statistical-Package-for-the Social-Sc iences?amp=1

Dar. (2022). View of Role Of Projected And Non-Projected Teaching Aids In Teaching Learning Process. Retrieved from Journal of Positive School Psychology: https://journalppw.com/index.php/jpsp/article/view/13497/8753

Demirel & Altun. (2012). Educational technology and Material design. Ankara: Pegem Akademi Yayıncılık.

Dienes. (1973). Mathematics through the senses, games, dance, and art. Windsor, UK: The National Foundation for Educational Research Publishing Company Ltd.

Frost, J. (2022, July 7). Cronbach's alpha: Definition, Calculations & Example. Statistics By Jim. Retrieved February 6, 2023, from https://statisticsbyjim.com/basics/cronbachs-alpha/

Idris, N. (2013). Penyelidikan Dalam Pendidikan. Mcgraw-Hill.

Isiaka, A., Ganiyu, A., & Tajudeen, A. (2013, August). Students' perception towards the use of computer-assisted instruction . futminna. Retrieved February 7, 2023, from https://staff.futminna.edu.ng/EDT/content/journal/PF0890/60.pdf

Jaiswal, S. (2023, January 10). 5 types of research design - elements and characteristics: Emeritus India. Emeritus. Retrieved February 5, 2023, from https://emeritus.org/in/learn/types-of-research-design/#:~:text=Research%20design%20is%20broadly%20divided%20into%20quantitative%20and%20qualitative%20research%20 design.

Kablan. (2010). The effect of using exercise-based computer games during the process of learning on academic achievement among education majors. Educational Sciences: Theory & Practices, 335-364.

Kenali, U. (2012, June 11). Instrumen Kajian. Retrieved February 6, 2023, from https://ustazkenali.wordpress.com/2012/06/08/instrumen-kajian/#:~:text=Definisi%3A% 20Secara%20umumnya%20instrumen%20kajian,memperolehi%20dan%20mengumpul% 20data%20kajian.

Walters, K., & Bailey, P. (2014, November). An Up-Close Look at Student-Centered Math Teaching: A Study of Highly Regarded High School Teachers and Their Students. Retrieved from https://files.eric.ed.gov/fulltext/ED611376.pdf

Kul, U., Aksu, Z., & Celik, S. (2018). The impact of educational material use on mathematics achievement : A Meta-Analysis. e-iji.net. Retrieved February 10, 2023, from https://www.e-iji.net/dosyalar/iji_2018_4_20.pdf

Kumar, A. (2023, January 24). Paired sample T-tests: Formula, examples. Data Analytics. Retrieved February 10, 2023, from https://vitalflux.com/paired-sample-t-tests-formula-examples/amp/

Lorina. (2022, May 12). John Dewey's theory. Retrieved February 10, 2023, from https://aussiechildcarenetwork.com.au/articles/child-development/john-deweys-theory

Lowe, N. K. (2019). What Is a Pilot Study? Retrieved from JOGNN: https://www.jognn.org/article/S0884-2175(19)30006-1/pdf

Mamolo, L. (2023, March). Digital interactive app and students' mathematics self-efficacy, anxiety, and achievement in the "new normal". Retrieved from Research Gate: https://www.researchgate.net/profile/Leo-Mamolo/publication/369620763_Digital_interactive_app_and_students'_mathematics_self-efficacy_anxiety_and_achievement_in_the_new_normal/links/64c4d0c30fae1319bfc2686c/Digital-interactive-app-and-students-mathematics

McCombes, S. (2022, December 1). Sampling methods: Types, techniques & examples. Scribbr. Retrieved February 10, 2023, from https://www.scribbr.com/methodology/sampling-methods/

Morales, A. (2021, December 16). Cognitivism. Retrieved February 9, 2023, from https://study.com/learn/lesson/cognitivism-education-learning-theory.html

Morgan, G., & Smircich, L. (1980). The case for qualitative research. The Academy of Management Review, 5(4), 491. https://doi.org/10.2307/257453

Anggo, M., & Arapu, L. (2018). The Use of Mathematics Teaching Aids to Train Metacognition Ability of Elementary School Students. Retrieved from IopScience: https://iopscience.iop.org/article/10.1088/1742-6596/1028/1/012143/pdf

Mwangi. (2006). Human Resources Management Practice. London: Kogan page.

Ordu, U. B.-A. (2021). The Role of Teaching and Learning Aids/Methods in a Changing World. Bulgarian Comparative Education Society (BCES), 210-216.

Ruja, N., Sari, R. M., & Utomo, D. H. (2019, December). Student perception on teaching materials development to increase Students' Knowledge of Aceh's Maritime Potential. Retrieved February 7, 2023, from https://dergipark.org.tr/tr/download/article-file/883541

Chand, S., & Chaudhary, K. (2021, April 23). Perceived Causes of Students' Poor Performance in Mathematics: A Case Study at Ba and Tavua Secondary Schools. Retrieved from Frontiers: https://www.frontiersin.org/articles/10.3389/fams.2021.614408/full

Shabiralyani , G., Hasan, K. S., Hamad, N., & Iqbal, N. (2015). Impact of visual aids in enhancing the learning process . eric.ed. Retrieved February 10, 2023, from https://files.eric.ed.gov/fulltext/EJ1079541.pdf

Sherman & Bisanz. (2009). Equivalence in symbolic and non-symbolic contexts: Benefits of solving problems with manipulatives. Journal of Educational Psychology, 88-100.

Sileyew, K. J. (2019, August 7). Research design and methodology. IntechOpen. Retrieved February 5, 2023, from https://www.intechopen.com/chapters/68505

Singh, P., Sidhu, G. K., & Chan, Y. F. (2009). A comprehensive guide to writing a research proposal. Venton.

Thomas, L. (2022, December 5). Cluster sampling: A simple step-by-step guide with examples. Scribbr. Retrieved February 10, 2023, from https://www.scribbr.com/methodology/cluster-sampling/

Vinz, S. (2022, November 29). What is a theoretical framework?: Guide to organizing. Retrieved February 9, 2023, from https://www.scribbr.com/dissertation/theoretical-framework/

Yahaya, M. (2019). The Effectiveness of Programmable Logic Controller Teaching Aids for Control System Modules in Vocational College. Educational Research, 51-59.

Li, Y., & Alan, H. (2019, December 19). Problematizing teaching and learning mathematics as "given" in STEM education. Retrieved from https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-019-0197-9