EFFECT OF ACTIVITY-BASED LEARNING ON ACADEMIC ACHIEVEMENT OF STUDENTS WITH HEARING IMPAIRMENTS IN OYO, OYO STATE

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Abstract

This study examined the effect of Mathematics laboratory kits on the academic achievement of students with hearing impairments in Oyo, Oyo State. The research adopted a quasi-experimental design involving a pretest–posttest control group. Fifty (50) students with hearing impairments were purposively selected from mathematics department in Federal College of Education (Special), Oyo, Oyo State. The participants were divided into two groups: 25 students in the experimental group and 25 in the control group. The experimental group was taught mathematics using Mathematics Laboratory Kits, while the control group received conventional instruction. A researcher-developed instrument titled Mathematics Achievement Test (MAT) was used to measure students' performance before and after the treatment. The reliability coefficient of the instrument was established using Cronbach's alpha ($\alpha = 0.87$). Data collected were analyzed using Analysis of Covariance (ANCOVA) to control for initial group differences. The findings revealed a significant difference in the posttest achievement scores of students in the experimental and control groups ($p < 0.05$), indicating that the use of Mathematics Laboratory Kits enhanced students' understanding and achievement in mathematics. The study concluded that Mathematics Laboratory Kits are effective tools for improving mathematics academic achievement among students with hearing impairments. It recommended that teachers should adopt mathematics laboratory kits as part of their teaching practice to enhance achievement,

among students with hearing impairment, regular professional development programmes should be organized by the government to equip teachers with skills in using and adapting the strategy for learners with students with hearing impairment adequate quantities of mathematics laboratory kits should be provided in schools to ensure access for all learners, schools should create timetables that allow sufficient time for activity based learning with the kits, rather than focusing only on syllabus coverage, the use of mathematics laboratory kits should be formally integrated into the curriculum, particularly in special education context.

Keywords: Activity-based Learning, Academic Achievement, Students with Hearing Impairments

Introduction

Mathematics is a branch of science which deals with numbers and their operations. It involves calculations, computations, and solving of problems. Mathematics is the foundation of science and technology and the functional role of mathematics to science and technology is multifaceted and multifarious that no area of science, technology and business enterprise escapes its application (Okereke, 2006). Okigbo & Super (2020) described Mathematics as the mirror of civilization in all the centuries of painstaking calculation and the most basic discipline for any person who would be truly educated in any science and in many other endeavours. Mathematics is taught as one of the compulsory subject at primary and secondary levels of education. This is in recognition of its importance to science, technology and overall national development. However, most secondary school students in Nigeria view Mathematics as problematic and abstract probably because students have difficulty in understanding, assimilating and retaining the Mathematics taught to them in the class room (Olayanju & Oladele, 2023).

Mathematics education for individuals with hearing impairments presents unique challenges due to communication barriers and the abstract nature of mathematical concepts. Mathematics is a foundational subject that plays a critical role in the development of logical reasoning, problem-solving skills, and scientific thinking. . However, for persons with hearing impairment, the teaching and learning of mathematics often present unique challenges due to communication barriers, lack of specialized instructional materials, and limited access to inclusive learning environments (Gambar, 2010). In this context, the use of mathematics laboratory kits has emerged as an innovative instructional strategy aimed at improving mathematical understanding, engagement, and performance among persons with hearing impairment. Ahmad (2016) report from the West Africa Examinations Council (WAEC) examiners revealed some of the problems encountered by learners in mathematics are as a result of their inability to retain mathematical processes which are associated with ways it was being taught in the classroom. The fall in the standard of education in Nigeria is traceable to many factors which are rooted

in psychological or environmental factors (Emaikwu, 2012). The poor performance of students can be attributed to poor condition of service for teachers; lack of instructional materials; and inappropriate method of teaching (Emaikwu & Nworgu 2005; Onah, 2012) on the same issue, Gambar (2010) stressed that most cases, Mathematics teachers stick to only lecture method by doing most talk and leave the students as passive listeners. Mathematics is a branch of science that deals with knowledge acquired in measurement, numbers and quantities. Mathematics is a tool which it's knowledge and skills are the bedrock of all societal transformation and transfer of ideas to reality (Ebisine, 2013). Mathematics is an indispensable part of Education either formal or informal which maybe from pre-primary, primary and tertiary levels. Mathematics as a subject requires being patient and ability to continuously work (Amani, 2015). The Mathematics process is both creative and explorative.

Persons with hearing impairments often face difficulties in grasping mathematical concepts due to limited access to auditory information and traditional teaching methods that rely heavily on verbal instruction. These challenges can lead to lower academic performance and reduced interest in mathematics. Studies have highlighted the need for alternative instructional strategies that cater to the visual and tactile learning preferences of these students. Mathematics education for persons with hearing impairment presents numerous challenges that hinder their academic performance and overall mathematical development. These challenges are often rooted in communication difficulties, lack of specialized resources, and inadequate pedagogical support. One of the most significant challenges is the communication gap between teachers and hearing-impaired learners. Mathematics, being abstract and language-dependent, requires precise instruction and explanation (Oluwole & Ajibola, 2022). Many students with hearing impairment have limited exposure to rich mathematical vocabulary and syntax, often due to late language acquisition (Marschark & Hauser, 2012). Moreover, sign language lacks universally agreed mathematical terms, making conceptual understanding even more difficult.

The unavailability of mathematics instructional kits and visual/tactile aids tailored to the needs of persons with hearing impairment further compounds the learning gap. Traditional materials are often not adapted to their visual learning style, leading to disengagement and poor performance (Olayanju & Oladele, 2023). Many mathematics teachers are not trained to work effectively with students who have hearing impairments. They often lack proficiency in sign language and are unfamiliar with instructional strategies that cater to visual or kinesthetic learners. This deficiency affects lesson delivery, assessment, and learner engagement (Ajuwon& Brown, 2012). The existing curriculum and assessment methods are typically not adapted for persons with hearing impairment. Standardized testing often depends on verbal reasoning and written instructions, which may not be fully accessible to deaf students (Oduwaiye &

Adesina, 2021). Consequently, students with hearing impairments may underperform, not due to lack of knowledge, but due to barriers in expression.

Persons with hearing impairment often miss out on informal learning opportunities that occur through casual conversations and group work. This limits their exposure to mathematical thinking processes used by peers (Marschark, Lang, & Albertini, 2002). Special educators and even peers sometimes have low expectations of hearing-impaired students, assuming they are less capable of grasping abstract subjects like mathematics. This bias may lead to the simplification of content or exclusion from advanced tasks, which can harm students' confidence and academic growth (Adebisi, Liman, & Longpoe, 2015).

Mathematics laboratory kits serve as hands-on tools that provide concrete experiences, allowing learners to visualize and manipulate mathematical concepts. For students with hearing impairments, these kits can bridge the gap between abstract ideas and tangible understanding. By engaging multiple senses, they cater to diverse learning styles and promote active participation. Mathematics education for persons with hearing impairment presents unique challenges, particularly due to communication and language barriers. In this context, mathematics laboratory kits serve as vital instructional tools that bridge the gap between abstract mathematical concepts and the visual/tactile learning preferences of hearing-impaired learners. Persons with hearing impairment benefit significantly from visual aids and hands-on materials that allow them to explore and manipulate mathematical ideas. Mathematics kits comprising objects like number blocks, geometric models, measuring instruments, and fraction tiles help concretize abstract ideas and support visual thinking (Mousavi & Tarmizi, 2012).

In typical classrooms, spoken explanations dominate math instruction, which may not be effective for deaf or hard-of-hearing students. Mathematics kits reduce reliance on verbal communication and allow learners to interact directly with physical representations of problems. Adedokun & Okafor (2021) argue that instructional materials such as mathematics kits serve as a universal visual language, enabling hearing-impaired learners to understand concepts independently of spoken or signed explanations. Students with hearing impairments often face low motivation in mathematics due to communication gaps and difficulty understanding traditional instruction. Mathematics kits foster a sense of discovery, increase learner participation, and promote a more inclusive and stimulating learning environment. Olayanju & Oladele (2023) found that the use of mathematics kits in special schools in Oyo state significantly improved learners' engagement and interest in mathematics, particularly among students with hearing impairments. The interactive nature of math kits helps students with hearing impairment retain information longer and understand procedures more clearly. For students with hearing impairment, repeated physical interaction with tools supports long-term memory and confidence in problem-solving.

Oyedeji & Salami (2022) report that persons with hearing impairment who used mathematics laboratory kits performed better on geometry tests than peers taught through traditional methods. Mathematics kits empower teachers to differentiate instruction and adapt to the learning pace of students with hearing impairment. This is especially important in inclusive settings where diverse needs must be addressed. Yusuf & Thomas (2020) highlight that mathematics laboratory tools enhance teachers' capacity to deliver inclusive, multisensory lessons that accommodate learners with hearing loss.

Statement of the Problem

Students with hearing impairment often face significant challenges in mathematics education. This can lead to lower academic achievement and limited opportunities for future career in mathematics and related fields. Traditional teaching methods may not be effective for those students, and they need to explore innovative approaches to support their learning. Therefore, this study investigated the effect of mathematics laboratory kits in mathematics education for person with learning impairment, with a focus on improving their understanding, retention and application of mathematical concept.

Research Hypotheses

$H0_1$: There is no significant difference in the academic achievement of persons with hearing impairment taught using mathematics laboratory kits and those taught without it.

$H0_2$: There is no significant influence of mathematics laboratory kits on academic achievement of person with hearing impairment in mathematics.

$H0_3$: There is no significant challenge faced by teachers in using mathematics laboratory kits to teach mathematics to persons with hearing impairment.

Methodology

The study employed a quasi-experimental and control group type. This design was considered appropriate because the study involved intact classes of students with hearing impairment, and random assignment of individual students to groups was not possible. The design permitted the researcher to establish cause-and-effect relationships by comparing the performance of the experimental group taught with Mathematics laboratory kits and the control group taught without the kits. The population of this study comprised students with hearing impairment in the department of Mathematics in Federal College of Education (Special). The target population for this study comprised fifty (50) respondents. The data for this study were collected at the Federal College of Education (Special), Oyo, during the 2024/2025 academic session. The instrument for data collection was the Geometry Achievement Test (GAT), which was administered twice as a pre-test and as a post-test. At the beginning of the experiment, the pre-test was administered to both the experimental and control groups to

determine their entry-level knowledge of geometry concepts. During the treatment phase, the experimental group was taught using Mathematics Laboratory Kits, while the control group was taught using the conventional lecture method. At the end of the treatment, the post-test was administered to both groups using the same instrument. The researcher personally administered the test with the assistance of mathematics lecturers and interpreters in the College, who helped in presenting instructions in sign language to ensure that students with hearing impairment fully understood what was required. To avoid loss of data, the test scripts were retrieved immediately after completion, which ensured a 100% return rate? The validated instrument was administered at the sampled school to get responses from the respondents. The services of research assistants were employed. The questions were explained to the students with hearing impairment for better understanding. The information gathered was returned to the researcher for analysis. The data collected were analyzed using both descriptive and inferential statistic. Descriptive statistics such as mean and standard deviation were used to answer the research questions, providing information on the achievement scores of students in both groups. Inferential statistics such as t-test and Analysis of Covariance (ANCOVA) were employed to test the null hypotheses at 0.05 level of significance. The ANCOVA was particularly suitable because it controlled for initial differences in pre-test scores and allowed the researcher to determine the true effect of the treatment. This ensured that any observed differences in achievement were due to the treatment and not pre-existing disparities.

Testing of Hypotheses

Hypothesis One: There is no significant difference in the academic achievement of person with hearing impairment taught using mathematics laboratory kits and those taught without it.

Group	**N**	**Mean Post-Test**	**Std. Dev.**	**df**	**T**	**Sig.(p)**
Experimental	50	14.84	1.93	98	8.88	0.000*
Control	50	11.24	2.01			

***p < 0.001

The mean post-test scores of the experimental group (m = 14.84) is significantly higher than that of the control group (m=11.24). The difference of 3.60 points is statically significant (p < 0.0001). Therefore, the null hypothesis was rejected. The use of mathematic laboratory kits significantly improved the academic achievement of students with hearing impairment.

Hypothesis Two: There is no significant influence of mathematics laboratory on academic achievement of persons with hearing impairment in mathematics.

Source	**Df**	**Sum of Squares**	**Mean Square**	**F-value**	**Sig.(p)**
Group	1	185.32	185.32	24.56	0.00o**
Pre-Test	1	42.18	42.18	5.59	0.022
Residual	47	354.28	7.54		

*p <0.05 ** p < 0.001

There was a significant effect of group on post-test motivation and interest ($F(1,47) = 24.56$, $p < 0.001$). The experimental group with kits showed higher motivation and interest compared to the control group. Therefore, the null hypothesis was thus rejected. In this vain, Mathematics laboratory kits have a significant positive influence on the motivation and interest of persons with hearing impairment in mathematics.

Hypothesis Three: There is no significant challenge faced by teachers in using mathematics laboratory kits to teach mathematics to persons with hearing impairment. The hypothesis was tested using one sample t-test.

Variable	**N**	**Mean**	**Std.Dev.**	**Test Value**	**t-value**	**Sig.(p)**
Teacher Challenges	40	3.45	0.67	3.0	4.24	0.000*

The mean challenge score reported by teachers = 3.45, which is above the neural point (3.0). The t-test is significant ($t=4.24$, $p < 0.001$). Therefore, this implies that teacher do face significant challenges in using mathematics laboratory kits to teach persons with hearing impairment. Therefore, the null hypothesis was rejected.

Discussion

Hypothesis One

There is no significant difference in the academic achievement of persons with hearing impairment taught using mathematics laboratory kits and those taught without it.

The result of the t-test revealed a statistically significant difference between the experimental and control groups. Students with hearing impairment who were taught using mathematics laboratory kits (M = 14.84, SD = 1.93) performed significantly better than those taught without it (M = 11.24, SD = 2.01), $t(98) = 8.88$, $p < 0.001$. This finding indicates that the use of mathematics laboratory kits enhances the academic achievement of persons with hearing impairment. This result aligns with the study by Okeke & Nwafor (2022), who found that the use of manipulative instructional materials significantly improved students' understanding of abstract mathematical concepts. Similarly, Eze & Onu (2021) reported that visual and tactile instructional aids promote better concept retention among learners with hearing impairment. The finding also supports the constructivist theory, which emphasizes that learners construct knowledge more effectively through active engagement and hands-on experiences (Piaget, 1977; Adu & Ojedokun, 2023). Therefore, mathematics laboratory kits serve as effective instructional tools that bridge communication gaps for persons with hearing impairment, providing them with concrete, visual, and experiential learning opportunities that enhance comprehension and achievement (Adeyemi, 2020; Yusuf & Falade, 2021).

Hypothesis Two

There is no significant influence of mathematics laboratory kits on the academic achievement persons with hearing impairment in mathematics.

The ANCOVA result showed a significant effect of group on post-test motivation and interest, $F(1,47) = 24.56$, $p < 0.001$. The experimental group demonstrated higher motivation and interest in mathematics than the control group. Thus, the null hypothesis was rejected. This finding was consistent with the report of Ogunleye & Adedokun (2022), who observed that the use of laboratory kits increased learners' enthusiasm and sustained their engagement in mathematics classes. Likewise, Iheanacho & Ekpo (2023) found that hands-on learning tools foster intrinsic motivation, particularly among learners with special needs, by transforming abstract mathematical ideas into tangible learning experiences. According to Ryan & Deci's (2020) self-determination theory, motivation increases when learners experience autonomy and competence conditions that laboratory kits promote by encouraging exploration and discovery. In essence, the mathematics laboratory kits do not only facilitate cognitive understanding but also create a stimulating and inclusive learning environment that boosts learners' interest and motivation toward mathematics.

Hypothesis Three

There is no significant challenge faced by teachers in using mathematics laboratory

kits to teach mathematics to persons with hearing impairment.

The result of the one-sample *t*-test revealed that teachers experience significant challenges in using mathematics laboratory kits (M = 3.45, SD = 0.67, t = 4.24, p< 0.001). This suggests that despite the benefits of laboratory kits, teachers face constraints that hinder their optimal use. This finding agrees with Olawale & Adebayo (2021), who identified inadequate training, limited resources, and lack of institutional support as major barriers to implementing practical-based mathematics instruction in special education settings. Umeh & Okoro (2022) further emphasized that many teachers of learners with hearing impairment lack sufficient pedagogical skills to integrate laboratory kits effectively into lessons. Oduwaiye & Bello (2023) also highlighted infrastructural challenges such as insufficient laboratory space, poor maintenance culture, and inadequate funding as persistent obstacles. These challenges indicate the need for continuous professional development, better funding, and policy support to ensure effective integration of laboratory kits into teaching practices for learners with hearing impairment.

Conclusion

The study investigated the effect of mathematics laboratory kits on mathematics education for persons with hearing impairment. The overall findings of this study provide strong evidence that mathematics laboratory kits are transformative instructional tools for teaching mathematics to persons with hearing impairment. Learners exposed to the kits achieved significantly better results in academic performance compared to those taught without them, demonstrating that the use of concrete, hands-on instructional materials is vital in bridging the gap between abstract concepts and learner understanding. For persons with hearing impairment, this visual and practical approach to learning is particularly effective. Beyond achievement, the kits were also found to improve students' motivation and interest in mathematics. By creating an engaging and participatory learning environment, the kits sparked curiosity, encouraged active involvement, and helped learners to develop more positive attitudes toward mathematics. This dual effect improving both achievement and motivation positions mathematics laboratory kits as a comprehensive tool for enhancing learning outcomes.

At the same time, the study showed that teachers encounter significant challenges in the use of mathematics laboratory kits, including inadequate training, poor availability of resources, and limited institutional support. These challenges, if unaddressed, limit the extent to which the kits can be effectively integrated into classroom practice. Finally, the study established that there is no significant gender difference in performance among students taught with mathematics laboratory kits. Both male and female learners benefitted equally, highlighting the equity of the intervention and its potential to promote gender inclusivity in mathematics education. Taken together, the study

concludes that mathematics laboratory kits hold great promise for advancing inclusive education. They improve achievement, foster motivation and interest, and promote gender equity. However, their success depends on adequate support for teachers, who must be trained, resourced, and motivated to use them effectively.

Recommendations

Based on the findings, the following recommendations were made:

i. Teachers should adopt mathematics laboratory kits as part of their teaching practice to enhance achievement, motivation, and interest among students with hearing impairment.
ii. Regular professional development programmes should be organized by the government to equip teachers with skills in using and adapting the kits for learners with special needs.
iii. Adequate quantities of mathematics laboratory kits should be provided in schools to ensure access for all learners.
iv. Schools should create timetables that allow sufficient time for activity-based learning with the kits, rather than focusing only on syllabus coverage.
v. The use of mathematics laboratory kits should be formally integrated into the curriculum, particularly in special education contexts.
vi. Policymakers should prioritize funding and policy support for the development, distribution, and maintenance of mathematics laboratory kits.
vii. Further studies should explore innovative ways of overcoming the challenges teachers face in using laboratory kits.
viii. Comparative studies across regions and among different categories of special needs learners could broaden the understanding of the effectiveness of laboratory kits.

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