



UTILIZATION OF INSTRUCTIONAL MATERIALS AND JUNIOR SECONDARY STUDENTS' ACADEMIC ACHIEVEMENT IN GEOMETRICAL-SHAPES

Manko Umar Ahmad^{1*}, Alhaji Zakariyya Aliyu², Alhaji Mohammed Liman¹

¹Niger State College of Education, Minna, Nigeria

²Ibrahim Badamasi Babangida University, Lapai, Nigeria

Email: yamanalkali@gmail.com

Abstract

This study investigates the utilization of instructional materials and junior secondary students' academic achievement in geometrical shapes. A quasi-experimental design with experimental and control groups, including pre-test, post-test, and post-posttest measures, was implemented. The target population consisted of 1329 JSS II Students from Bida Local Government Area, Niger State, with sample size of 171 (Male=84, Female=87) students from two schools and two intact classes. Sample was determined through purposive and simple random sampling, selecting all mixed schools with experimental and control groups. Three research questions and hypotheses were formulated to guide the study. Data collected employed instruments: The Geometry Performance Test (GPT), Geometry Achievement Test (GAT), Lesson model for the control and experimental group. The GPT and GAT were validated by three experts and also demonstrated good reliability. The results revealed that students taught with instructional material performed better comparing with those taught without instructional materials and also there is no significant differences found in gender in the experiment group. In addition, there is significant difference in the retention ability of those who were taught using instructional materials and those taught without instructional material. Based on these results, mathematics teachers should use instructional materials during teach mathematics especially geometrical shapes.

Keywords: Academic achievement, Conventional method, Geometrical shape, Instructional material, Retention ability.

Abstrak

Penelitian ini menyelidiki manfaat bahan ajar dan prestasi akademik siswa SMP pada materi bentuk-bentuk geometri. Desain kuasi-eksperimental dengan kelompok eksperimen dan kontrol, termasuk pretest, postes, dan pos-postes, diterapkan. Populasi target terdiri dari 1329 siswa JSS II dari Wilayah Pemerintah Lokal Bida, Negara Bagian Niger, dengan sampel 171 siswa (Laki-laki=84, Perempuan=87) dari dua sekolah dan dua kelas utuh. Sampel ditentukan secara purposif dan acak sederhana, memilih semua sekolah campuran dengan kelompok eksperimen dan kontrol. Tiga pertanyaan penelitian dan hipotesis diformulasikan untuk memandu penelitian ini. Data dikumpulkan menggunakan instrumen: Geometry Performance Test (GPT), Geometry Achievement Test (GAT), model pembelajaran untuk kelompok kontrol dan eksperimen. GPT dan GAT divalidasi oleh tiga ahli dan menunjukkan reliabilitas yang baik. Hasil penelitian menunjukkan bahwa siswa yang belajar dengan bahan ajar memiliki kinerja yang lebih baik dibandingkan dengan mereka yang tidak, dan tidak ditemukan perbedaan signifikan antar jenis kelamin pada kelompok eksperimen. Selain itu, terdapat perbedaan signifikan pada kemampuan retensi antara siswa yang belajar menggunakan bahan ajar dan yang tidak. Berdasarkan hasil ini, guru matematika direkomendasikan untuk menggunakan bahan ajar saat pembelajaran matematika, terutama materi geometri bidang.

Kata kunci: Bahan ajar, Bentuk geometris, Kemampuan retensi, Metode konvensional, Prestasi akademik.

How to Cite: Ahmad, M. U., Aliyu, A. Z., & Liman, A. M. (2024). Utilization of Instructional Materials and Junior Secondary Students' Academic Achievement in Geometrical-Shapes. *Brillo Journal*, 3(2), 102-112.

INTRODUCTION

Mathematics is an instrument for the advancement of science and technology. Mathematics is the study of numbers, patterns, shapes and spaces. It is academic discipline that is mandatory at primary and post primary level in Nigeria school system, due to its contributions to scientific and technological, and human development (Ahmad & Aliyu, 2022). At post primary, mathematics is divided into seven major areas, one of which is geometry. Geometry is the segment of mathematics that dealt with shapes, angles, dimensions and sizes of a variety of objects. Studying geometry at post primary provides many background skills and assists to build the thinking skills of logic, deductive reasoning, analytical reasoning, and problem-solving.

Despite the significant nature of mathematics and vital role in secondary education in Nigeria, the achievement in mathematics, especially geometry has recorded poor achievement in the subject (Ahmad & Aliyu, 2022; Oguche & Usman, 2019). This poor achievement in the subject especially geometry concept has raised concerns among mathematics educators, teachers and researchers (Ahmad & Aliyu, 2022; Aliyu & Ahmad, 2021). Studies by Adebule and Ayoola (2016) and Dalnaik (2022) have identified some challenges facing teaching and learning mathematics, especially geometrical shapes in our junior secondary schools. These challenges include; large class size, inadequacy qualified teacher, instructional method and teaching without using instructional materials. The conventional teaching mode of teaching mathematics in our secondary schools have been found very defective and full of many inadequacies that do not allow students to actively construct their mathematical knowledge. It has adversely affected effectively learning of mathematics at different levels of education. The conventional mode is described as teacher-center and teacher uses force, commands and threats to attacks individuals' personality. The teacher remains rigid and dominate the class without admit and recognize the psychological inevitability of individual differences. Oguche and Usman (2019) pointed out that students' personality variables such as interest and gender can be attributed for the low achievement. Since learners are not carry along and does not consider the varying abilities, interests, learning styles and readiness of the students, the teacher cannot achieve the desired learning outcome.

Achievement can be defined as a measure of students' level of knowledge, skills or performance (Ahmad & Aliyu, 2022). Others, like Oguche and Usman (2019) described achievement as level of goal setting. It could be seen as the successful accomplishment of goals and how students are able to exhibit their intellectual capabilities in mathematics task through testing period.

Instructional materials are materials that aid teaching and facilitate learning. There are wide range of materials providing realistic image of enhancing curricular content and consequently enhancing the learning. These are forms of audio, visual or combination of the two. These materials are used by the teachers and students for the purpose of ensuring effective teaching and learning (Dalnaik, 2022). Adebule and Ayoola (2016) explained that instructional materials are materials or tools locally made or imported that could make tremendous enhancing lesson delivery, if properly use. They explained further that instructional materials can be seen as resources or aids which teacher uses during lesson presentation in order to make the content of the lesson understandable to the learners. Green (2023) stressed that instructional materials facilitate learning of abstract concepts by assisting to concretize ideas and stimulate students' imagination. Also, the use of instructional materials assists to increase active interaction and participation in the teaching-learning process, while saving teacher energy, reducing the verbal instructions.

The instructional materials are relevant in education because they employed for the transference of information from one person to another, assist the teacher in extending the learners' horizon of experience, stimulate learners' interest and assist both teachers and learners to overcome physical limitations during the delivery of lesson, among others (Inekwe, 2019; Purwitaningrum & Prahmana, 2021). Green (2023) observed that instructional materials are apparatus of teaching, may include textbooks, charts, audio, visual aids, work book, kits and other relevant materials that will draw learners' attention and which should only be introduced at appropriate time by the teacher.

Utilization of instructional materials plays a vital role in the context of junior secondary school. It is very crucial in the teaching and learning process, in enhancing learners' memory retention as pointed out by Oguche and Usman (2019). They commented that the use of instructional material in the teaching-learning process improve performance and retention ability. In addition, Dalnaik (2022) conducted a study on the effect of instructional materials on academic achievement in mathematics and revealed

that there is statistically significant difference in the students' academic achievement between students taught using instructional materials and those taught without using instructional materials. On the issue of gender in mathematics teaching and learning, seem to be a controversy, there are many views in other to ascertain which view is dependable, some studies showed comparative performance. In this study, therefore, there is need to investigate the gender issue of gender difference. For instance, according to Dalnaik (2022) that there is no significant difference in academic achievement of male and female students taught mathematics using instructional materials. Oguche and Usman (2019) submitted that there is significant difference in academic performance of male and female students.

Instructional materials develop a proper image in the mind of learners when learner see, observe, experience and experiment properly. It furnishes a concrete and complete example for conceptual learning, thinking of learners and improve retention ability (Green, 2023). The utilization of instruction materials or educational resources in the teaching- learning situation involves not only the sense of hearing but also that of sight and touch. Following Chinese adage that sum it all as: "What I hear I forget, what I see I remember, and what I do, I understand". In light of this, the researchers looked into whether junior secondary students' academic achievement will improve when using instructional materials to teach geometrical-shapes.

Statement of the problem

Geometrical concept is one of theme that must be learn and examine in the final year SSCE mathematics examination. Research reports revealed that students face several challenges, one of the most significant of which are insufficient and utilization of instructional materials at the junior secondary school level (Adebule & Ayoola, 2016; Dalnaik, 2022; Green, 2023). This shortage has a negative impact on teaches' capacity to improvise instructional materials for teaching at all levels, which has resulted persistence failure in geometrical concept of mathematics. Junior secondary mathematics content has difficulty when it comes to students learning as a result of inadequacy of instructional resources which can lead to convey the instructional objective.

According to Purwitaningrum and Prahmana (2021), one of the obstacles that mathematics educators face in classroom is a lack of sufficient instructional materials or materials of low quality. This contributes to the difficulty of the teaching-learning

process. Green (2023) reported that students are unable to make meaningful learning in the context of instructional process, due to ineffective teaching method and lack of teaching aids. The conventional teaching mode adopted in all levels of education, made the teacher be autocratic and dictatorial, does allow him to use data, new information and experience. There is serious need to use and integrate instructional materials in teaching geometrical-shapes. Thus, on this background this study seeks to assess the utilization of instructional materials on the academic achievement of junior secondary students in geometrical-shapes of mathematics.

Aims and objectives of the study

The study aims to explore the utilization of instructional materials and junior secondary students' academic achievement in geometrical-shapes in Bida local government area Niger state, Nigeria. Specifically, the study sought to determine the following: (1) Compare the academic achievement of students who are were taught geometrical shapes using instructional materials and those without instructional materials, (2) Compare the academic achievement of male and female students who are were taught geometrical shapes using instructional materials, (3) Compare the retention ability of students who are were taught geometrical shapes using instructional materials and those without instructional materials.

Research questions

The following research questions were asked to find answers to the issues raised: (RQ1) How does the academic achievement of those taught geometrical shapes with instructional materials differ from those taught without instructional materials?; (RQ2) What is the academic achievement of male and female students who are were taught geometrical shapes using instructional materials?; (RQ3) What is the retention ability of students who are were taught geometrical shapes using instructional materials and those without instructional materials?

Null hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance: (H01) There is no significant difference in the academic achievement of students taught geometrical-shape using instructional materials and those

taught without instructional materials; (H02) There is no significant difference in the academic achievement of male and female students taught geometrical-shape using instructional materials; (H03) There is no significant difference in the retention ability of students taught geometrical-shape using instructional materials and those taught without instructional materials.

RESEARCH METHODS

Quasi-experimental design was utilized for the study. The target population of the study covered a total of 1329 JSS II students in the ten public schools distributed over Bida local government area. The sample size of this study consisted 171 (84 males; 87 females) students. The sample size was determined through purposively sampling all the mixed schools, while the students were selected using simple random sampling. The reason for the use of mixed schools is to permit the representation of both sexes within each of the groups. This gives the breakdown as follows: Experimental group numbering 84 (43 males; 41 females) and Control group 87 (41 males; 46 females).

The researchers developed two instruments for data collection, titles: Geometry Performance Test (GPT) and Geometry Achievement Test (GAT). Each of the instrument comprises twenty objective questions with options (A-D). The GPT was pretest, the items were drawn from mathematics textbook JSS One to assessed the initial knowledge of the groups, while GAT was posttest and post-posttest to evaluated the academic achievement and retention ability of the groups after the treatment. Question items are derived from plane and solid shapes, rectangle, square, cube, cylinder and cone. The scripts of posttest and post-posttest were collected and marked, then rated 100%. The results recorded were subjected *t*-test analyze to establish statistical significant that will have served as indicators to evaluate academic achievement and retention ability. The instruments were validated by three experts from department of science education IBBU Lapai and FUT Minna. The reliability of the instruments was achieved through test-retest with reliability coefficient of 0.78 for GPT and 0.81 for GAT.

Before the treatment of the groups pretest was administered and the instrument was retrieved from the students. At treatment session, the experiment group were taught geometrical shapes contents using instructional materials, the control group were taught without instrument materials. Experimental group were taught using prepared lesson model integrating instructional materials. This model was developed by National

Teachers' Institute (2012) and adopted by the researchers. The model has four major steps in preparing to integrating instructional materials (Geo-board, model of cylinder and cone). The steps are: preparation of the teacher, preparation of the learners, actual preparation and integration of instructional materials, and lastly activities and evaluation. The control group were taught using lesson model without integrating instructional material. The lesson model designed by National Teachers' Institute (2010) was adopted and modified. The mode has the following components: general information, instructional objective, previous knowledge, introduction, presentation, conclusion and evaluation. Treatment session lasted for two hours and the exercise lasted four weeks. GAT was administering and after two weeks' post- posttest was administered with assumption that students may have forgotten the questions. Data collected were analyzed using different statistical tools, descriptive statistics such as; mean, standard deviation and mean difference for research questions, while *t*-test to analyzed the null hypotheses (H01, H02, and H03).

RESULTS AND DISCUSSION

The posttest was used to compare the academic standing of the groups. Table 1 displays the investigation's finding addressing RQ1 and H01.

Table 1. Comparison of *t*-test results for posttest score

Group	N	Mean	SD	<i>df</i>	<i>t</i> -value	<i>p</i> -value	Remark
Experimental	84	40.91	14.31	169	6.92	0.001	Sig.
Control	87	23.68	12.63				

Note: SD= Standard Deviation; *df*= degree of freedom; Sig.= Significant at *p*-value < 0.05.

Result in Table 1 revealed that mean and standard deviation of experimental group was 40.91 and 23.68 respectively, while that of control group recorded 23.68 for mean and 12.63 for standard deviation. This means that the students in the experimental group score higher than those in control group. In order to establish whether there is significant difference, *t*-test was utilized to test the hypothesis.

Table 1 showed that *p*-value was 0.001 less than 0.05, by the implication the stated null hypothesis is rejected. This means that there was significant difference between academic achievement of experimental and control groups. Furthermore, the result indicates that integrating instructional materials with conventional mode is more effective

in improving learners' performance in geometrical shapes than the conventional mode without instructional materials.

Additionally, the results of the analysis in Table 2 are intended to answer RQ2 and H02.

Table 2. Comparison of *t*-test result on gender post-test of experimental group

Gender	N	Mean	SD	<i>df</i>	<i>t</i> -value	<i>p</i> -value	Remark
Male	43	41.21	16.13	82	0.23	0.73	Not Sig.
Female	41	40.39	14.04				

Note: SD= Standard Deviation; *df*= degree of freedom; Not Sig.= Not Significant at *p*-value < 0.05.

Table 2 revealed that the mean and standard deviation on gender academic achievement of experimental group. It showed that male students mean score and standard deviation of 41.21 and 16.13 respectively, while the female students have mean score 40.39 and 14.04 for standard deviation. The mean difference was 0.82, which is fairly close. However, to establish whether the closeness is statistically significant, *t*-test was utilized to test the stated hypothesis.

The record in Table 2 showed that *p*-value is greater than 0,05 level of significance. Therefore, the stated null hypothesis is hereby retained. This means there is no significant difference between the academic achievement of male and female students taught using instructional materials.

Furthermore, the results of the analysis in Table 3 are intended to answer RQ3 and H03.

Table 3. Comparison of *t*-test results for post-posttest score

Group	N	Mean	SD	<i>df</i>	<i>t</i> -value	<i>p</i> -value	Remark
Experimental	84	49.81	14.28	169	7.59	0.001	Sig.
Control	87	30.39	13.26				

Note: SD= Standard Deviation; *df*= degree of freedom; Sig.= Significant at *p*-value < 0.05.

Result in Table 3 showed that the mean and standard deviation of post –posttest of experimental group stand as 49.81 and 30.39, while control group stand as 30.39 and 13.26 respectively. The mean difference of 19.42 favored the experimental group, since the instructional mode encourages active participation, social interaction, construction of mathematics knowledge and communication among classmates. Students are rarely allowed to explain their thoughts and reach a consensus on mathematics ideas. In addition,

this was achieved by the students in experimental group due to retaining more concepts after treatment using instructional materials comparing with control group. In order to establish whether there is significant difference the result obtained was subjected to *t*-test analysis. The result in Table 3 revealed that *p*-value 0.001 is less than 0.05 level of significance. Therefore, the null hypothesis was rejected. This means there is significant difference between the retention ability of experimental group and control group. The result confirms that integrating instructional materials or learning resources is more effective in improving retention ability.

Discussion of findings

A significant difference in the academic achievement of students who were taught geometrical shapes using instructional materials is shown by the results obtained from research question one and null hypothesis one, which were analyzed through an independent sample *t*-test. The academic achievement of experimental group was significantly higher than that of control group. The result showed that students in experimental group had mean score 40.91 with standard deviation of 14.31, whereas control group had mean score 23.68 with standard deviation 12.63. This is evident that students who were taught using instructional materials scored mean score comparing to students taught without instructional materials. Furthermore, the *p*-value is 0.001 less than 0.05, which resulted to rejection of the stated null hypothesis. This study confirmed the studies of Adebule and Ayoola (2016), Dalnaik (2022) and Green (2023). They stressed that teaching with instructional materials is means of improving the teaching-learning process and better performance in mathematics. They observed that the utilization of instructional resources makes students to active participation in learning process, which in turn better performance. Unlike the students in control group, where social interaction and communication among peers are not important to the teacher. The teacher solely take responsibility for emphasizing and preparing the mathematics content, but not making students' experiences and reasoning about the content visible in way that enables them to take responsibility for their learning process.

The second null hypothesis results read that there is no significant difference among academic achievement of male and female taught geometrical-shapes with instructional materials. To be more specific, male students in the group had mean score of 41.21, with standard deviation of 16.13, whereas the female students had mean score of 40.39, with

standard deviation of 14.04. The mean difference recorded was 0.82, which is fairly close. However, to achieve whether the closeness is statistical significant *t*-test was used. The result showed that *p*-value (0.73) is greater than 0.05 level of significant, which led to retaining of stated hypothesis. This implies that both sexes can have achieved equally under the same condition during teaching-learning process, since achievement has to do with mental and intellectual ability and not gender. These findings are in line with some studies (i.e Adebule & Ayoola, 2016; Dalnaik, 2022; Oguche & Usman, 2019).

The third null hypothesis results showed that there was significant difference in the retention ability of students taught geometrical-shapes using instructional materials and those taught without using instructional materials. This finding is in agreement with that of Green (2023) and Oguche and Usman (2019). They stressed that using instructional materials enhances learners' memory retention. Furthermore, students taught using instructional materials or resources tends to better longer information retention and performance due to highly critical thinking and problem solving skills.

CONCLUSION

It can be concluded that using instructional materials is significantly better than teaching without instructional material. It is also recorded that there was no significant difference between male and female students taught geometrical-shapes. In addition, students taught geometrical shapes using instructional material stimulates learning and assist in retention memory of learners.

Based on these findings, the following recommendations were made: (1) Mathematics teachers at junior secondary school level should embark on the use of instructional materials during instructional presentation; (2) Workshops, seminars and conferences should be organizing by professional bodies like Mathematical Association of Nigeria (MAN), Science Teachers Association of Nigeria (STAN), and Government to equip them with necessary skills for creating and using of instructional materials in classroom; (3) Promote the use of instructional materials that serve as motivational tools and encouraging students to actively participate in learning activities. This can be actualizing through improvement in mathematics teachers working conditions and better remuneration.

REFERENCES

- Adebule, S. O., & Ayoola, O. O. (2016). Impact of instructional materials on students' academic performance in mathematics in secondary schools in Ekiti State, Nigeria. *Research Journal of Educational Studies and Review*, 2(1), 1–4.
- Ahmad, M. U., & Aliyu, A. Z. (2022). Innovative pedagogical strategies for teaching and learning of perceived difficulties in mathematics. In M. L. Kaurangini (Ed.), *Proceedings of the 58th Mathematical Association of Nigeria Annual National Conference* (pp. 246–256). Mathematical Association of Nigeria.
- Aliyu, A. Z., & Ahmad, M. U. (2021). Effect of team teaching method on secondary school students' achievement in trigonometry in Bida Educational Zone, Niger state. *Kano Journal of Educational Psychology*, 3(1), 162–168.
- Dalnaik, S. K. (2022). Usefulness of instructional materials on academic achievement in mathematics among higher secondary school students of Majurbahanj District, Odisha. *International Journal of Advances in Engineering and Management (IJAEM)*, 4(12), 581–586.
- Green, B. (2023). Improvisation of instructional materials and junior secondary school students' academic achievement in basic science in Rivers State, Nigeria. *Faculty of Natural and Applied Sciences Journal of Mathematics, and Science Education*, 5(1), 102–110.
- Inekwe, O. I. (2019). *Mathemaphobia: A Differential Derivative [43rd Inaugural Lecture]*. Michael Okpara University.
- National Teachers' Institute. (2010). *Mathematics Course: Nigeria Certificate in Education (NCE) Cycle 2*. National Teachers' Institute.
- National Teachers' Institute. (2012). *Mathematics Course: Nigeria Certificate in Education (NCE) Cycle 3*. National Teachers' Institute.
- Oguche, B. A., & Usman, K. O. (2019). Effect of improvised instructional materials on students' achievement and interest in Longitude and Latitude. *International Journal of Research and Innovation in Social Science*, 3(4), 313–320.
- Purwitaningrum, R., & Prahmana, R. C. I. (2021). Developing instructional materials on mathematics logical thinking through the Indonesian realistic mathematics education approach. *International Journal of Education and Learning*, 3(1), 13–19. <https://doi.org/10.31763/ijele.v3i1.178>