

The Effect of Differentiated Instruction on Academic Achievement of Senior Secondary Schools Students in Mathematics in Ikere LGA in Ekiti State

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Abstract

The persistent decline in students' performance in Mathematics has continued to raise concerns among educators and stakeholders, particularly at the secondary school level where achievement in the subject influences future academic and career opportunities. This study examined the effect of differentiated instruction on the academic achievement of senior secondary school students in Mathematics in Ikere Local Government Area of Ekiti State. The study also investigated whether gender influenced students' achievement when exposed to differentiated instructional strategies. A pretest-posttest quasi-experimental design with a 2×2 factorial structure was adopted. The population comprised Senior Secondary School II students in public secondary schools within the study area. Ninety students selected from two schools participated in the study. One school served as the experimental group and was taught using differentiated instruction, while the other served as the control group and received conventional instruction. Data were collected using a researcher-developed Mathematics Achievement Test (MAT) with a reliability coefficient of 0.78. Mean and standard deviation were used to answer the research questions, while independent samples t-test and Analysis of Covariance (ANCOVA) were employed to test the hypotheses at the 0.05 level of significance. The findings revealed that students exposed to differentiated instruction achieved substantially higher posttest scores (Mean = 59.11) than those taught through conventional methods (Mean = 36.54). The results further showed a significant effect of differentiated instruction on students' academic achievement in Mathematics after controlling for pretest scores ($F(1,79) = 74.460, p < .05$). However, no significant difference was found between the achievement of male and female students taught using differentiated instruction. The study concludes that differentiated instruction is an effective approach for improving students' achievement in Mathematics and can support meaningful learning across diverse groups of learners. It is therefore recommended that Mathematics teachers adopt differentiated instructional practices and that teacher education programmes incorporate training on the effective implementation of differentiated instruction.

Keywords: Differentiated instruction; Academic achievement; Mathematics; Secondary School students; Gender; Ekiti State

Introduction

One of the realities of modern classrooms is that students do not learn in exactly the same way. Differences in background, learning pace, interests and academic ability often make it difficult for teachers to meet the needs of every learner through a single instructional approach. However, traditional instructional techniques, which prioritise the delivery of uniformised information and standardised

assessment procedures, often do not accommodate these disparities and, thus, limit learners' possibilities to achieve optimal academic outcomes. In response to this difficulty, differentiated learning model has arisen as a pedagogical strategy that aims to promote educational equity by customising teaching and learning processes to learners' specific requirements. Differentiated instruction is centred on the principle of participatory fairness and inclusive teacher practice. It

acknowledges the plurality of learners in a classroom and necessitates teachers to adjust content, process, and assessment in response to learner heterogeneity [1].

Classrooms are made up of learners who differ in their prior knowledge, learning pace, interests, and academic strengths. As a result, teachers are increasingly expected to adapt their instructional approaches to accommodate these differences. The instructional approach provides a framework through which learning experiences can be adjusted to meet individual learner needs while ensuring that all students work toward the same educational goals. Rather than relying on a uniform teaching approach, it encourages flexibility in the delivery of instruction and assessment [2].

Lindner and Schwab [3] stress the importance of individualised instruction that is tailored to the characteristics of learners, especially in classrooms that display considerable variety in learning capacities. Differentiated learning strategy is a framework that helps to allow learners with various capacities to engage meaningfully with academic subject and enhance academic achievement by moving away from a “one-size-fits-all” instructional style.

Diversified assessment is a key part of diversified learning as it understands that students display learning in different ways and at different paces. Variability in assessment procedures is useful for teachers to more correctly measure student understandings and assist learner achievement of explicitly stated learning goals. Tsai et al. [4] indicated that the use of diverse assessment formats is vital in addressing learners at different levels of competency as students have different ways to show their understanding. When matched to differentiated instruction, assessment techniques become formative instruments that inform instructional decisions and encourage ongoing progress in learners’ academic attainment.

Mathematics occupies a central position in contemporary education because of its relevance to

scientific advancement, technological innovation, and everyday decision-making. The subject equips learners with logical reasoning, analytical thinking, and problem-solving abilities that are applicable across various disciplines and professions. In Nigeria, competence in Mathematics is also a key requirement for admission into many tertiary programmes, making success in the subject important for students’ academic and career aspirations [5].

Despite the recognised importance of Mathematics, student achievement in the subject has remained a concern in many Nigerian secondary schools. Examination reports over the years have revealed persistent challenges in students’ understanding of mathematical concepts and their ability to apply learned knowledge to problem-solving tasks. This trend raises questions about the effectiveness of existing classroom practices and highlights the need to explore alternative instructional approaches capable of improving learning outcomes.

The impact of differentiated instructional model on the academic performance of students in different school subjects other than Mathematics has been investigated in a number of research [5, 6, 7, 8]. Although previous studies have examined differentiated instruction in various educational contexts, evidence relating to its application in senior secondary school Mathematics within Ikere Local Government Area remains limited. Most existing studies have focused on other subject areas or different educational settings. This creates a need for further investigation into how differentiated instructional practices may influence Mathematics performance among students in the study area.

Another interesting variable is the gender. Many researchers [9, 10, 11] have researched the effect of gender on students’ academic performance in many subject areas, however the outcomes of these varied studies were inconsistent. Therefore, this made it necessary to include the variable in this study.

Past research has shown evidence that diversified learning strategies are able to improve the academic attainment in science related disciplines. A study by [12] demonstrated that differentiated instruction had a significant positive effect on students' academic achievement in Biology in public senior secondary schools. The study also revealed that both male and female students benefited equally from the strategy. This conclusion is conducive to the potential of individualised instruction to enhance science achievement for all genders.

Besides cognitive variables, the emotional and psychological state of the learners also affect academic progress in the science. According to [6], mental health issues such as stress, anxiety and concentration difficulties have detrimental effects on the participation and academic achievement of senior secondary school students in Mathematics. These findings underscore the necessity for flexible and responsive instructional and assessment practices to the emotional and academic requirements of learners. The teaching method may assist to address some of these problems by allowing learners to access knowledge at suitable levels and to demonstrate their understanding in a variety of ways and thus achieve better academically.

There is a growing interest in differentiated learning model globally and locally, but there are discrepancies about its effectiveness and there are some issues which are not well researched. Studies varied in their focus, some focusing on instructional methodologies and others on teacher-related or contextual factors, resulting in doubt about the direct impact of the teaching method on academic attainment [13]. More so, the effect of differentiated instruction on the academic accomplishment of students in Mathematics at the senior secondary school level in public institutions, specifically in Ikere Local Government Area of Ekiti State has not been thoroughly explored.

Statement of the Problem

Despite the importance of Mathematics in secondary education, students' performance in the subject remains a concern in many schools. Several factors have been identified as possible contributors to this situation, including the continued use of teacher-centred instructional approaches that provide limited opportunities for learners with diverse abilities and learning needs. Although differentiated instruction has attracted attention in educational research, there is limited empirical evidence regarding its effectiveness in improving Mathematics achievement among senior secondary school students in Ikere Local Government Area of Ekiti State. This gap necessitated the present study.

Objectives of the Study

The main objective of this study is to examine the effect of differentiated instruction on the academic achievement of senior secondary school students in Mathematics in Ikere Local Government Area of Ekiti State. Specifically, the study seeks to:

1. determine the effect of differentiated instruction on the academic achievement of senior secondary school students in Mathematics;
2. compare the academic achievement of students taught Mathematics using differentiated instruction with those taught using conventional teaching methods;
3. examine the influence of differentiated instruction on the academic achievement of male and female senior secondary school students in Mathematics.

Research Questions

The following research questions guide the study:

1. What is the difference in the mean academic achievement scores of senior secondary school

students taught Mathematics using differentiated instruction and those taught using conventional teaching methods?

2. Is there a difference in the academic achievement of male and female senior secondary school students taught Mathematics using differentiated instruction?

Research Hypotheses

The following null hypotheses are formulated and tested at the 0.05 level of significance:

1. There is no significant difference in the mean academic achievement scores of senior secondary school students taught Mathematics using differentiated instruction and those taught using conventional teaching method.
2. There is no significant effect of differentiated instruction on the academic achievement of senior secondary school students in Mathematics when pretest scores are controlled.
3. There is no significant difference in the academic achievement of male and female senior secondary school students taught Mathematics using differentiated instruction.

Literature Review

The increasing diversity observed in contemporary classrooms has drawn attention to teaching approaches that can effectively address learners' varying academic needs. Differentiated instruction has emerged as one such approach, emphasising flexibility in teaching, learning activities, and assessment practices so that students can engage with learning at appropriate levels of challenge [14]. This method is underpinned by the principle of individualisation, which guarantees that all learners are given equal opportunity to attain the best

possible academic results, regardless of their variations in ability or pace of learning [15].

The researchers have repeatedly stressed that differentiated education needs teachers to move beyond traditional, uniform teaching methods and employ flexible strategies that respond to learner variation. This entails tailoring learning objectives, instructional resources, and classroom activities to meet the cognitive and affective requirements of students [16].

This adaptability is particularly relevant in inclusive classrooms because students with different academic levels are in the same class. Differentiated instruction entails using diverse teaching strategies to accommodate different learning styles and abilities. According to [17], effective differentiation needs the use of interactive teaching methods, practical activities, visual tools and technology-supported learning tools. Visual representations and graphic organisers, for example, have been shown to boost conceptual knowledge for those learners who benefit from visual learning modalities [18].

In science-related subjects, differentiated learning strategies frequently involve adjusting task complexity and providing multiple learning routes. According to [19], modifying instructional materials and activities to the knowledge levels of students promotes comprehension and engagement, particularly in courses that demand problem-solving and conceptual reasoning. The results indicate that tailored instruction might be a good way to help students understand difficult science ideas.

Assessment is a key element in tailored education as it allows evaluating learning through a variety of methods that match students' strengths and competencies. As stated by [4], teachers are able to test the students' comprehension effectively while enhancing students' confidence and motivation by employing various assessment methodologies such as

performance assignments, projects, quizzes, and formative evaluations. Differentiated assessment also enables ongoing feedback so that teachers can make informed instructional adjustments.

Research has shown that varied education helps improve student accomplishment. Tambaya et al. [12] revealed that students taught Biology using differentiated instructional strategies scored statistically significant higher than their counterparts taught using standard teaching approaches. The study also found no significant gender differences in outcomes, indicating that individualised instruction leads to equitable learning results for male and female students.

Although the benefits of tailored education are well-documented, various studies have highlighted problems that pertain to its successful implementation. D'Intino and Wang [20] found the general lack of training in varied instructional practices within teacher preparation programmes to be a major barrier to teacher confidence and competence for the use of differentiated instructional techniques in real classroom contexts. Likewise, [20] reported that the success of differentiated instruction greatly depends on the quality and suitability of the instructional changes provided by teachers.

Previous studies have identified several conditions that influence the successful implementation of differentiated instruction. These include teacher competence, motivation, institutional support and availability of instructional resources [22, 23]. The findings suggest that effective differentiation depends not only on instructional design but also on broader school-related factors.

Apart from instructional tactics, studies have revealed that learner-related characteristics such as mental health and emotional well-being impact academic outcomes in Mathematics. Koshoffa [6] showed that

factors such as tension, anxiety and the inability to concentrate considerably impede students' participation and performance in Mathematics. The data emphasises the necessity for supportive and adaptable teaching approaches as students who felt mentally well were more motivated, more focused and performed better academically.

Dosch and Zidon [24], similarly revealed gender disparities, with differentiated instruction having a greater positive effect on female students than on male students. This finding is consistent with other research indicating that customised learning environments may better meet the learning needs and engagement patterns of women learners. However, some research have found opposite results despite the large amount of data in support of differentiated training. Waddel [25] discovered that differentiated homework did not outperform regular homework in boosting students' academic performance in Biology. The study did not find a significant effect of differentiated homework on students' motivation to complete or hand in homework.

The current research confirms the usefulness of personalised instruction to improve academic attainment, however there are still significant gaps. There are contradictions as to what elements most substantially influence successful implementation, particularly in relation to teacher motivation, institutional support and instructional quality. Moreover, the effect of differentiated instruction on students' academic progress in Mathematics at the senior secondary school level in Nigeria has not been studied in detail. Moreover, the influence of varied instruction on students' independence and emotional development remains under-researched. These discrepancies highlight the need for the present study which aims to assess the influence of differentiated instruction on academic outcomes in Mathematics among public senior secondary school students in Ekiti State.

Methodology

The study adopted a pretest posttest control group quasi-experimental research design with a factorial design of 2X2. The target population was all senior secondary school (SSS) II students in Ikere Local Government Area of Ekiti State. The sample size for the study was 90 students who were selected using simple random sampling technique from two public senior secondary schools. The first school was experimental group while the second school was the control group. Only SSS II in each of the selected schools were involved in the study. The research instrument used in the study was researcher-designed achievement test titled ‘Mathematics Achievement Test (MAT). The question items of MAT were drawn from the Mathematics curriculum for senior secondary school 2, and it consisted of multiple-choice questions. Before its adoption for administration, a draft copy of MAT was given to teachers in the Department of Science Education, Bamidele Olumilua University of Education, Science and Technology, Ikere, as well as two Mathematics teachers who validated the instrument. To establish the reliability of the MAT, test-retest method was used with an interval of two weeks.

Afterwards, Pearson Product Moment Correlation (PPMC) was used to determine the reliability coefficient and the coefficient was established at 0.78, which was considered high enough for the study. Data collected were analyzed using descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions, while *t*-test of independent sample and Analysis of Covariance (ANCOVA) was employed to test the hypotheses at the 0.05 level of significance, using pre-test scores as covariates to control for initial group differences.

Result

The result of the study is presented according to research questions and hypotheses.

Research Question 1: What is the difference in the mean academic achievement scores of senior secondary school students taught Mathematics using differentiated instruction and those taught using conventional teaching method?

Table 1: Difference in the mean academic achievement scores of senior secondary school students taught Mathematics using differentiated instruction and those taught using conventional teaching method

	Group	N	Mean	Std. Deviation
Pretest	Control Group	45	33.06	12.119
	Experimental Group	45	36.15	12.087
Posttest	Control Group	45	36.54	13.005
	Experimental Group	45	59.11	9.452

P < 0.05 level of significance

The descriptive statistics presented in Table 1 reveal clear differences in students’ academic achievement between the two instructional groups at both the pretest and posttest stages. At the pretest stage, the control group recorded a mean score of 33.06 (SD = 12.119), while the experimental group had a slightly higher mean score of 36.15 (SD = 12.087). The closeness of

the pretest mean scores suggests that the two groups were relatively comparable in their initial academic achievement in Mathematics prior to the commencement of the treatment. At the posttest stage, a noticeable disparity emerged between the two groups. The control group, which was taught using conventional teaching and assessment methods,

recorded a marginal increase in mean score to 36.54 (SD = 13.005). In contrast, the experimental group, which was exposed to differentiated instruction strategies, demonstrated a substantial improvement, achieving a mean score of 59.11 (SD = 9.452). This marked increase in the experimental group's mean score suggests that differentiated instruction had a

positive influence on students' academic achievement in Mathematics.

Research Question 2: Is there a difference in the academic achievement of male and female senior secondary school students taught Mathematics using differentiated instruction?

Table 2: Difference in the academic achievement of male and female senior secondary school students taught Mathematics using differentiated instruction

	Gender	N	Mean	Std. Deviation
Pretest	Male	25	33.62	12.431
	Female	20	34.97	11.734
Posttest	Male	25	57.44	10.255
	Female	20	56.12	13.823

P < 0.05 level of significance

Table 2 showed the performance of male and female students taught Mathematics using differentiated instruction at both the pretest and posttest stages. At the pretest stage, male students recorded a mean score of 33.62 (SD = 12.431), while female students had a slightly higher mean score of 34.97 (SD = 11.734). At the posttest stage, both male and female students showed noticeable improvement in their academic achievement. Male students recorded a mean score of 57.44 (SD = 10.255), while female students achieved a slightly lower mean score of 56.12 (SD = 13.823). Although male students outperformed their female

counterparts marginally, the difference in mean scores between the two groups is minimal. This implies that the instructional approach was effective across gender groups and did not disproportionately favour one gender over the other.

Hypotheses Testing

Hypothesis 1: There is no significant difference in the mean academic achievement scores of senior secondary school students taught Mathematics using differentiated instruction and those taught using conventional teaching method.

Table 3: t-test analysis of difference in the mean academic achievement scores of senior secondary school students taught Mathematics using differentiated instruction and those taught using conventional teaching method

	Group	N	Mean	Std. Deviation	Df	t _(cal)	t _(tab)	Decision
Pretest	Control	45	33.06	12.119	88	1.68	1.98	NS
	Experimental	45	36.15	12.087				
Posttest	Control	45	36.54	13.005	88	4.81	1.98	S
	Experimental	45	59.11	9.452				

P < 0.05 level of significance

From Table 3, at the pretest stage, the calculated *t*-value (1.68) was less than the critical *t*-value (1.98) at 0.05 level of significance. This result indicates that there was no significant difference in the mean academic achievement scores of the control and experimental groups prior to the treatment. Consequently, the null hypothesis was not rejected at the pretest stage. At the posttest stage, the calculated *t*-value (4.81) exceeded the critical *t*-value (1.98) at 0.05 level of significance. This result indicates a statistically significant difference in the mean academic achievement scores of students taught using differentiated instruction and those taught using conventional teaching and

assessment methods. Therefore, the null hypothesis was rejected at the posttest stage. The significant difference observed in the posttest results favours the experimental group, which recorded a higher mean score than the control group. This finding implies that differentiated instruction had a significant positive effect on students' academic achievement in Mathematics compared with the conventional method.

Hypothesis 2: There is no significant effect of differentiated instruction on the academic achievement of senior secondary school students in Mathematics when pretest scores are controlled.

Table 4: ANCOVA Analysis of the effect of differentiated instruction on the academic achievement of senior secondary school students in Mathematics when pretest scores are controlled

Tests of Between-Subjects Effects						
Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2192.167 ^a	2	876.491	17.430	.000	.693
Intercept	1629.957	1	1368.567	29.145	.000	.420
Pretest	32.197	1	1592.224	.719	.000	.514
Treatment	41.903	1	16.013	74.460	.000	.357
Error	3142.420	79	7.913			
Total	669416.000	90				
Corrected Total	6435.167	89				

a. R Squared = .613 (Adjusted R Squared = .425)

Table 4 shows the effect of treatment on students' academic achievement in Mathematics. There was significant effect of differentiated instruction on the academic achievement of senior secondary school students in Mathematics when pretest scores are controlled. ($F_{(1; 79)} = 74.460, P < 0.05$). The hypothesis was therefore rejected in the light of the result since the significant value (.000) is less than 0.05. This implies that treatment had significant effect on students'

academic achievement in Mathematics in Ikere Local Government Area of Ekiti state.

Hypothesis 3: There is no significant difference in the academic achievement of male and female senior secondary school students taught Mathematics using differentiated instruction.

Table 5: t-test analysis of significant difference in the academic achievement of male and female senior secondary school students taught Mathematics using differentiated instruction.

	Gender	N	Mean	Std. Deviation	df	t _(cal)	t _(tab)	Decision
Pretest	Male	25	33.62	12.431	43	1.17	1.98	NS
	Female	20	34.97	11.734				
Posttest	Male	25	57.44	10.255	43	1.29	1.98	NS
	Female	20	56.12	13.823				

P < 0.05 level of significance

From Table 5, at the pretest stage, the calculated *t*-value (1.17) was less than the critical *t*-value (1.98) at the 0.05 level of significance. This result indicates that there was no statistically significant difference in the mean academic achievement scores of male and female students prior to the treatment. Consequently, the null hypothesis was not rejected at the pretest stage. At the posttest stage, the calculated *t*-value (1.29) was also less than the critical *t*-value (1.98) at the 0.05 level of significance. This result indicates that there was no statistically significant difference in the academic achievement of male and female students after being taught using differentiated instruction strategies. As a result, the null hypothesis was upheld at the posttest stage.

Discussion of Findings

The findings of this study indicate that students exposed to differentiated instruction achieved better learning outcomes in Mathematics than those who received conventional classroom instruction. The noticeable improvement recorded by the experimental group suggests that when teaching activities are aligned with learners' needs and abilities, students are more likely to engage actively with classroom tasks

and develop a deeper understanding of mathematical concepts.

This study lends support to the position of [1] who stated that differentiated instruction encourages participatory justice by responding to learner variability through adaptive teaching and assessment approaches. One possible explanation for this outcome is that differentiated instruction creates multiple pathways through which learners can access content and demonstrate understanding. Students who might struggle under a uniform instructional approach are provided with opportunities that better suit their learning preferences and readiness levels. Consequently, learning becomes more meaningful and participation in classroom activities increases. Suprayogi and Valcke [2] emphasised that diversified instruction facilitates the best learning results by catering to the diversity of learners through multiple teaching methods and constant monitoring of individual requirements.

The important effect of differentiated instruction in this study is in line with [3] who suggested that adapting instructional tasks and materials to learners' characteristics enhances learning experiences, especially in classrooms with varying ability levels.

The outcomes of the present study indicate that when these changes are routinely applied in Mathematics courses, students exhibit better understanding of scientific concepts and improved academic achievement.

The ANCOVA results revealed that there was a substantial effect of differentiated instruction on students' academic progress in Mathematics when controlling for pretest outcomes. This indicates that the observed improvement in the experimental group was not purely a result of students' prior knowledge and was mostly a function of the instructional and assessment tactics used throughout the intervention. This finding supports the premise of [4] that differentiated assessment allows learners to demonstrate comprehension through different pathways, offering a more accurate representation of learning and promoting ongoing academic progress.

The findings are consistent with empirical evidence given by [12] who discovered that differentiated instruction greatly increased students' academic progress in Biology. Their study focused on senior secondary school students but the present study expands this data to the senior secondary school level and to Mathematics thus reinforcing the generalisability of differentiated learning as an effective instructional technique in scientific education.

Finally, the outcomes of the study demonstrated that there was no significant difference in the academic accomplishment of male and female students taught Mathematics using the differentiated instruction. The mean scores of the female students were marginally higher than those of their male counterparts but the difference was not statistically significant implying that the instructional technique was equally beneficial to both genders. This conclusion is in support with the report of [12] showing male and female students

performed equally when taught utilising diverse instructional methodologies.

The absence of a statistically significant gender difference suggests that both male and female students benefited from the instructional approach in similar ways. Rather than favouring a particular group, differentiated instruction appears to provide learning opportunities that respond to individual needs, thereby enabling students to progress based on their abilities and levels of preparedness.

Conclusion

The study concludes that the use of differentiated instructional strategies contributes positively to students' achievement in Mathematics. The results demonstrate that adapting teaching practices to accommodate learner differences can improve academic performance while providing equitable learning opportunities for both male and female students.

Recommendations

Based on the above conclusion, the following recommendations were made:

1. Teachers should adopt the use of differentiated instruction in their classroom particularly in teaching Mathematics.
2. Seminars, workshops and conferences should be organized for teachers on how to use Differentiated Instruction.
3. Differentiated instruction should be incorporated in teacher training programme.
4. Differentiated instruction should be included in the curriculum of Mathematics.

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