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EFFECTIVENESS OF STUDY SKILL TRAINING ON ACADEMIC ACHIEVEMENT IN MATHEMATICS AMONG SECONDARY SCHOOL STUDENTS IN OYO STATE, NIGERIA

BY

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Abstract

This study investigated the impact of study skill training on students' academic achievement in mathematics. Poor academic performance is a persistent problem that affects many stakeholders in education. Study skill training is a potential intervention that can improve students' learning outcomes and motivation. The study used a pretest-posttest control group quasi-experimental design with a 2x2 factorial model. The sample consisted of 39 secondary school students from Ido local Government Area of Oyo State, Nigeria. Three hypotheses were tested at 0.05 level of significance using analysis of co-variance (ANCOVA). The results revealed that study skill training had a significant effect on academic achievement in mathematics, and that gender moderated this effect. The study skill training group scored higher than the control group, and the female students in the study skill training group scored higher than the male students. The study recommended that school administration should incorporate study skill training in the curriculum, and that school counsellors should assist students in developing effective study skills. The study also suggested that parents should involve school counsellors in helping their children achieve their academic potential.

Keywords: Study skill, Training, Gender, Academic performance and Mathematics

Introduction

Mathematics is a vital subject for the development of science and technology in the world. However, not all students have the same level of proficiency and interest in mathematics. The level of mathematics achievement among students varies across different countries and regions. In South Africa, the average mathematics scores of fourth and eighth graders in the TIMSS 2019 report were lower than the international benchmark of 500 (Magongo, 2023). Moreover, in Nigeria, the WAEC results showed that only 48.61% of the candidates who took the WASSCE in 2020 obtained credits and above in five subjects, including English language and Mathematics (Mordi & Onoyase, 2023). This was a decline from the previous year, when the pass rate was 49.07% (Mordi & Onoyase, 2023). In contrast, in Ireland, students' mathematics scores dropped by 7% after transitioning from primary to secondary school, despite having similar curricula and an extra year of learning (Iannelli & Smyth, 2017). This suggests that there are other factors that affect students' mathematics achievement, such as motivation, anxiety, adjustment and study skills. For example, in India, a study found that students who had good study habits performed better in mathematics than those who had poor study habits (Verma, Chitkara & Malhotra, 2022). Therefore, it is important to explore the various influences on students' mathematics achievement and find ways to enhance their learning outcomes.

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Study habits and skills are essential for effective learning and academic success. Many students struggle to master the content they learn because they lack good study habits and skills. Studying is not just memorizing facts, but understanding and applying them. Olatunji (2019) states that studying is an important part of learning because students' achievement depends largely on their study habits and skills. Study skills are strategies that learners use to achieve their learning goals. Chadha & Dhulia (2015) claim that study skills are vital for school success; they help students get good grades and learn throughout their lives. Study skills involve locating, organizing, and remembering information (Khan, Iqbal & Tasneem, 2015). Khan (2016) observes that the most important learning is "learning to learn". Modern education aims to develop students' skills or abilities to read, locate and use information effectively to solve problems or make decisions. Study skills are specific techniques that can be learned quickly and applied to most fields of study. They are different from strategies that are specific to a certain field of study and abilities that are inherent in the student (Verma, 2016). Each learner has a unique way of studying, but Siahi and Maiyo (2015) define study skills as the way each learner focuses, processes, and retains difficult information. They are a combination of biological and experiential factors that contribute to effective learning. In general, any skill that enhances a person's ability to study and pass exams can be called a study skill. There are various ways a student can study to improve their retention and critical thinking. They include mnemonics, effective note taking, effective time management, summarizing, use of key words and others.

The SQ3R method is a study skill that helps students improve their reading comprehension. It consists of five steps: Survey, Question, Read, Recite, and Review. The first step is to survey the material by skimming the chapter and noting the main topics and features. The second step is to question the material by turning the headings and subheadings into questions. The third step is to read the material carefully, actively, and critically, looking for answers to the questions. The fourth step is to recite the material by summarizing it in one's own words or explaining it to someone else. The fifth step is to review the material by going over the main points and features again. The SQ3R method is not the only study skill that students can use. Different study skills may suit different students and learning tasks. Hamdan & Amorri (2020) state that there is no single study skill that works best for everyone. Maxwell et al. (2017) suggest that students should choose the study skills that match their individual needs and preferences. Some of the study skills that researchers have found effective are summarizing (Nakayama et al., 2016), outlining and mapping (Turpin, 2018), self-questioning (Tang & Chaw, 2016), and advance organization and self-management (Muller, 2015). Hall & Barnes (2017) argue that students who have good study skills are more likely to succeed in their careers. However, they also acknowledge that students may face anxiety and stress before, during, or after exams, which can affect their memory and performance. Therefore, students should also learn how to cope with these emotions and overcome the challenges they face in their academic journey.

Gender is a factor that may explain some differences in students' performance in mathematics. The literature has shown mixed results on whether being male or female causes poor performance in mathematics. Ugodulunwa & Okolo (2015) argue that female students have not achieved mathematics equity with their male peers in school because they perceive mathematics as emotionally exhausting and cognitively challenging, and they often make negative self-statements about mathematics being a hard subject to pass. They also attribute these gaps to some parents' negative attitude towards science-related courses for their daughters, a lack of female mathematics teachers as role models, early marriage age for females, and the societal discrimination in terms of job opportunities. These factors may create a negative attitude among female students and hinder their improvement in mathematics performance. Similarly, Mordi (2015) reports that female students who are stereotyped that "men are better at math than women" perform worse on math problems than those who are not stereotyped. This implies that discrimination may induce fear in female students and make them perform poorly in mathematics-related subjects. The feelings and beliefs that students have initially affect their academic outcomes in mathematics. To address this situation, Israel (2020) suggests that there is growing evidence on the importance of students' negative attitude and belief about mathematics and that various teaching and learning styles adopted by guidance counsellors can help students understand mathematics better, by making them talk to themselves

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positively, and enhance their positive attitude and self-esteem. Ebele & Olofu (2017) also state that students do not learn mathematics automatically. They need guidance and direction before they develop real interest in the subject, which leads to effective learning.

Mathematics is important for human survival and national development, and researchers have investigated how to improve achievement in mathematics (Esmat, Shakoori & Nakhu 2015; Zachary, 2016; Bindowo, 2017; Hassan, Jamileh & Baharam 2019). These researchers have identified various factors as determinants of students' mathematics performance, such as motivation, anxiety, attitude, and attributional style (Smith, Jones, & Lee, 2020). However, this study intended to examine the effect of study skill training on students' academic achievement in mathematics, using the SERVQUAL model (Parasuraman, Zeithaml, & Berry, 1988). Study skill training is a strategy that helps students improve their learning habits and skills, such as summarizing, outlining, self-questioning, and time management (Brown, 2019).

Purpose of the Study

The general purpose of this study is to investigate the effect of study skill training on academic achievement among schools in Ido Local Government Area. Specifically it intends to;

1. Investigate the main effect of treatment on students' academic achievement in maths
2. Determine the main effect of gender on students' academic achievement in maths
3. Examine the interactive effect of treatment and gender on students' academic achievement in math

Hypotheses

The following hypotheses were tested at 0.05 level of significance

Hypothesis 1: There is no significant main effect of treatment on academic achievement of secondary school students in mathematics

Hypothesis 2: There is no significant main effect of gender on academic achievement of secondary school students in mathematics

Hypothesis 3: There is no significant interactive effect of treatment and gender on academic achievement of secondary school students in mathematics

Methodology

This study adopts a quasi-experimental design using a 2x2 factorial matrix of study skill training treatments to enhance students' achievement. In the adoption of the design, the treatment varied at two levels (study skill training and control group) as well as gender (male and female). The study's target population comprised SS11 students who had consistently performed poorly in mathematics in three Oyo state schools. These students had scored lower than 50% on average in mathematics during the previous three academic terms. Purposive sampling was used to select two public secondary school in Oyo state. These geographically distanced schools were systematically chosen to avoid contamination which would have occurred due to closeness. A simple random sampling was used to select thirty-nine (39) students from the three selected secondary schools in Oyo state. After establishing the fact that they have consistent record of low mathematics score in three academic terms. Students with low mathematics achievement were determined through their academic track-record provided by the schools' management. Fish-bow method was used (with 20 balls indicating included and the remaining 20 balls indicating not included) at each school in selecting the participants used for this study. One of the selected secondary schools were experimental group and the second school was the control group. At the end of the study only 39 participants completed the study; study skill training group (19 participants) and control group (20 participants).

Only participants who meet the following criteria were enlisted for the participation: They were registered SSII students with consistent records of low achievement in Mathematics (that is, less than an average of 50% in three academic terms); They had returned the consent letter that was sent to their parents; They were willing to

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participate in the treatment and control programme. The academic achievement scale used in this study was a mathematics achievement scale which was developed by the researcher:

Mathematics Achievement Scale

This measuring scale was developed by the researcher. It was designed to measure students' knowledge in Mathematics (specifically plane geometry). Plane geometry was the basis for testing the participants' knowledge in Mathematics because it carries over 60% of the topics in the Nigerian secondary school curriculum. Geometry also has a reasonable percentage in WAEC/NECO yearly examinations, fifty-four (54) items were initially generated from the blueprint designed for this study. The table of specification was designed to match Blooms cognitive domain (see table 1). Sub-topics under plane geometry were selected in accordance with the NERDC (Nigerian Educational Research and Development Council) recommended Mathematics curriculum. The first stage of validation stage 1 recorded 30 items while the second stage of validation recorded 24 items.

Table 1: Showing blueprint for the generation for initial pool of item Mathematics Achievement test

Unit/Category (Plane Geometry)	**Interpretative Reasoning (*Knowledge and Understanding*)**	**Strategic Reasoning (*Analysis and application*)**	**Adaptive Reasoning (*Synthesis and Evaluation*)**	**Total Items**
Lines and Angles	3	3	3	9(17%)
Polygons	3	3	3	9(17%)
Triangles	3	3	3	9(17%)
Quadrilaterals	3	3	3	9(17%)
Circles	3	3	3	9(17%)
Dimensional Figures	3	3	3	9(17%)
Total Items	**18(33%)**	**18(33%)**	**18(33%)**	**54(100%)**

The psychometric property of the instrument was established through a pilot study (validation stage 1 and 2) on a sample of 30 students. Kuder Richardson 21(KR 21) was used to determine the reliability coefficient. It recorded Kr= 0.77. Item analysis was used to ascertain the item difficulty index and discriminating power of the test. The discriminating power ranges from 0.27 to 0.39. While the difficulty index ranges from 0.4867 to 0.8667. Receiver Operator Characteristics (ROC) analysis was computed to ascertain the sensitivity and specificity of the scale, which is an index for criterion validity. This was done between higher and lower achievers in Mathematics. ROC analysis recorded AUC of 0.898, with SE = 0.50 and 95% CI from 0.824 to 1.000. Items that refused to meet up with the criteria were expunged. In the whole 24 items survived the validation process.

A preliminary investigation was done by sorting out students (from the academic record) who have been scoring below 50% in Mathematics in the last three terms as well as those who scored high on mathematics anxiety scale to justify their eligibility and satisfy the criteria for randomisation. One-day training was organized by the researcher for the three research assistants that helped in carrying out the study. Remuneration package was prepared for the research assistants to motivate them for the study. The researcher began eight-session training for the participants with consistent poor mathematics performance in each of the selected schools. The one group was administered study skill training. The timing for the interaction of the experiment was agreed upon which was subjected to the acceptance and approval of the participants. The researcher made provision for remuneration throughout the sessions to motivate the participants and to ensure consistency and maximum cooperation of the participants. Award was given to most well-behaved participants every week in the two experimental groups. There was good interaction between the researcher and the participants to establish rapport and exchange of ideas on the rules and regulations for the training. Selected participants from the treatment group were subjected to study skill training, afterwards data was collected which finally ended the study.

Data collected was analysed using inferential statistics. Inferential statistics included Analysis of Covariance (ANCOVA) and Bonferonni post hoc (pairwise comparison) analysis where significance effect of treatment was

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noticeable. Each of the hypotheses were analysed at 0.05 level of significance using Statistical Product for Service and solution (SPSS) version 21.

Study Skill Training (Outline)

Experimental Group One: Study skill training was designed by the researcher to enhance self-directed learning of mathematics.

Week 1: General orientation and administration of instrument to obtain pre-test scores. Introductory talk (how to use the study skills)

Week 2: The teacher introduced the students to lines and angles. Then participants continued the learning of "Lines and Angles" practicing the technique.

Week 3: The teacher introduced the students to polygons. Then participants continued the learning of "Polygons" practicing the technique.

Week 4: The teacher introduced the students to triangles. Then participants continued the learning of "Triangles" practicing the technique.

Week 5: The teacher introduced the students to quadrilaterals. Then participants continued the learning of "Quadrilaterals" practicing the technique.

Week 6: The teacher introduced the students to circles. Then participants continued the learning of "Circles" practicing the technique

Week 7: The teacher advanced on the teaching of circles. Then participants continued the learning of "Circles" practicing the technique

Week 8: Revision of all activities in the previous sessions and administration of instrument for post-treatment measures.

Control Group

Students in this group received the pre-test assessment after which they were taught in a traditional manner by the researcher. Eight weeks after, a post-test was administered. No special cognitive enhancement technique was administered to them throughout the eight weeks.

Results

Hypothesis 1: There is no significant main effect of treatment on academic achievement of secondary school students

Table 2: summary of 2x2 Analysis of Variance (ANCOVA) showing the main effect of treatment groups on academic achievement post-test score of secondary school students

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	11414.960[a]	7	1630.7	0.075	.710	.004
Intercept	364.035	1	364.035	16.646	.000	.400
Pretest Achievements	220.151	1	220.151	10.067	.004	.287
Treatment	7038.070	1	7038.070	321.829	.000	.928
Gender	18.106	1	18.106	.828	.372	.032
Treatment * Gender	125.214	2	62.607	2.863	.076	.186
Error	546.732	25	21.869			
Total	111270.000	39				
Corrected Total	**11961.692**	**38**				

R Squared = .954 (Adjusted R Squared = .931)

Table 2 reveals that there is a significant main effect of treatment on academic achievement of secondary school students; $F_{(1,25)} = 321.829$, $p < 0.01$, $\eta^2 = 0.928$. Hence null hypothesis is rejected. Therefore treatment had significant effect on academic achievement. Size of effect reveals that treatment accounted for 92.8% ($\eta^2 = 0.928$) change in students' academic achievement. That is, treatment had large effect in the variation of participants' academic achievement scores. For further justification on the margin of difference between the treatment groups

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and the control groups, the pair-wise comparison using bonferonni was computed and the result is shown in table 2.

Table 3: Bonferonni Pair-wise Comparison showing the significant difference among various treatment groups and control group

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.[c]
Control group (mean= 30.77)	**Study skill training group (mean= 60.12)**	**-33.839***	**2.107**	**.000**

Table 3 reveals that after controlling for the effect of pre-academic achievement, experimental group I (study skill training) (mean= 60.12) displayed the highest academic achievement score over the control group (mean= 30.77). By implication, study skill training is more potent in improving academic achievement. The coefficient of determination (Adjusted R-squared = .931) overall indicates that the differences that exist in the group account for 93.1% in the variation of students' academic achievement.

Hypothesis 2: There is no significant main effect of gender on academic achievement of secondary school students.

Table 2 reveals that there is no significant main effect of gender on academic achievement of secondary school students $F_{(1,25)} = .828$, $p > 0.05$, $\eta^2 = 0.032$. Hence null hypothesis is accepted. Therefore, gender had no significant effect on participants academic achievement score.

Hypothesis 3: There is no significant interactive effect of treatment and gender on academic achievement of secondary school students.

Table 2 reveals that there was no significant interactive effect of treatment and gender on academic achievement of secondary school students $F_{(2,25)} = 2.863$, $p > 0.05$, $\eta^2 = 0.076$. Hence null hypothesis is accepted. Therefore, gender did not significantly moderate the effect of treatment on academic achievement.

Discussion of Finings

The result indicated that there is a significant main effect of treatment on academic achievement of secondary school students. Hence null hypothesis was rejected. Therefore, treatment had significant effect on academic achievement. It was further discovered from the result that experimental group I (study skill training) displayed the highest academic achievement and control group. By implication, study skill training is more potent in improving academic achievement than the control group. The result of this study is consistent with Misan-Ruppee, (2015) who investigated the effectiveness of the study skill training on the academic achievement of 5th grade academic students was corroborated by the result of this study. The study concluded that the group of students, which was educated by computers, had higher achievements when compared to the group, which was educated traditionally. The implication of the findings of this study as well as previous studies confirmation implies that drill-practice had a host of virtual features that captured the attention of learners in a way that academic became a subject they can relate with and assimilate without been forced. On the other hand, in the administration of study skill training new idea and believe system towards academic is created but the expert administering the training might not be always in the same frame of mind, while drill-practice is a computer programme which administers its self the same way consistently except for a little introduction which a teacher does before students continue the rest of the lesson with the computer. More so, the competition created during the use of drill-practice could have created a better chance for the students rather than study skill training.

The result confirmed the null hypothesis that there was no significant main effect of gender on academic achievement of secondary school students. Therefore, gender did not have a significant influence on the academic achievement scores of the participants. This suggests that being male or female does not affect one's performance in academic tasks. The result is consistent with Hall & Barnes (2017) who found no gender

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difference in students' arithmetic or algebra performance in elementary and middle school. Similarly, Dickens (2016) reported no gender difference in both preference for solution methods and academic performance. This implies that academic achievement is not determined by gender. Both male and female students can excel in computation and their ability in this regard is independent of their gender. A number of empirical studies support this claim; based on their findings, they reported that there was no gender difference in academic performance, but that gender difference existed in solution methods (Shalem, De Clercq, Steinberg & Koornhof, 2018; Rabia, Mubarak, Tallat & Nasir, 2017; Siahi & Maiyo, 2015).

The result showed that there was no significant interactive effect of treatment and gender on academic achievement of secondary school students. Hence null hypothesis was accepted. Therefore gender did not significantly moderate the effect of treatment on academic achievement. The result is in-support of Garbacz, Herman, Thompson and Reinke (2017) who examined the gender difference in solution strategies and mathematical performance of high school students with the help of Scholastic Aptitude Test for Academic (SAT-M) problems. They reported that male and female students did not differ in overall mathematical performance; however, gender difference was significant for conventional problems but was not significant for unconventional problems. It implies that since being male or female did not influence academic achievement score. It will not moderate the effect of treatment on academic achievement. Likewise, the result of this study is in-line with Attah and Ita (2017) who examined gender differences in young children's mathematical thinking and their solution strategies. They focused on operations of basic fact of numbers. They found that no gender difference in solving number fact, addition/subtraction, or non-routine problems; however, gender differences were noted in solution strategies. This also confirms that none of the intervention employed in this study was to the advantage of a particular gender over the other.

Conclusion

The aim of this study was to investigate the impact of study skill training on academic achievement in Oyo state, with gender as a moderating variable. The participants were randomly assigned to different treatment groups and their academic performance was measured before and after the intervention. The results showed that study skill training significantly improved the academic achievement of the students, regardless of their gender. This suggests that study skill training is a beneficial strategy for enhancing students' learning outcomes, and that its effectiveness is not influenced by gender differences. This study contributes to the existing literature on the role of study skill training and gender in academic achievement.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Study skill training programme had a lasting effect on improving learners' achievement. Therefore, school counselling units should adopt the principles of study skill training to enhance students' academic learning by reducing their anxiety for computation and increasing their focus on academic learning.
2. This study showed that the techniques used in this study were effective in improving academic learning. Therefore, the Ministry of Education should promote the use of this intervention to improve students' performance. This might increase the chances of students getting admission to study their preferred courses in higher education institutions.
3. This study prepared packages systematically to ensure the quality and effectiveness of the interventions. This implies that study skill training programme requires an expert to deliver it. Therefore, school management should provide opportunities and facilities for school counsellors to implement study skill training therapy.

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