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EFFECT OF REALIA STRATEGY IN TRIGONOMETRY ON PERFORMANCE AND INTEREST AMONG NIGERIAN CERTIFICATE IN EDUCATION (NCE I) STUDENTS IN KADUNA STATE, NIGERIA

BY

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Abstract

This study investigated the effect of the Realia Strategy (RS) in Trigonometry on performance and interest among Nigerian Certificate in Education (NCE I) students in Kaduna State, Nigeria. The study population consisted of all NCE I mathematics students in the two coeducational Colleges of Education in Kaduna State, with 214 Mathematics students. Intact classes were used for both experimental and control groups comprising 85 students, 45 students in the experimental group (25 males and 20 females) and 40 students in the control group (20 males and 20 females). The experimental group were taught using Realia Strategy (RS), while the control group ware taught using conventional methods. Two research instruments were used: the Trigonometry Performance Test (TPT), and Trigonometry Interest Scale (TIS). Both instruments were validated by experts and pilot-tested for reliability. Data were collected using Trigonometry Performance Test (TPT; $\alpha = 0.72$) and Trigonometry Interest Scale (TIS; Cronbach's $\alpha = 0.80$). Results indicated that students exposed to RS significantly outperformed their peers in mathematics ($M = 69.51$, $SD = 8.81$) compared to the control group ($M = 53.68$, $SD = 8.59$), $t(83) = 8.374$, $p < 0.001$, Cohen's $d = 1.08$. RS also significantly enhanced students' interest, ($U = 393.50$, $Z = -4.47$, $p < 0.001$, $r = 0.48$). The findings suggest that RS is an effective instructional approach for improving both academic performance and interest in mathematics. It is recommended among others that mathematics educators and teacher training programs should adopt Realia Strategy to foster active, engaging, and inclusive learning environments.

Keywords: Realia strategy, Performance, students' interest and Trigonometry

Introduction

Mathematics is fundamental for many professions, especially science, technology, and engineering. Yet, mathematics is often perceived as difficult and many students leave disciplines in science, technology, engineering, and mathematics (STEM) as a result, closing doors to scientific, engineering, and technological careers (Li & Schoenfeld, 2019). Mathematics, commonly taken as a complicated subject, has been further challenging for students with learning difficulties. Learning difficulties are the difficulties of learners acquiring the knowledge and skills to the average level expected of those of the same age, primarily because of mental disability or cognitive disorder. Effective teaching approaches are required to meet the needs of diverse students in enhancing mathematics learning (Khanal, 2022).

Practical teaching and learning methods in higher education can enhance students' and teachers' ability to solve real-life problems and achieve objectives (Falcón, Rios, Palomino, & Salazar, 2021). A practical (Realia) approach is a situation in which teachers employ the use of physical objects that can be touched, manipulated and utilized proficiently in the teaching and learning process. Practical work provides the most effective means by which understanding and comprehending mathematical concepts can be improved. It enables students to reason out the mathematical ideas which are contained within the various activities, thus making them become critical thinkers. The learners are then guided to find information and understand concepts through appropriate activities and demonstrations which encourages them to discover patterns in mathematics leading to rules and formulae. Mathematical knowledge has much to offer in applying a practical approach to everyday living. It can stimulate students' thereby developing confidence and ability in problem-solving. According to Indriani and Julie (2017), mathematics learning will be more meaningful for students if the mathematical ideas are linked to real-life situations. The fact that students understand the intimate relationship between mathematics and practice will become the motivation for students to learn about mathematics, and at the same time, is the

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basis for students to relate and apply mathematics in fields of practice. On the contrary, if students learn mathematics without being attached to practical experiences, they will quickly forget knowledge and not apply mathematics to other sciences or real life (Freudenthal, 2012).

A practical approach (Realia) can help students develop a positive attitude towards learning by reducing cognitive load and enhancing emotional and physical development. It also allows for hands-on activities both inside and outside the classroom, as well as fostering a social and democratic classroom environment through group work. Unlike a theoretical approach, a practical approach encourages interaction during problem-solving and allows for a variety of assessment forms to accommodate different learning styles. This approach can ultimately improve students' overall performance in mathematics and reduce anxiety. The academic performance of a student can have a significant impact on how they perceive themselves in comparison to others. It generally refers to the level of success achieved in academic or scholastic work, measured by factors such as final course grades and grade point average (Olivier et al., 2019). The performance of students in mathematics exercises, for example, can be influenced by various factors, including their interest in the subject, characteristics and environment, teaching methods, and instructional materials (Fatawu et al., 2022). It is important to note that academic performance isn't solely determined by grades; other factors like curriculum breadth, teaching methodologies, personalized teaching, students' prior knowledge, and their level of formal thinking also play a role (Kasi & Prasad, 2020). Grades are commonly used as the primary indicator of academic performance and are considered the benchmark for academic results (Fernandes et al, 2019). They serve as a social and legal standard for a student's academic performance and also provide valuable information for parents and educational authorities. The role of mathematics in the educational curriculum is crucial for the development of critical thinking and problem-solving skills. However, many students, especially at the Nigerian Certificate in Education (NCE) level, struggle with mathematics, leading to poor performance and low interest in the subject. In recent years, there has been a growing emphasis on innovative teaching strategies to enhance students' understanding and engagement in mathematics. One such strategy is the Realia strategy, which includes hands-on activities, real-world applications, and interactive learning experiences which can enhance both academic performance and students' interest.

Interest in learning is a vital source of intrinsic motivation that drives students to engage in academic tasks willingly, ultimately influencing their academic achievement (Rosfiani et al., 2019). As noted by Slameto (as cited in Teluambanua, Laia, Waruwu, Tafonao, & Laia, 2023), interest is defined as a persistent tendency to pay attention to and retain information related to certain activities. When students are genuinely interested in a subject, they exhibit sustained attention, enthusiasm, and enjoyment, which fosters a sense of satisfaction and encourages greater diligence in learning. Interest is widely recognized as a key predictor of success in education, particularly in mathematics learning (Arif et al., 2023; Darmayanti et al., 2023; Muhammad et al., 2023). This study aims to examine the effect of the Realia strategy on the performance and interest of NCE I students in Kaduna State.

Statement of the Problem

Despite the importance of mathematics, many NCE students in Kaduna State struggle with poor performance and low interest in the subject. Learning mathematics with understanding is very important because it will help remove the perception students have that mathematics is difficult and abstract as well as enable them to reduce rote memorization to the barest minimum. Once these impeding factors are controlled, students are most likely to understand as they are most likely to achieve huge success in their achievement in mathematics. Most lecturers use ineffective methods and strategies in the process of teaching and learning among other factors contribute to students' poor performance and interest. Mathematics teachers are utilizing the traditional strategy of teaching and learning in mathematics classrooms. This strategy of teaching practice in mathematics classrooms has yet to produce a significant result rather than promoting rote learning for many years back, where students memorized facts, formulae, rules and procedures. The method prevents students' social development and academic achievements in mathematics at large. Traditional teaching methods have been cited as a significant contributor to these issues (Egara & Mosimege, 2024).

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Realia Strategy has been proposed as an alternative approach that emphasises hands-on activities and real-world applications of mathematical concepts. The driving force now is to search for a better way of making the teaching of mathematics concepts more meaningful and to improve students' performance in mathematics generally. However, empirical evidence on the effectiveness of Realia Strategy in enhancing performance and interest among NCE students in Kaduna State are limited. This study aims to fill this gap by investigating the impact of Realia on these variables.

Objectives of the Study

The specific objectives are to:

1. determine the effect of Realia strategy on performance in mathematics among NCE I students in Kaduna State
2. examine the effect of Realia strategy on interest in Mathematics among NCEI students in Kaduna State

Research Questions

The following research questions were used to guide the study:

1. What are the effects of the Realia strategy on the performance of NCE1 students in mathematics?
2. What is the influence of Realia strategy on interest in mathematics among NCE1 students in Kaduna state?

Null Hypotheses

The following null hypotheses ware formulated and tested at α=0.05 level of significance:

H_{O1}: There is no significant difference in the mathematics performance of NCE1 students taught mathematics using the Realia Strategy and those taught using the conventional method.

H_{O2}: There is no significant difference in the interest of NCE1 students taught mathematics using the Realia Strategy and those taught using the conventional method.

Methodology

This study adopted a quasi-experimental design. Two groups were involved, one experimental and one control group. Each group was pretested (0_1) prior to the treatment to ascertain their homogeneity. After the pretest, the experimental group received treatment (X_1) while the control group received no treatment (X_0). Both groups were subjected to posttest (0_2) to measure their performance and interest.

The population of this study covered all the colleges of education in Kaduna state. There are two colleges of education in Kaduna state which are coeducational, Federal College of Education Zaria and College of Education Gidan Waya. The population was 214. F.C.E, Zaria (114) and C.O.E Gidan Waya (100) respectively. The sample size for the study is 85 students. Intact classes were used for both experimental and control groups comprising of 85 students. The sample of 85 students follows the central limit theory, which according to Tuckman (1975), says a minimum of 30 participants can be used to look at relationships between groups in this type of experimental research. Two instruments were used for data collection in this study: The Trigonometry Performance Test (TPT) and the Trigonometry Interest Scale (TIS). To ensure the validity and appropriateness of the Trigonometry Performance Test (TPT), it was subjected to experts review by three lecturers from the Department of Mathematics at the Federal University of Education, Zaria while the Trigonometry Interest Scale (MIS) was also was reviewed by a panel of experienced experts from the Department of Mathematics at the Federal University of Education, Zaria. The reliability coefficient for Trigonometry Performance Test (TPT) was obtained using test-retest within two weeks interval. The scores were subjected to Pearson Product Moment Correlation (PPMC) and a reliability coefficient of 0.72 was obtained while the reliability for the Trigonometry Interest Scale (TIS) was obtained using split-half method (odd and even number), and Cronbach's alpha statistic was used and a reliability coefficient of 0.80 was also obtained.

The data obtained from the experimental and control groups were analyzed using appropriate statistical tools to answer the research questions and test the null hypotheses that guided the study. All analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 26.0. Research questions were answered using descriptive statistics while null hypotheses were analysed using t- test and Mann-whitney u-test.

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Results

Research Question One: What are the effects of the Realia strategy on the performance of NCE students in mathematics?

Table 1: Descriptive statistics on effects of the Realia strategy on the performance of NCE students in mathematics

Group	N	Pretest M($\bar{X}$)	Pretest SD	Posttest M($\bar{X}$)	Posttest SD	Mean Difference
Experimental	45	59.20	9.10	69.51	8.81	15.8
Control	40	50.10	8.70	53.67	8.59	

Table 1 presents the descriptive statistics for the experimental and control groups on the Trigonometry Performance Test (TPT). At pretest, the experimental group (n = 45) recorded a mean score of 59.20 (SD = 9.10), while the control group (n = 40) obtained a mean of 50.10 (SD = 8.70). Following the intervention, the experimental group's posttest mean increased to 69.51 (SD = 8.81), whereas the control group recorded a posttest mean of 53.67 (SD = 8.59). The descriptive results show that the experimental group had a higher posttest mean score than the control group, with a mean difference of 15.8.

Research Question Two: What is the influence of Realia strategy on interest in mathematics among NCE I students in Kaduna state?

Table 2: Descriptive statistics on influence of Realia strategy on interest in mathematics among NCE I students

Group	N	Pretest M($\bar{x}$)	Pretest SD	Posttest M($\bar{x}$)	Posttest SD	Mean Difference
Experimental	45	3.70	0.55	4.124	0.4955	0.5469
Control	40	3.45	0.56	3.577	0.5122	

Table 2 presented the descriptive statistics for the experimental and control groups on the Mathematics Interest Scale (MIS). At pretest, the experimental group (n = 45) recorded a mean interest score of 3.70 (SD = 0.55), while the control group (n = 40) recorded a mean score of 3.45 (SD = 0.56). At posttest, the experimental group's mean increased to 4.124 (SD = 0.4955), whereas the control group obtained a posttest mean of 3.577 (SD = 0.5122). The resulting mean difference obtained was 0.5469.

Ho_1: There is no significant difference in the mathematics performance of NCE students taught using the Realia Strategy and those taught using the conventional method.

Table 3: Summary of Independent Sample t-test Statistics for the Difference in performance between Experimental and Control Group

Group	N	Mean	SD	MD	*df*	t-value	p-value	Cohen's d	Remark
Experimental	45	69.51	8.81	15.8	83	8.374	0.001	1.08	Reject Ho
Control	40	53.68	8.59						

Significant $\propto > 0.05$

Table 3 presented the independent samples t-test results comparing the posttest performance scores of students in the experimental and control groups. The experimental group (n = 45) recorded a mean score of 69.51 (SD = 8.81), whereas the control group (n = 40) recorded a mean score of 53.68 (SD = 8.59). The analysis showed that there was a statistically significant difference between the two groups, t(83) = 8.374, p < 0 .001. The computed effect size (Cohen's *d* = 1.08) indicated a large practical effect. Based on these findings, the null hypothesis stating that there was no significant difference in the mathematics performance of students taught using the Realia Strategy and those taught using the conventional method was rejected.

Ho_2: There is no significant difference in the interest levels in mathematics of NCE students taught using the Realia Strategy and those taught using the conventional method.

Table 4: Mann–Whitney U Test Results for Students' Interest Scores by Group

Group	N	Mean Rank	Sum of Ranks	U	Z	P	r
Experimental	45	54.26	2441.50	393.50	-4.47	0.001	0.48
Control	40	30.34	1213.50				

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Table 4 presented the Mann–Whitney U test results comparing the interest scores of students in the experimental and control groups. The analysis showed a statistically significant difference between the groups, U = 393.50, Z = –4.47, p > 0.001. The experimental group (Mean Rank = 54.26, n = 45) had higher interest scores than the control group (Mean Rank = 30.34, n = 40). The calculated effect size (r = .48) indicated a large practical effect. Based on these results, the null hypothesis stating that there was no significant difference in the interest scores of students in the experimental and control groups was rejected.

Discussion of the Findings

The results of RS on performance indicate that students taught mathematics using RS significantly outperformed those taught with the conventional method on the Trigonometry Performance Test (TPT). The experimental group (n = 45) achieved a mean score of 69.51 (SD = 8.81), compared to the control group's mean score of 53.68 (SD = 8.59), with a mean difference of 15.8. The independent samples t-test revealed a statistically significant difference, t(83) = 8.374, p < .001, with a large effect size (Cohen's d = 1.08). This suggests that RS accounts for approximately 10.8% of the variance in mathematics performance, highlighting its substantial impact. This finding is supported by Sochima (2020) and Rosfiani et al. (2019), who reported that student-centered strategies such as practical activities significantly improve performance in mathematics. The result also aligns with Kolb's Experiential Learning Theory (1984), which posits that students learn more effectively when they engage in direct experiences that involve active exploration and reflection. However, this finding contrasts with Akpan and Umobong (2013), who warned that some innovative methods may show temporary improvements in performance due to novelty rather than sustained learning. Thus, while the RS appears highly effective, further studies could investigate its long-term impact on retention and conceptual mastery.

Whether Realia strategy affects interest in mathematics, the results shows that RS significantly increased students' interest in mathematics, as measured by the Mathematics Interest Scale (MIS). The experimental group (n = 45) recorded a mean interest score of 4.124 (SD = 0.4955), compared to the control group's mean score of 3.577 (SD = 0.5122), with a mean difference of 0.5469. The Mann-Whitney U test confirmed a significant difference, U = 393.50, Z = -4.47, p < .001, with a large effect size (r = .48). This result supports findings by Nakasiita et al. (2023) and Yin et al. (2020), who concluded that context-based and interactive teaching methods enhance learners' motivation and interest in mathematics. The RS appears to have created a more engaging and relevant learning environment, which may explain the increase in interest. Nonetheless, some researchers (e.g., Jegede & Okeleye, 2012) argue that traditional teaching environments can sometimes produce better outcomes when matched to high-achieving or highly self-motivated students. While this was not the case in the present study, it suggests that the effectiveness of RS may vary based on learner characteristics.

Conclusion

The findings of the study lead to the following conclusions: the Realia Strategy (RS) was an effective teaching method for enhancing both the performance and interest of NCE students in mathematics. RS offers a practical and inclusive approach to mathematics education, effectively addressing the challenges associated with traditional teaching methods.

Recommendations

Based on the findings, the following recommendations are proposed:

1. Adoption of RS in Mathematics Teaching: Mathematics teachers at all educational levels should incorporate Realia strategy (RS) into their teaching practices to enhance student outcomes.
2. Mathematics Teacher Training: Teacher training institutions should include RS in their curriculum to equip future educators with the necessary skills for effective implementation of this strategy.

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