RESEARCH ARTICLE

European Journal of Education and Pedagogy
www.ej-edu.org

Effects of Drill-and-Practice Instructional Package on Junior Secondary School Students' Performance in Mathematics in Ondo State, Nigeria

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ABSTRACT

Mathematics as a subject requires great attention because success in it at the secondary level determines how far a student can go in further studies. This is because those students who fail to attain a credit pass might not gain admission into tertiary institution. This poor performance is probably attributed to lack of frequent practice on the part of students. Therefore, this study investigated the effects of drill-and-practice instructional package on junior secondary students' performance in Mathematics in Ondo State, Nigeria. The study used pretest posttest control group quasi-experimental design. The population comprised all Junior Secondary School two (JSS2) students in public co-educational schools in Ondo State. Two schools were purposively selected out of which two intact classes were randomly assigned experimental and control groups. Total sample used for the study was 68 students, consisting of 30 males and 38 females. The instruments used for data collection were Mathematics Achievement Test (MAT)(r=0.78) and Students' Attitude towards Mathematics Questionnaire (SAMQ) (r=0.73). Data collected were analyzed using inferential statistics of Analysis of Covariance (ANCOVA). Findings from the study revealed that students in the treatment group had higher academic achievement compared to students in the control group; however, no significant difference was found in the posttest scores of the ability levels exposed to treatment. The study concluded that, since students' performance was enhanced when exposed to the drill-and-practice instructional package compared with the control group, the package could be advantageously used to improve students' performance in Mathematics. Based on the findings of the study, it was recommended that more attention should be accorded to the use of the drill-and-practice instructional package in the Nigerian school system.

Keywords: ability levels, drill-and-practice, instructional package, junior secondary schools, mathematics, performance.

Published Online: January 16, 2023

ISSN: 2736-4534

DOI: 10.24018/ejedu.2023.4.1.547

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I. INTRODUCTION

Mathematics as a subject affects almost every aspect of human life. The social, economic, political, geographical, scientific, and technological aspects of human beings actually seem to center around numbers. Mathematics appears to be a subject that determines individuals' functionality in any given society. It is an essential requirement in every field of intellectual endeavor and human development to cope with the challenges of life. It can also be seen as a vital tool in the study of the school subjects since it cuts across the school curriculum (Martins, 2013). Fajemidagba *et al*. (2012) considered Mathematics as a central subject and tool for the development of all scientific disciplines such as technology, astronomy, graphics, industry, and analytical thinking in everyday life.

Moreover, Azuka (2000) and Harbor-Peters (2001) posited that mathematics is not only foundational to science but also to technology, which is the bedrock of modern development. It can therefore be deduced that Nigeria as a nation needs a strong secondary school (with particular reference to the junior secondary school which is the rudimentary level) mathematics orientation and achievement for her scientific and technological aspirations to sail through. Setidisho (1996) asserted that mathematics is the basic science necessary to understand most other areas of education. He further emphasized that it is surprising that no other branch of science forms such a powerful force. The Science Teachers Association of Nigeria (STAN, 1992) has identified mathematics as a central intellectual field of technological societies. Odusoro (2002) submitted in his contribution that the knowledge of sciences remains superficial without mathematics. Mathematics is important for Science and Science is important to technology, which is very important in the world, therefore, for any nation to be relevant, such nation must not overlook the importance of mathematics in her educational system. This underscores the premium placed on the study of Mathematics as one of the core and compulsory subject in both Junior and Senior

Secondary school curriculum for the advancement of scientific knowledge.

This implies that mathematics enjoys a prominent position in Nigeria school curriculum (Federal Republic of Nigeria, 2013). This, in turn, is expected to translate to students' performance at its best in the subject, especially in the external examinations, but the reverse is the case. This is seen from the result analysis of Junior School Certificate Examination (JSCE) in mathematics between 2010 and 2013 in Ondo State secondary schools. The analysis did not record hundred percent at credit level and above in any year (Ogunboyede, 2018). Various reasons have been attributed to this poor performance by different scholars, which include lack of frequent practice, poor mathematical background, laziness, inadequacy of teachers and poor method of teaching (Salman *et al*., 2012); fear of the subject and strictness (Jameel and Ali, 2016); negative attitude (Karigi and Tumuti, 2015). Furthermore, mathematics phobia as an offspring of teachers' method of teaching, teacher-student's relationship, use of abusive words on students (Ihechukwu and Ugwuegbulam, 2016).

Furthermore, class composition variable with respect to students' ability grouping also plays a crucial role in determining students' performance in mathematics. Students' ability grouping is the process of grouping all students in a classroom according to their academic achievement. The grouping is usually based on high, average and low ability level. According to Gamoran (1992), ability grouping is one of the most common responses to the problem of providing for student differences. He said that grouping has different effects in different circumstances. In selective high school, Lacey (1970), as reported in a study by Ireson *et al*. (1999) observed that students in upper groups received more attention and resources, leading to higher levels of achievement, but this had a negative effect on children in lower groups. In another development, Ireson *et al*. (1999) and Lacy (1974) found that the performance of the best-performing students was unaffected by the change, while that of the lowest-performing students improved. He stressed that the ability range of the pupils in this study, however, was clearly restricted by the selective nature of the intake.

The global world has gone dynamic with the advancement in technology. There is application of technology in almost all human tasks and undertakings so much so that, as time goes by, the influence of technological development may render traditional skills inadequate and inefficient. Virtually, all aspects of human life such as communication, entertainment, fashion and even worship are complying with the trend in this era of technological advancement literally known as computer age. Learning, as a process, is equally expected to move with the trend of technological development if the desired result must be achieved. Cepni *et al*. (2004) found that most students receive information from visual content sources, such as computers, which are very commonly used in their daily lives, making it more difficult to teach students in conventional ways. Where the principle of learning is taken into account; richness of visual content makes education more sustainable and effective (Mudasiru and Adedeji, 2010).

Several studies have reported benefits of ICT-based activities (Dewiyanti *et al*., 2007 and Kilic-Cakmak, 2010). This includes improving communication and collaboration, the ability to provide more learning opportunities to geographically dispersed users, promoting active learning, and improving learner feedback processes. Particularly, one of the most important ICT-based learning activities is drill-and-practice which is the structured repetitive review of previously learned concepts to a predetermined level of mastery (Wiersma, 2000). Drill and practice software provides exercises in which students perform sample tasks, typically one at a time, and receive feedback on their correctness. Programs vary greatly in the type of feedback they provide in response to student input. Feedback can range from simple display like "correct" or "incorrect," "ok" or "no, try again," to detailed animated display or verbal explanations. Some programs simply present the next item if the student answers correctly.

Drill-and-practice is used as a mean of teaching and perfecting skill or procedure. Mudasiru and Adedeji (2010) submitted that drill-and-practice, as an instructional package, entails acquisition of knowledge or skill through systematic training by multiple repetitions, rehearse and practice that involves repetition of specific skills. They posited that a typical drill and practice design involves four steps: computer screen presents student with questions to answer or problems to solve; the student responds; the student get informed whether the answer is correct; if the response is correct, the student receives another problem to solve, but if otherwise, the computer displays the correction.

Several studies have been carried out in line with the study under review, either with exactly the same or slightly different terminologies such as: drill-and-practice, web-based practice, systematic practice and so on. These studies have pointed out that using the method has positive effect on students' performance in comparison with traditional methods such as lecture method, monitor discussion and so on. Nguyen and Kulm (2005) used an innovative web-based practice instrument (WebMA) designed with randomized short-answer, matching, and multiple-choice items with automatically adapted feedback. Using middle school students in both fraction and decimal operations, they reported that the web-based group performed significantly better than the paper-and-pencil group. Gee and Umar (2014) examined the impact of drill-and-practice courses on student performance and motivation in learning English. They opined that drill-and-practice activities as well as immediate feedback offered in the courseware helped the students to learn and understand better. Similarly, the study of Igweh (2012) revealed that students who were taught Basic Electronics with computer tutorials and drill performed better than those students taught with conventional teaching method.

The class composition variable with respect to students' ability grouping is envisaged to play a crucial role in determining students' performance but studies have shown that class grouping plans little or no effect. Rolstad *et al*. (2005) opined that higher-performing students have a higher affinity for study and therefore make greater progress in learning when separated from their peers. Grouping of students according to ability level could make the slow learners develop lackadaisical attitude towards their studies as a result of inferiority complex which may set in, and which may in turn hinder performance. In a study by Slavin (1990a), using a method of best synthesis revealed that the effect of ability grouping on academic attainment was limited. The study compared ability grouped classes with heterogeneous, mixed ability and grouping. He concluded that comprehensive grouping plans between classes had little or no effect, and that the effect of grouping on achievement was essentially zero. Provided by studies using matched groups. Taken together, the median effect sizes for high-, average-, and low-performing students are +0.05, -0.10, and -0.06, respectively, and are still very small. Isijola (2015) also found that comprehensive grouping schemes had little or no effect between classes, and ability grouping effects were essentially zero.

According to National Policy on Education (NPE) of the Federal Republic of Nigeria (FRN, 2013), Junior Secondary Education is the education which a child receives immediately after primary education with the objective to provide the students with diverse basic knowledge and skills for educational advancement. This suggests that for a student to experience any educational advancement in mathematics as a subject, such student must have been properly groomed at the elementary stage (i.e., junior secondary education). Moreover, students' performance at junior school certificate examination determines their placement in the senior secondary education (i.e., Science class, Art class or Commercial class) and sometimes at the tertiary level. However, students' performance at the Junior School certificate examination and other external examinations has not really measured up to these expectations. It appears that the teaching-learning method may be one of the factors responsible for this. This study, therefore, aimed to look into the effects of Drill-and-practice instructional package on junior secondary school students' performance in mathematics.

II. Objectives of the Study

This study investigated the effects of drill-and-practice instructional package as a treatment on students' performance in Mathematics. Specifically, the study seeks to find out the: effect of treatment (drill-and-practice instructional package) on students' academic achievement in Mathematics and effect of treatment on different ability levels of the students.

III. Research Hypotheses

The following null hypotheses were formulated to guide the study.

Ho1: There is no significant difference between the posttest scores of students exposed to treatment (drill-and-practice instructional package) and those in the control group.

Ho2: There is no significant difference among the posttest scores of students in high, average, and low ability levels in the treatment group.

IV. Methodology

The study made use of pretest posttest control group quasi-experimental design. There was an experimental group exposed to drill-and-practice instructional package as a means of practicing after the classroom teaching and a control group who goes home with paper-pencil practice exercise after classroom teaching. The study also takes numerical ability at three levels (high, average, and low). The population comprised the Junior Secondary School Two (JSS2) students in public co-educational schools in Ondo State, Nigeria. A total of sixty-eight (68) students, consisting of 30 males and 38 females, formed the sample for the study. A purposive sampling technique was used to select two schools that formed the sample for the study. The major criterion for selection was availability of well-equipped Computer laboratory. A random sampling technique was then used to select two intact classes for the research in the schools and the two classes were also randomly assigned: one for treatment and the other for control.

The instruments used were Mathematics Achievement Test (MAT) and Students' Attitude towards Mathematics Questionnaire (SAMQ). MAT is a 25-item multiple-choice type covering the content areas used for the study (i.e., algebraic process). The items were adopted from past Junior School Certificate Examination (JSCE) conducted by Ondo State Ministry of Education. SAMQ is divided into two sections. The first section is about respondents' personal information. The second section is a 20-item 4-point Likert type scale. The items were adapted from Attitude Toward Mathematics Inventory developed by Tapia (1996). The instruments were pilot tested in a school outside the sample population but within the same environment. The study adopted Kuder-Richardson reliability method to estimate the reliability of the instruments. KR20 of MAT was 0.78 while that of SAMQ was 0.73, indicating that the instruments were adequately reliable.

The two groups (Experimental and Control) were subjected to pretest using SAMQ and MAT. Both groups then proceeded to a six-week period of treatment. Thereafter, SAMQ and MAT was administered as posttest. Inferential statistics of Analysis of Covariance (ANCOVA) was used to test the hypotheses formulated for the study at 0.05 level of significance.

V. Result

Ho1: There is no significant difference between the posttest scores of students exposed to treatment (drill-and-practice instructional package) and those in the control group.

Table I revealed that there is a significant difference between the academic achievement of students exposed to treatment (drill-and-practice instructional package) and those in the control group [$f=14.689$; $p<0.05$]. Moreover, there is a significant difference between the mean score of pretest and posttest of students exposed to instructional package [$f=25.795$; $p<0.05$]. Also, there is a significant difference in the mean score of students in the control group [f=469.13; p<0.05]. This indicated that students exposed to treatment have high academic achievement compared to students in the control group. Hence, the null hypothesis is rejected. This implied that drill-and-practice instructional package increased students' achievement score in mathematics.

TABLE I: SUMMARY OF ANCOVA SHOWING THE SIGNIFICANT DIFFERENCE IN THE ACADEMIC ACHIEVEMENT OF STUDENTS EXPOSED TO TREATMENT (DRILLED-AND-PRACTICE INSTRUCTIONAL PACKAGE) AND THOSE IN THE CONTROL GROUP

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Instructional Package	158.697	1	158.697	25.795	0	0.166
Control	2886.188	1	2886.188	469.130	0	0.783
Instructional Package * Control	90.369	1	90.369	14.689	0	0.102
Error	799.788	130	6.152			
Corrected Total	3911.888	133				

a. R Squared=0.796 (Adjusted R Squared=0.791)

Ho2: There is no significant difference among the posttest scores of students in high, average, and low ability levels in the treatment group.

TABLE II: SUMMARY OF ANCOVA SHOWING THE SIGNIFICANT DIFFERENCE IN THE POSTTEST SCORES OF HIGH, AVERAGE AND LOW ABILITY LEVELS IN THE TREATMENT GROUP

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Group	1469.446	1	1469.446	203.745	0
Ability*Group	0.398	2	0.199	0.028	0.973
Treatment*Ability	25.431	2	12.715	1.763	0.181
Error	418.308	58	7.212		
Corrected Total	2357.938	63			

a. R Squared=0.823 (Adjusted R Squared=0.807)

The result in Table II revealed that treatment has significant effect on the achievement score of students [f=203.75; p<0.05]. However, there is no significant difference between the ability score of pretest and posttest of students exposed to instructional package [f=0.028; p>0.05]. This indicated that students' ability levels have no effect on their academic achievement. The result showed that there is no significant interaction effect of ability level and treatment on students' achievement [f=1.763; p>0.05. The null hypothesis is therefore retained. This implied that drill-and-practice instructional package helped students in different ability levels to perform at the same level.

VI. DISCUSSION OF FINDINGS

Analysis of Covariance (ANCOVA) on hypothesis one indicated a significant difference between the posttest scores of students exposed to treatment and the control group at 0.05 level of significance. Specifically, the students exposed to treatment had higher academic achievement compared to students in the control group. The implication of this is that treatment has helped to raise the cognitive development of the students, and this in turn has enhanced their academic achievement. This is because the treatment (drill-and-practice instructional package) entails active engagement of students and their frequent interaction with computers. This finding is in agreement with the earlier researchers such as Nguyen and Kulm (2005), Gee and Umar (2014) and Isijola (2015) who variously reported that web-based practice and/or drill-and-practice instructional package enhance students' academic achievement. Findings also revealed that, there was a statistically significant difference between the mean scores of the group exposed to drill-and-practice instructional package and those students in the control group in the achievement test. The implication of this finding therefore is that drill-and-practice instructional package is effective in enhancing students' achievement in mathematics. This finding is similar to the finding of Igweh (2012) who found that students taught basic electronics with computer tutorials and drill had a higher mean achievement score than those students taught using the conventional teaching method. Therefore, null hypothesis one which states there is no significant difference between the posttest scores of students exposed to treatment (drill-and-practice instructional package) and those in the control group is rejected.

ANCOVA test on hypothesis 2 showed that there was no significant interaction effect of ability and treatment on students' academic achievement. This finding is in agreement with Isijola (2015) who found out that there was no significant difference in academic achievement of students when they were grouped according to their ability levels. The null hypothesis that there is no significant difference among the posttest scores of students in high, average and low ability levels in the treatment group is upheld. This implied that ability grouping does not make any effect on students' performance.

VII. CONCLUSION

Based on the findings of this study, the following conclusion could be drawn. Students' performance will be enhanced when exposed to drill-and-practice instructional package compared with the control group. This implies that drill-and-practice instructional package could be used to improve students' performance in mathematics. Moreover, the findings showed that the package benefits low, average, and high ability level students without any disparity.

RECOMMENDATIONS

It is recommended that mathematics teachers should adopt the use of the drill-and-practice instructional package to teach mathematics in Junior Secondary Schools. Also, curriculum planners such as Nigerian Educational Research and Development Council (NERDC) should consider review of curriculum for mathematics for secondary schools with a view to incorporating the drill-and-practice instructional package. Since, students who worked on the drill-and-practice instructional package had better performance than those in the control group, students should be encouraged to develop interest in the use of computer. The Government should also provide relevant equipment for the teaching of mathematics in schools using drill-and-practice instructional package.

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