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Use of Demo Kits as Strategy for Enhancing Senior Secondary School Students' Academic Achievement in Computer Studies in Ogun State, Nigeria

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Abstract

Demo kits are experimental devices that promote physical observation of the concepts being discussed by the teachers. They are used to compensate the impossibility of demonstrating the objects due to their size or lack of their availability. This study examined the use of demo kits as strategy for enhancing senior secondary school students' achievement in computer studies in Nigeria. The study adopted pre-test and post-test comparison group quasi-experimental research design using 2 x 2 factorial matrix. The population for the study was made up of all senior secondary (SS 2) students in Ijebu-North Local Government Area, Ogun State. The sample for the study was drawn from two public senior secondary schools that met the selection criteria using intact classes. The schools were randomly assigned into experimental or comparison groups. The gathered data were analyzed using both descriptive and inferential statistics. The major findings of the study revealed a significant main effect of the strategy that the students exposed to the use of demo kits performed significantly better than those in the comparison group which learnt using the conventional method of teaching. The results also indicated no significant gender difference in students' performance in computer studies after the exposure to the use of demo kits. It is, therefore, recommended that teachers adopt the use of demo kits to teach computer studies when computer systems are not available for use instead of insisting on the teaching of the subject in well-equipped computer laboratories.

Key words: Demonstration kits, strategy, academic achievement, computer studies

Introduction

Computer science is vital in the present-day digital society where computer competencies in are increasing in demand. They provide citizens with skills such as creativity, collaboration, communication, problem-solving, and computational thinking which are prerequisite for meaningful contribution to the society. Computer competencies confer competitive advantages on those in the emerging labour markets who acquires them. Mamman (2014) describes computer science as a medium for sustainable development and human capacity building in Nigeria.

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Computer education was introduced in the thematic Senior Secondary Education Curriculum (SSEC) by the Nigerian Educational Research and Development Council (NERDC) in 2011 after several failed attempts. According to Oye et al. (2012), the objectives of computer education in secondary schools are to expose students to the basic rudiments of computers, lay a solid foundation in computer science at early stage of educational exposure, encourage and stimulate student interest towards computer science, and pave the way for easy application of computer knowledge in other disciplines.

As a matter of fact, the attainment of the highlighted laudable objectives is being undermined as reflected in the performance of students in the majority of the themes in the subject in external examinations conducted by the West African Examinations Council (WAEC). The WAEC Chief Examiners reports (2014, 2015, 2016, 2017 & 2018) reported inconsistent students' performance in several themes of the subject. WAEC Chief Examiners (2014) reported that students' performances in various areas testing their knowledge of themes were either average or poor. Similar trends were also reported by WAEC Chief Examiners (2015, 2016, 2017 & 2018). For instance, the WAEC Chief Examiners' Report (2018) noted that a good number of candidates were confused between computer registers and attendance register and many avoided questions on programming, which subsequently led to their poor performance in these areas. Indeed, the students' academic performance in some of the themes as depicted in the trends of outcomes in the examinations conducted by WAEC from 2014 to 2018 could be best described as average. This is not a good report of a subject that is meant to equip students with some of the skills and competencies necessary to function in the prevailing sophisticated society they live.

The chief examiners identified inadequate exposure to laboratory practical classes, lack of skilled computer teachers, lack of effective tutorship and teaching strategies and erratic power supply as some of the factors contributing to this students' dissatisfactory performance in computer studies. Meanwhile, the solutions to some of the identified problems included adequate funding of computer education by the stakeholders. Arguably, Amannah and Ahiakwo (2013) reported that there is not only gross underfunding of educational sector in Nigeria, but also a lack of maintenance of physical facilities. Consequently, instructional and learning conditions have continued to deteriorate in many schools due to insufficient classrooms, under-equipped libraries and laboratories. Similarly, the Federal Ministry of Education declared that the funding of education at all levels is below the 26% recommended as benchmark by UNESCO. Instead of the 26% of the budget, Nigeria has been allocating 6% to fund education (Laleye, 2018). The same view was expressed by Oralu and Oladele (2015) that funding of education in Nigeria is below the benchmark recommended by UNESCO. The implication of these is that there will continue to be a lack of resources both in human and instructional terms to implement computer education effectively. Specifically, Aboderin and Solomon (2014) reported a lack of funds for purchasing computer resources and creating a suitable environment in schools as one of the factors militating against the expected achievement of computer education objectives, thus resulting in the students' weak performance in the subject.

The implication of not having adequate facilities either due to a lack of funding or poor maintenance culture is that teachers should find such ways of teaching the subjects that students can somehow develop all the skills appertaining to the subject. As identified by the WAEC examiners' reports, teaching strategies should be given an urgent attention. This implies that the conventional method of teaching computer education may not be adequate to provide the kind of support required by students to perform well. Although there are several methods of teaching suggested in literature to teach Computer Studies, but the poor funding situation of computer education in Nigeria may not encourage teachers to adopt many of them. Invariably, there is the need to come up with cost-effective but impactful methods of teaching.

Literature review

Kob et al. (2019) argued that a teacher can use such learning aid as a kit to replace the conventional method of teaching so as to improve students' learning outcomes. Abimbola (2015) also suggested that teachers should provide alternatives such as demonstration kits when the real objects are not available. Thus, this study adopted the use of demonstration kits which are not only capable of simulating and motivating the learners, but also have the capability to significantly improve their academic performance. Also, demo kits have been used by different authors to teach subjects such as physics (Musasia & Fanuel, 2016; Kob et al., *2019*) and biology (Adeoye & Abimbola, 2016). Thus, coupled with its efficacy in other subject areas and cost effectiveness, the researchers were motivated to investigate its efficacy in computer studies as a school subject.

Abimbola (2015) defined demo kits as the act of showing something to describe and explain how something works. Demonstration kits which are more than chalk and talk bring real world into the classroom, by providing a necessary link between concepts being taught and everyday life (Ferrer-Roca et al., 2016). Demo kits are experimental devices that promote physical observation of the concepts being discussed by the teachers. They could be used to illustrate the topic before or after teaching theoretically. They not only expose how things work in reality, but also why they function in such a manner. Adeoye and Abimbola (2016) described demo kits as a box or package that contains different items or materials needed to demonstrate contents for effective learning by students.

Pointedly, Abimbola (2015) maintained that demo kits used in computer studies should consist of screen shots which are applied for demonstration in conditions of limited computer lab resources. The author explained that demo kits can be used to teach or learn any topic unlike the content-specific demonstration kits which is only adequate for specific-content area. They are to facilitate learners' thinking and problem-solving skills which can be transferred to any other domain of use. Chapman (n.d) also observed that demo kits can help students to understand concepts that are hitherto difficult to learn. They help students to visualize the objects being learnt.

Several studies have reported on the effectiveness of demonstration kits. Adeoye and Abimbola (2016) investigated the effects of senior secondary use of demo kits on their academic achievement in biology in Omu-Aran, Nigeria. The findings revealed a significant difference in the achievement of students who learned biology using demo kits in comparison with those that learnt the subject without the kits. Kob et al. (2019) also investigated the effectiveness of learning kits used as demonstration kits and reported that the kits led to improved performance of students in the topics taught. In addition, the study of Musasia and Fanuel (2016) investigated the effect of integrating micro-science kits on students' achievement in physics practical work among form two students in Kakamega Central sub-county. The study revealed that the kits enhanced students' understanding of physics concepts when compared to students in the control group. The researchers reported that the kits provided necessary fun and enjoyment derivable from a toy or game and several open-ended educational possibilities of an instructional tool.

The biological difference in gender creates different needs and capacities for boys and girls or men and women which should not naturally result in unequal social status and achievement (United Nations Children's Fund, 2011). However, Yadav et al. (2017) described the gender gap in computer science as the worst among any science, technology, engineering and mathematics (STEM) disciplines. Accenture (2016) observed that the gender gap in computer science, which is against female students, is getting worse and universal access to computing in schools cannot solve the problem unless teaching and learning activities are directed to meet the specific needs of female students. Akinola (2016) argued that the gender gap is as a result of female students' fear, interest and attitudes towards the subject. Berdousis and Kordaki (2015) observed that female computer scientists are treated as inferior and many of them also believed that computing is predominantly a male profession which females

should stay away from. The authors also attributed gender gap to "geek factor," i.e. a situation where girls often perceive career in computing as a lifetime spent writing codes in a cubicle without freedom and this will prevent them from raising family in the future due to the time involved. In general, findings on gender performance gap have been inconsistent and inconclusive. While some researchers (Morris & Trushell, 2014) reported that one sex outperformed the other, other studies (Adigun et al., 2015) reported no significant gender performance difference. Berdousis and Kordaki (2015) investigated the relationship between gender and achievement in various subject of computer science. The study which used graduate students as participants reported that male students have slightly better grades in most of the compulsory courses with no clear pattern in elective courses. The study also reported that female students performed slightly better in the courses chosen by the majority of them. This implies that encouraging many female students to offer computer education may facilitate their learning of the subject.

Adigun, Onihunwa, Irunokhai, Sada and Adesina (2015) in a study on the effect of gender on students' academic performance in computer studies in secondary schools in New Bussa, Borgu local government area of Niger state, Nigeria revealed no significant difference in the performance of the male students compared to their female counterparts. Adeoye and Abimbola (2015) also reported no significant difference in the achievement of male and female students. In view of gender gap in computer science coupled with the inconsistent findings on the influence of gender on achievement in computer science, this study incorporated gender as a moderating variable to examine its effect on students' achievement.

Objectives of the study

The main objective of this study was to investigate the efficacy of demo kits for improving the performance of students in Computer Studies.

Specifically, the objectives were to:

i. determine the efficacy of demo kit on students' achievement in computer studies; and

ii. examine the gender performance gap on students' achievement in computer studies.

Hypotheses

i. There is no significant effect of exposure to the use of demo kits on students' achievement in computer studies.

ii. There is no significant gender difference in the achievement of students in computer studies after exposure to the use of demo kits.

Methodology

Research design

This study employed pre-test - post-test comparison group quasi-experimental research design using 2 x 2 factorial matrix. The two groups (experimental and comparison) will interact with gender (male and female) as a moderating a variable.

Target population

The target population for the study consisted of all senior secondary (SS) 2 students in Ijebu North local government area of Ogun state.

Sample and sampling techniques

The sample for the study was drawn from two public senior secondary schools that met the selection criteria which included the availability of qualified computer studies teachers, willingness of the school management to approve the conduct of the study and offering of computer studies at SS 2 class, among others. Computer studies is an elective subject and consequently not all schools offer the subject up to SS 2. Therefore, the study involved the students from the schools offering Computer Studies in the selected schools as intact classes. This implies no randomisation of students into the groups. However, the schools were randomly assigned into either the experimental or comparison group.

Instrumentation

The study used learning instructional guide and Computer Studies Achievement Test (CSAT). The learning instructional guide was prepared by the researcher to teach the topics highlighted for the study based on the approved scheme of work in the experimental group. The guide was to ensure that the researchers followed the directives of the study design and to ensure its internal validity. The teacher of the comparison group was encouraged to use his usual method to teach the topics. This is regarded as the conventional method in this study.

The CSAT was a researcher-developed instrument to measure students' understanding of the topics learnt during the study. The face and content validities of the instrument were ensured by giving it to secondary school computer studies teachers and two postgraduate students in evaluation for a critique. Their comments and suggestions were used to modify the test items. Thereafter, the initial one-hundred-item CSAT was given to 100 students of schools not participating in the study but sharing similar characteristics to attempt the test. The scores obtained were subjected to item difficulty and discrimination analysis which revealed that only forty items were useful for the final test. Out of the forty items, the researchers selected twenty items for the final test, which spanned across the topics designed for the study. The twenty questions were considered adequate by number and quality to measure their achievement in the areas schemed for the study.

To determine the reliability of the final CSAT, it was administered on twenty students of the school that did not participate in the study and also were not part of the schools that responded to the initial CSAT. The test was administered twice at two weeks interval. The two sets of scores were analysed and yielded test-retest reliability coefficient of 0.75, which is an acceptable result.

Method of data collection

The researchers took permission from the authorities of the selected schools and thereafter approached the teachers and the students to solicit their support. The approvals were obtained from the stakeholders after an exhaustive discussion on the reason for the study.

The study which lasted for eight weeks involved the training of teachers on the use of the instructional package and administered CSAT as pre-test during the first week. There was an intensive teaching and learning process using the package from the second week to the seventh week. The topics taught were BASIC programming and information and communication technologies. These are some of the topics identified by the WAEC Chief Examiners' Report as being difficult for students to understand.

The researchers developed kits in the form of computer screen shots of the outputs of either the programming tasks or Internet pages for demonstration to the students. The teachers discussed the steps to achieve the task and displayed the pictures to the students as to what the outputs would look like on the computer screen. Some of the steps to be taken to achieve certain

tasks on computers were also screen shots for use as demonstration for the students. The eighth week was used to administer the CSAT as post-test and appreciated the selected schools for their cooperation.

Data analysis

The data analysis involved the use of descriptive and inferential statistics. The descriptive statistics tools used were mean and standard deviations while the inferential statistics involved the use of Analysis of Covariance (ANCOVA) with pre-test scores as covariates. The hypotheses generated were tested at 0.05 level of significance.

Results

Table 1: Descriptive statistics of students' demographic data by strategy and gender

Strategy/Gender		Number of students	Percentage (%)
Demo kit		38	52.8
Conventional method		34	47.2
Total			**100**
Gender	**Male**	34	47.2
	Female	38	52.8
Total			**100**

Table 1 revealed that while 38 students were in the experimental group, 34 students participated in the comparison group. The table also revealed that 34 males participated in the study as against 38 females. This shows that females are more represented in the computer studies in the schools selected than their male counterparts.

Test of hypotheses on the efficacy of the use of demo kits

$H_0$1: There is no significant effect of exposure to the use of demo kits on students' achievement in Computer Studies.

Table 2: Summary of analysis of covariance of students' achievement scores according to strategy and gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	848.749[a]	4	212.187	30.956	.000
Intercept	403.456	1	403.456	58.860	.000
Covariates (pretest)	348.977	1	348.977	50.912	.000
Strategy	302.511	1	302.511	44.133	.000
Gender	5.775	1	5.775	.843	.362
Error	459.251	67	6.854		
Total	**24636.000**	**72**			
Corrected Total	**1308.000**	**71**			

a. R Squared = .649 (Adjusted R Squared = .628)

Table 2 depicts the ANCOVA results of the effect of strategy on the students' achievement in computer studies. The results revealed a significant main effect of the strategy, $F_{(1, 67)} = 44.133$, $p < 0.05$). This implies that students exposed to the use of demo kits performed significantly better than those in the comparison group who learnt using the conventional method of teaching. Therefore, the null hypothesis was rejected.

$H_0$2: There is no significant gender difference in the achievement of students in computer studies after the exposure to demo kits.

Table 2 also revealed that the effect of gender on students' performance in computer studies after the exposure to the use of demo kits is not significant, $F_{(1,67)} = 0.843$, $p > 0.05$). This implies that there exists no gender performance difference in the students' post-treatment achievement. Thus, the null hypothesis is provisionally retained.

Discussion

The findings revealed that more female than male students participated in computer studies in the schools where the research was held. This is in sharp contrast to some earlier findings which showed female underrepresentation in subjects like computer science. For instance, Accenture (2016) and Akinola (2016) reported that female students are always underrepresented in computer science. This may be due to the change in the perception of female students that computer science is a male-dominated discipline.

The findings also revealed a significant effect of demo kits on students' achievement in computer studies as reflected in the significant improvement in the post-treatment mean scores of the students exposed to the strategy in comparison to those who were exposed to the conventional method. This significant difference may be attributed to the capability of demo kits to facilitate learners' thinking and problem-solving skills. These competencies probably enhanced their capability to understand the concepts. This finding lends credence to that of Adeoye and Abimbola (2016) and Kob et al. (2019) who had earlier reported on the effectiveness of the demo kits. It is, therefore, assumed that the current study filled a gap in the existing research; this is simply because it was the first study of its kind in the study area and will possibly lead to further studies on demonstration kits as a teaching strategy on learning outcomes.

Furthermore, the findings revealed no significant effect of gender on achievement in computer studies of the students exposed to demo kits in comparison to those who learned using the conventional method. This implies that there is no significant difference in the mean performance scores of male and female students exposed to the use of demo kits to learn. This finding may have been due to the fact that the female students' desire to work harder to change the notion that the biological difference in them can lead to lower academic performances compared to their male counterparts and thus proving that they are not inferior in dealing with computer studies. It may also be attributed to the female students' appreciation of computing skills as being perquisites to effective exploration of the 21st century highly competitive labour markets. This study also revealed that the use of demo kits actually met some specific needs of the female students as reflected in the non-significant difference between their performances when compared to the male students. This is line with the suggestion of Accenture (2016) that teachers should apply innovative methods of teaching that can meet specific needs of female students in order to bridge the gender and performance gaps. This study corroborates the findings of Adigun et al. (2015) and Abimbola (2015) which revealed no significant difference in the achievement of male and female students in computer studies.

Conclusion

The study investigated the use of demo kits in enhancing students' academic achievement in computer studies. The study concluded that the use of demo kits in the schools where sufficient computers are not available for teaching, either due to financial reasons or the lack of maintenance culture, can improve students' academic achievement. Also, the use of demonstration kits in computer studies has the tendency to bridge the perceived gender performance gaps.

Recommendations

Consequent upon the findings, the study recommended that teachers should make use of demo kits where enough computers are not available or when erratic power supply to schools will make it impossible to use the available ones. Therefore, the lack of well-equipped computer laboratories should not be a barrier for computer studies teachers from teaching computer science to their students. It is also recommended that, while teachers are using the demo kits to bridge the gaps due to lack of computer facilities, governments should endeavour to properly fund computer education to make the facilities available. This is because computer skills are best demonstrated via using computer systems. No doubt, the development of kits requires funding which cannot be compared to that of making computer laboratories functional. Therefore, school managers should assist teachers by making funds available for the development of kits.

The study found the use of demo kits effective. The government and stakeholders in the education should assist to organise regular workshops, conferences and seminars to train computer teachers on how to use demo kits to enhance learning. It is also recommended that teachers of other subjects endeavour to develop demo kits in their areas since demo kits can be adapted to teach any school subjects.

Suggestion for further studies

No researcher can exhaust all the variables on a particular area of study. To this end, it is suggested that other researchers in and beyond Nigeria should further confirm the efficacy of the strategy by not only teaching the same topics using demo kits, but also to extend the teaching to other topics.

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