European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

DOI: 10.46827/ejes.v7i4.4680 Volume 7 | Issue 4 | 2020

EFFECT OF AUGMENTED LEARNING ON STUDENTS' ACQUISITION OF PROCEDURAL SKILLS IN COMPUTER SCIENCE

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Abstract:
The study investigated the effects of the augmented-learning package on the acquisition of computer science procedural skills among junior secondary students of Offa local government, Kwara State. The study adopted the pre-test- post-test experimental research design. The sample for the study comprised 40 students drawn from two junior secondary schools, using a purposive sampling technique. Three research instruments were used to gather data for this study; Computer Science Achievement Test (C-SAT-I), Computer Science Achievement Test (C-SAT-II) and Students' Classroom Engagement Observational Checklist (SCEOC). The Pearson Product Moment Correlation coefficient (PPMC) was used in determining the reliability of the instruments (r=0.72). The result showed that the augmented-learning package had a significant effect on the academic performance, acquisition of procedural skills and classroom engagement of the students in Computer Science. The study concluded that the use of an augmented-learning package should be deployed in teaching Computer Science in secondary schools because it promises to improve students' performance.

Keywords: augmented learning, performance, engagement, computer science, procedural skills

1. Introduction

Over the years, there had been strong advocacy that the psychomotor domain of students' learning is strengthened and given adequate attention. However, it is irrefutable to point out that the three domains of learning are somewhat related. While the cognitive domain focuses on the intellectual processes of knowledge and comprehension, the affective domain involves learners' emotions, feelings and attitudes;

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and the psychomotor domain assesses the skills (physical functions) of learners (Hoque, 2016). It can be surmised that an improvement of learners' mental ability coupled with attitudinal balance could bring about enhancement of their ability to perform tasks, in order to carry out specific operations. This means that psychomotor learning can be better improved when the cognitive and affective domains of learning are enhanced.

Skill acquisition is one of the important indicators of learning especially as it relates to the psychomotor domain. It involves the process of training students to possess the ability and competencies for a particular task. Williams & Ford (2009) posited that skill acquisition can be referred to as motor learning and it is the science which stands as the basis for learning by movement (performance and practices). It is no doubt therefore that the acquisition of procedural skills by students is very germane to their learning, especially for science-inclined subjects which require both theoretical classrooms teaching as well as practical sessions. Procedural skills could be described as a complete set of specific physical skills that are required by a person or a team to accomplish some given tasks. Foley and Spilansy (1980) defined procedural skills as the intellectual and mechanical expertise required to execute some set of manual tasks. They further argued that procedural skills can be applied to either simple tasks or complex tasks and in any case, learning any procedure follows some fundamental processes, which in turn allows for procedural skills acquisition to be based on a well-established framework. Sawyer, White, Zaveri, Chang, Ades, French, Anderson, Auerbach, Johnston and Kessler (2015) affirmed that the use of procedures is fundamental to the attainment of science education goals and so, students' acquisition of competency in procedural skills for science-related subjects becomes necessary.

Apparently, the subject of students' learning has received popular attention from stakeholders of education in recent times due to the fact that it is a paramount index to ascertaining the worthwhileness of education investments. This is mostly manifested especially among parents as they often seek to receive and observe good reports about their children in terms of better performances. Thus, learning is an essential process of acquiring knowledge or skills which often surface in all stages of life and can be acquired by students differently (Dunlosky, Rawson, Marsh, Nathan & Willingham, 2013). In education parlance, learning and teaching are two crucial complementary themes that cannot be separated; in fact, teaching is a vital pre-requisite activity that is expected to take place for learning to occur.

Teaching is a polymorphic exercise which involves reading, spelling, writing, demonstration, explanation and so on (Mariotti & Fischbein, 1997). However, it is remarkable to note that technological advancement has posed a huge improvement in teaching such that it is no longer an activity that is restricted to the usual classroom face-to-face interactions between the teacher and the learners (Cloete, 2017). While this study does not condemn the traditional method (classroom teaching) of instructional delivery, the emphasis remains that the introduction of augmented learning procedures seems to be an important means of complementing traditional classroom teaching in order to ensure better students' classroom engagement for improved learning outcomes.

Learning and skills acquisition has been found to be intricately linked as both concepts are somewhat relevant for students' performance analysis. The acquisition of skills by the students is an indication that learning has occurred. This, therefore, underscored the reason augmented learning may contribute immensely to students' acquisition of procedural skills. Sheehy, Ferguson and Clough (2013) postulated that augmented learning is a form of learning interaction which employs electronic devices to solidify students' understanding of their current environment. It could as well be described as a concept that allows for learners' transformation vis-à-vis their learning situations by making use of several augmented devices such as text, images, audio records and video records. Augmented learning is a form of E-learning repository which help to enhance what is being taught in order to improve students' academic performance through effective classroom engagement.

It is no gain saying that augmented learning can help students acquire knowledge with in-depth understanding to solve complex issues. More so, it has the capacity to stimulate learners' attention with a special interest in subjects and topics of instruction, by helping them to acquire skills and concretizing all aspects of instruction which seem abstract. Despite the myriad of benefits attributed to this style of learning (augmented learning), yet, it appears that it has not been fully embraced by teachers and school administrators. Observation shows that the current Nigerian classrooms seem to be saturated with traditional note-taking and rote learning activities which may not help students to better comprehend what they are taught especially in science-related subjects which involve complex processes and requires procedural skills. It is consequent upon this backdrop that this study considers it expedient to investigate the effect of augmented learning package on the acquisition of Computer Science procedural skills among junior secondary students in Offa local government, Kwara State, Nigeria.

2. Statement of the Problem

One of the most essential reasons for establishing the school is to create an environment that is conducive to effective teaching and learning so as to ensure the realization of educational goals and objectives. Specifically, the education offered at the junior secondary school level is expected to enable the students to acquire skills in the area of science, commerce and art. This indicates that the school administrators as well as the teachers have the primary mandate to provide and utilize the necessary facilities and competencies to augment students' classroom engagement in order to help them acquire the basic skills that may be needed for better academic performances and eventual survival in life. However, it has been observed that the majority of students in Nigerian secondary schools are poorly engaged in their learning pursuit, particularly for science-related subjects which require that learning should be augmented to transit from hearing to seeing and to doing for better acquisition of knowledge and skills. The result is that many schools are lagging and lacking in the provision of better classroom engagement and effective teaching and learning experiences for learners; the aftermath of this is a

poor learning process which has always resulted in poor academic performances of students. Literature has shown that augmented learning provides students with an on-demand and engaging remedial learning environment which helps learners discover additional information for the enhanced learning experience. Many of these studies have pointed attention to the efficacy of augmented learning on motivation, engagement and procedure, but the efficacy of augmented learning packages on the acquisition of procedural skills is still under-researched. It is therefore imperative to examine the effect of the augmented-learning package on the acquisition of Computer Science procedural skills among junior secondary students, hence this study.

3. Literature Review

3.1 Studies on Augmented Learning

Sheehy, Ferguson, & Clough, (2014) conducted a study on augmented education with a focus on bringing real and virtual experiences together and affirmed that the use of technology has helped in bridging the gap between the physical and virtual environments as the latter is being influenced by the real-life situations. It was further established that augmented learning involves the use of new technologies to extend learners' interaction with their learning environment by bringing new learning possibilities to life. Moreover, augmented learning allows for the re-organization and re-articulation of space in such a manner that motivates learners to acquire new knowledge. This gives them the opportunity to interact with a technology-saturated classroom which augments their abilities and learning, thereby transforming their personal identity as learners and their potential to become functional members of society.

Esmahi (2009) worked on an agent-based framework for personalized e-learning services and established that technology plays important role in supporting learning as it is capable of providing affordable and individualized learning environments. It is as a result of this that recent studies are focusing more on assisting learners to explore, design, construct and make meaning out of their own learning with the use of adaptive systems which is made possible through technology. This, therefore, provides learners with the opportunity to take personal responsibility and control over several aspects of their learning in a flexible manner. According to Esmahi, personalized learning through augmentation by technology is a crucial aspect of the modern education system which must be planned and delivered considering three basic dimensions. The first is the user characteristics which include their learning style, background and experiences, prior knowledge, preferences and individual personality traits among others. The second dimension is referred to as interaction parameters which include goals and tasks to be achieved, the interest of the user as well as users' collaborative activities. Lastly, the technology parameters dimension involves the device features, connection type, network state, bandwidth and so on. Consequently, it is instructive to note that considering these three dimensions of personalized learning new technologies are essential for augmenting students' learning.

It is evident from the work of Müller, Fehling and Urban (2015) on social augmented learning that the conceptualization and implementation of learning applications are very germane to enhancing the training of media technologists particularly in the print media profession. According to the study, these applications could make use of mobile devices, augmented reality tools, 3D visualisation and communication through social network platforms. It was found that socially augmented learning application supports learning in gaining more understanding of complex processes and attainment of their own learning. As a result, relevant concepts are easily summarized with new technologies. The study further concluded that there is significant acceptance of the learning application and solutions by instructors, trainees and trainers.

In addition, the study by Seirafi & Wiencek (2017) on augmented learning in museums posited that augmented learning will become a globally adopted practice in the near future both in the industries as well as other sectors, education inclusive. It was found that the use of technology is very crucial towards enhancing cultural exhibition and learning which therefore makes augmented learning to be considered a promising practice in the education sector. New learning possibilities and values were identified as monumental benefits of technology which should be well-integrated to bring about improved learning experiences for the students.

3.2 Studies on Procedural Skills and Education

Sawyer, White, Zaveri, Chang, Ades, French, Anderson, Auerbach, Johnston & Kessler (2015) worked on an evidence-based pedagogical framework for procedural skill training in medicine and established a six-step process for the acquisition of procedural skills ranging from Learn, See, Practice, Prove, Do and Maintain. This framework was anchored on the theory of adult learning with a comprehensive conceptual guide for educators in the teaching of procedural skills. Major components of the framework for effective implementation include competence-based evaluations through simulation, performance-based evaluations during real-life situations and skill maintenance through simulation-based training. The framework emphasized a paradigm shift in the processes involved in the teaching and learning of procedural skills from the traditional method that is devoid of hands-on training to modern and technological-based training to improve learners' competency both in simulated learning environments and real-life situations. Grantcharov & Reznick (2008) also supported that learners must be assigned the expected learning outcome which is to be completed and exposed to the right learning environment that will facilitate the accomplishment of the desired outcome.

A cursory look at the work of Bruce, Kumar & Malekzadeh (2017) on procedural skills of entrustable professional activities relative to the preparedness of medical graduate students to perform procedural skills in residency in United State concluded that learners often gain a higher level of confidence in their pursuit to acquire procedural skills when formally assessed with their level of mastery. This is because the formal assessment will provide effective feedback for necessary corrections and reinforcement performances. The study posited that there is no relationship between learners'

confidence and competence. However, learners' confidence in procedural skills is a good indicator of their competence which is necessitated by the well-established training programme and competency-based assessment that they have undergone. This, therefore, underscores the important role of a structured training programme and formal evaluation of procedural as it has been found to be directly associated with learners' attainment of competence and confidence in the performance of the skill.

Sethi and Badyal (2019) on clinical procedural skills assessment during an internship in ophthalmology in India submitted that direct observation and assessment of learners' competence of procedural skills is lacking simply because learners' future and professional performances cannot be judged by conventional and controlled assessment (examination). However, the study affirmed that the directly observed method of procedural skills remains a vital tool for ascertaining the ability of learners to translate the knowledge and skills acquired to perform specific procedures in real-life situations. The direct observation assessment technique, because of its feedback feature, provides an opportunity for improvement in teaching and learning procedural skills as well as helping instructors to design a well-structured training programme for learners. In addition, the study recommended the use of the direct observation procedure skills technique for learners' assessment because it is capable of providing learners with significant improvement over a repetitive period in their quest for mastery of procedural skills needful for their profession (Bagher, Sadeghnezhad, Sayyadee & Hajiabadi, 2014). It was also suggested that an internship should be planned to improve learners' skills acquisition with unique assessment techniques like direct observation, not only to ascertain mastery but also their readiness to take up future professional responsibilities.
It is evident from the work of Nothnagle, Reis, Goldman and Diemers (2010) on improving feedback on procedural skills in residency established that feedback is a vital instrument to improving learners' procedural skills. The development of the Global Procedural Skills Evaluation (GPSE) which is a feedback tool designed to assist teachers in providing thorough feedback and encourage reflection on learners' performances was a notable proposition of the study. The GPSE was developed to stimulate learners' self-assessment of the procedural skills they have performed and allow for experts' judgement in order to give room for improvement. It was concluded that reflection allows for feedback to be integrated into existing knowledge. Consequently, the reflection will promote quality feedback which serves as a self-assessment tool after the performance of the skill. Therefore, it is imperative for instructors to promote self-assessment as a way of reflection before providing feedback so that learners' performance of procedural skills can be improved. It was also argued that reflection, not only on a completed procedure but on each action taken during the performance of the procedure is important to procedural skill learning. This exercise will arouse the ability of learners to self-guide, identify their own limits and call for help when needed so as to ensure safe and independent skill performance (Epstein, Siegel & Silberman, 2008).

Furthermore, the development of GPSE was conducted to accommodate the assessment of learners' self-awareness of the procedural skill they are to perform and

their need for help where and when necessary. In a case where learners need help, an expert instructor will have to assist during the performance of the procedure, which could be in form of reviewing how the equipment was set up, proposing a change in positioning and movement or complete takeover of the performance should the learner be unable to complete the procedure safely (Collins, 2006). By implication, teachers, who are the drivers of knowledge and skill competencies must be committed to providing necessary guidance right from the teaching of procedural skills to the point of assessing learners' performance competencies through appropriate feedback mechanisms so as to ensure that the objective of teaching and learning is not defeated.

Ganesha's (2016) study posited that procedural skills are a complete set of physical skills required for the performance of a task. It does not only involve the ability to perform the practical task with or without tools but also to understand the procedure and the possibility of success or failure. It was affirmed that procedural skills involve some general basic features which learners and teachers should duly put in perspective. These include: indications, contraindications, technical processes, time of skill performance, location of skill performance, order of skill performance, equipment to use, regular practice and assessment to determine learners' mastery.

The acquisition of procedural skills should not only be the focus of learners in their academic-related tasks, much more but they must also be determined to improve themselves to the point of gaining mastery so that they can achieve better results with it in real-life situations from time to time. Skill simulation training was suggested as a proven technique to ensure that learners improve their procedural skills, as it will allow them to practice and repeat procedures as often as necessary. This can be done by identifying the right skill-simulated training, creating an appropriate learning environment and establishing a well-structured feedback or assessment tool that can help in correcting learners' errors, thereby maximizing their learning outcomes. By implication, education stakeholders, especially the government, school administrators and teachers have a vital role to play by ensuring that the school curriculum is designed and the right and adequate resources for its execution are optimally provided in order to achieve the intended outcome.

A similar study by Touchie, Humphrey-Murto, and Varpio, (2013) argued that procedural skills are very significant to professionals in practice who anticipate a better future. It was asserted that acquiring and evaluating procedural skills in learners can be based on a self-guided approach. Moreover, the expert direct observation technique was adjudged to be an important tool for assessing procedural skills learning as learners affirmed their confidence in it for its ability to provide adequate feedback. The study concluded by recommending that measures must be put in place to ensure that learners are provided with self-guided learning especially now that competency-based training is the most advocated training technique for teaching procedural skills. This should be done with a view to making available more simulation centers because it will allow learners to acquire a step-wise knowledge of procedural skills coupled with direct observation of experts and feedback.

A review of Wearne's (2011) work on teaching procedural skills in general practice revealed that educators and practitioners are responsible for providing opportunities for learners to acquire procedural skills. The study underscored the inadequacy of the 'See one, do one, teach one technique of teaching procedural skills and thus recommended an alternative model hinged on the psychology of skill learning. The model encourages that skill training should be designed to complement learners' prior experience and encourage deliberate practice until self-competence is achieved, which will be sustained with an ongoing practice schedule. Also, teachers need to take responsibility for the continued guidance of the learners until they are able to perform the procedural skills, exhibit the right values and understand the appropriate time to act. By so doing, teachers will be able to achieve their goal of providing appropriate blended support to enhance learners' skills, arouse their motivation and promote their confidence during skill performance.

Findings by Sudarmani, Rosana and Pujianto (2018) on improving students' procedural and conceptual knowledge with an emphasis on physics instruction media submitted that the teaching of science-related subjects such as computer science or physics affords learners the opportunity of acquiring basic problem-solving skills to overcome daily life challenges. It was emphasized that the inclusion of media (technology) in the teaching-learning process will aid students to acquire competence. Moreover, learners stand to gain more as their understanding of concepts and processes is improved, procedural skill is better understood and performed, and their understanding of applying scientific techniques in real-life experiences. This implies that technology-based instructional strategy is an effective method for improving learners' cognitive knowledge, procedural skills and scientific literacy with the intent of rightly applying them in scientific inquiries in order to proffer solutions to a societal problem.

4. Objectives of the Study

The specific objectives of the study are to:

1) design an augmented learning package for teaching Computer Science in junior secondary schools in Offa local government area of Kwara State;
2) examine the effect of augmented learning package on the acquisition of procedural skills in Computer Science;
3) determine the effect of the augmented learning package on students' performance in computer science among junior secondary students of Offa local government, Kwara State.

4.1 Hypotheses of the Study

The following hypotheses were set for the study:

H_{o1}: There is no significant effect in the acquisition of procedural skills of students exposed to augmented learning packages and those that will not.

H_{o2}: There is no significant effect on the performance of students exposed to the augmented learning package and those that will not.

5. Method

The study employed pre-test- post-test experimental research design. The population for the study comprised 6,813 Junior Secondary School two (JSS2) students in Offa Local Government Area of Kwara State. The sample for the study comprised 40 students drawn from two junior secondary schools in Offa local government area of Kwara State. The 2 schools were selected using a purposive sampling technique based on the availability of Computer science teachers and equipped computer science laboratory. Intact classes were used and each school represented a group. The experimental group was exposed to an augmented learning instructional package while the control group was taught using the traditional expository method of teaching.

Two research instruments were used to gather data for this study; Computer Science Achievement Test (C-SAT-I), Computer Science Achievement Test (C-SAT-II). The C-SAT-I which was used to determine the effect of the augmented learning package on students' academic performance contained 20 multiple-choice questions which were administered to the students in the two groups during the first and the last week of the experiment to determine the students' performance for pre-test and post-test. Also, the CSAT-II which was used to examine the effect of an augmented learning package on the acquisition of computer science procedural skills was administered to the experimental and control group after the treatment was administered to the experimental group. The CSAT-II contained a set of instructions to perform some procedural skills based on the instruction given to the students.

The research instruments were subjected to face and content validity procedures. This was carried out by giving the instruments to the researcher's supervisor as well as other experts in the field of educational technology, and tests and measurements. The reliability of the instruments was ascertained using a test re-test reliability measure. The instruments were administered twice to 10 students selected by simple randomization procedure within the population but outside the sample at an interval of two weeks. The Pearson Product Moment Correlation coefficient (PPMC) of the analysis of the data gave $r = 0.722$ therefore, the test re-test coefficient indicated that the instrument is consistently valid and a good measure of the intended construct.

The study lasted for eight (8) weeks. During the first week, pre-test was administered to determine the students' previous knowledge and students were assigned into two groups. The second week was the start of lessons for the two groups. Treatment was administered to the experimental group with an opening orientation of about 20 minutes. The orientation helped them pay interest in the teaching procedures. Treatment was administered between the second and the fifth week. The content the students were taught in Internet 1. The topic was divided into sub-topics such as Definitions, Internet browsers, creating e-mail accounts, Samples of e-mail addresses, Benefits of the internet,

Abuses of the internet. The two groups were taught simultaneously with the help of a research assistant. The sixth week was used to administer the post-test to the students to determine their performance. The researcher gave two weeks intervals after the post-test and then conducted a retention test during the eight weeks.

6. Results and Discussion

Hypotheses One: Augmented learning package does not have a significant effect on students' acquisition of procedural skills in Computer Science. To test this research hypothesis, the post-test scores of the sample students were used. The sample was exposed to the procedure of account opening on the internet and was asked to repeat the procedure to open an account for themselves. The scores were subjected to a t-test and the results are presented in Table 1.

Table 1: T-test showing the differential effect of augmented learning the package on the acquisition of procedural skills in Computer Science

Group	N	Mean	SD	t	df	P
Experimental [a]	20	5.00	3.044	-5.176	38	0.000*
Control [b]	20	1.30	0.979			

A= Students exposed to an augmented learning package
B= Students not exposed augmented learning package
*p-value<0.05 (Significant)

Table 1 shows that the mean scores of the two groups were different and were subjected to a t-test to determine if the mean difference was significant. The independent t-test result reveals t = -5.176, df = 38 and p = 0.0000 <0.05. This implies that the augmented learning package had a significant effect on students' acquisition of procedural skills in Computer Science. As such, the null hypothesis was rejected.

Hypotheses Two: Augmented learning package does not have a significant effect on students' performance in Computer Science. To test this research hypothesis, the pretest and post-test scores of the students on the 20 objective items were used to assess the performance of the students for the control and experimental groups and were subjected to a t-test and results are presented in Table 2.

Table 2 presents the pre and post-tests conducted using an augmented learning package. The statistical parameters during the pre-test show that there was no significant difference in the performance of the students before treatment (X = 18.00, 18.75; t = -0299; df = 38; p = 0.767 which is greater than 0.05 level of significance. However, after the intervention, the table shows a difference in the mean scores of the two groups. The independent t test yielded t-value = -2.231, df = 38 and p = 0.032 <0.05. This implies a significant difference in the mean values, meaning the augmented learning package significantly improved the performance of students.

Table 2: T-test showing the differential effect of the augmented learning package on students' performance in computer science among junior secondary students

	Group	N	Mean	SD	t	df	P
Pre-test	Control [a]	20	18.00	6.95	-0.299	38	0.767*
	Experimental [b]	20	18.75	8.81			
Post-test	Control [a]	20	24.60	8.95	-2.231	38	0.032**
	Experimental [b]	20	30.75	8.48			

a = Students not exposed to augmented learning package
b= Students exposed augmented learning package
*p-value>0.05 (not significant); **p-value<0.05 (Significant)

7. Discussions

The use of an augmented learning package had a significant effect on the acquisition of procedural skills of students. The use of the procedure is one of the fundamental requirements for teaching and learning skill-related subjects. Skills are tasks or abilities in an individual to perform certain actions, which can be acquired through training or education. Skill acquisition as well as procedural skill is essential in virtually every profession, of more importance to the education sector because of its skillful procedures. This finding is consistent with the review of Wearne's (2011) on teaching procedural skills in general practice. The study revealed that educators and practitioners are responsible for providing opportunities for learners to acquire procedural skills.

It is noteworthy to observe that the students used for the experiment had no idea what skill acquisition/procedural skill is in relation to the subject (Computer Science). In fact, it was not an interesting subject to them and schools saw no significance of the subject thus it was relegated to always hold during the last period on the timetable and only once in a week. Schools were also of the notion that the students will mismanage the computers if they were allowed to access the computer laboratory, so, students were only taught theories. The use of an augmented learning package gave the opportunity to the experimental group to operate on the computer for the first time. Students were exposed to the package and some of them were able to answer the performance task questions after the lesson. This was not so with the control group, who were taught the traditional method. Students gained knowledge of both the theory and the practical aspect of the lessons.

The result showed that the academic performances of the two groups during the pre-test were poor compared with their performances during the post-test. An augmented learning package was used in teaching the experimental group which is of great positive effect on their performance during the post-test, while the control group was taught using the traditional method of teaching of which their performance during the post-test was still poor when compared with that of the experimental group.

The study, therefore, concluded that augmented learning environment is beneficial to students and should be deployed to teach Computer Science in secondary schools.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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