Enhancing Electronics Technology Students' Learning Experience and Satisfaction: The Role of Computer Simulation Software Packages

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ABSTRACT

This paper examined the role of computer simulation software packages in enhancing the learning experiences and satisfaction of students undertaking electronics technology course. Emphasis was laid on defining learning experience as all the activities and interactions within the school system from which students can learn. As well as student satisfaction, which is students' perceptions of learning experiences and perceived value of a course. The factors affecting electronics technology students' learning experiences and satisfaction such as: quality of staff, student teacher relationship, socio-cultural background, teacher-student ratio and admission standards were highlighted. It was established from the literature reviewed that, electronics technology is capital intensive and the funds required for procuring equipment and consumables are not often readily available. Hence, in order to address the challenges, the use of computer simulation software packages such as MATLAB, Multisim, PowerSim, PSPICE, Schematic and CircuitLab were identified and discussed in the paper considering the advantages they offer. The paper further recommended that both teachers and students of electronics technology are encouraged to embrace the use of computer simulation software for enhancing students' learning experiences and satisfaction.

Keywords: Learning, experiences, satisfaction, electronics, simulation, software.

INTRODUCTION

Providing qualitative education to all is one of the goals of the government of Nigeria. It therefore does not come as a surprise that the fifth item on the list of beliefs, that midwifed Nigeria's philosophy of education, was captured thus: "education is to be qualitative, comprehensive and relevant to the needs of the society" (Federal Republic of Nigeria (FRN), 2013). In giving further credence to this position, Etor, Mbon and Ekpenyong (2013) remarked that qualitative education as a development agent that is valued by all nations of the world because it has brought total liberation to man, transformed man from ignorance and misery to knowledge and happiness, and has made man useful to himself, his generation and beyond. In the same vein, Thom-otuya and Inko-tariah (2016) rightly noted that the quality of education determines the quality of manpower and their products; reduce the rate of unemployment, since graduates and technicians can become self-employed after graduation. In the light of these, it is expected that every form of formal education in Nigeria must strive to bring this belief to realization. This is one of the reasons why improving the learning experiences and satisfaction of students of higher education has been on the front

burners in recent times. In fact, Douglas, Douglas, McClelland and Davies (2015) revealed that the learning experiences and satisfaction of students of higher education is accorded a lot of importance such that in some climes, they serve as yardsticks for rating institutions of higher learning with relations to others of similar standing.

Additionally, apart from impacting in a negative way on the academic achievement of students of higher institution, student learning experience and satisfaction from enrolment point of view, can go a long way in impacting in the way certain courses and higher institutions are subscribed for. Dhaqane and Afrah (2016) agree with this position when they submitted that the retention of students is significant for fulfilling the primary objectives of educating and graduating students, but also from the viewpoint of college enrolment management, student satisfaction supports their intention to stay in college. Hence, when students of higher education courses get what they deserve, their needs met, others are likely to be attracted to those courses. Just as it is today in Nigeria, certain courses are over subscribed for, while others are simply fizzling out.

This is why in order to become effective, Lo, (2012) revealed that less-than-optimal learning environments should be redesigned to include a variety of learning activities and opportunities shown to foster achievement of the desired learning outcomes. The researcher further submitted that instructors (lecturers) should provide evidence of student learning by assessing students' understanding and their demonstration of desired results. This is in line with the fact that, student demographics have changed greatly in recent years, as have teaching and learning technologies; because the student population is increasingly diverse and unevenly fascinated by these technologies, instructors seeking to obtain accurate learning outcomes may need to use a variety of methods, in deference to the students' differential learning styles and thinking paths (Hooker, 2017). This is with a view of enhancing the learning experiences and satisfaction of the students.

Concept of Students' Learning Experience and Satisfaction

Learning experiences are all the activities and interactions within the school system from which students can learn. According to Hassan, Ismail and Ibrahim (2013), learning experience refers to any interaction, course, programme, or other experience in which learning takes place, whether it occurs in traditional academic settings (schools, classrooms) or non-traditional settings (outside-of-school locations, outdoor environments), or whether it includes traditional educational interactions (students learning from teachers and professors) or non-traditional interactions (students learning through games and interactive software applications). The quality of learning experience serves an indicator for successful teaching (Zerihun, Beishuizen & Van Os, 2012). A lecturer using the right skills to the best of his ability is more likely to have a positive effect on students learning experience, but ineffective or improperly used skills could have a detrimental effect (Stevenson and Harper, 2006). In effect, Stevenson and Harper further noted that the impact made by the lecturer is made evident in students' increased knowledge and skills as a result of their experiences. Hence, proper planning and execution of teaching episodes lead students to that point where they feel the satisfaction that accompanies the learning experiences, and

it can happen while they are still in school or after they graduate.

Student satisfaction refers to student perceptions of learning experiences and perceived value of a course (Kuo, Walker, Belland & Schroder, 2013). To Lo (2012), student satisfaction is the subjective perceptions, on students' part, of how well a learning environment supports academic success. In the same nein, student satisfaction is defined as the favourability of a student's subjective evaluation of the various outcomes and experiences associated with education (Dhaqane & Afrah, 2016). Kuo *et al*. (2013) posited that student satisfaction is an important indicator of the quality of learning experiences. As much as student satisfaction is often influenced by the quality of interpersonal interaction between the student and the lecturer; the quality of their learning experience can also be affected by the student's own behaviour or misbehaviour. Hence, one role necessarily belonging to the student is to capitalize on challenges posed through instructional methods such as problem-solving exercises, in order to strengthen their critical thinking and creativity (Lo, 2012).

As rightly noted by De Smet, Valcke, Schellens, De Wever and Vanderlinde (2016), in an environment that is truly student centred, students are continually confronted with stimulating instructional methods and related environmental features, which generate student satisfaction that are linked to successful academic outcomes. Little surprise then that student satisfaction (and dissatisfaction), is one of the many criteria that contribute to universities' league table positions in the United Kingdom (Douglas *et al.*, 2014). As a result, student satisfaction ratings which unfortunately have been both continuously and increasingly poor and therefore potentially damaging in terms of the recruitment and retention of staff and students (Dean, 2011). To further buttress this position, Calvo, Markauskaite and Trigwell (2010) noted that students' experiences of their learning and the teaching in the subjects they are studying are one of the more ubiquitous sources of information about the quality of teaching for institutions and individual academics. Invariably, the results are used in the design of new courses and degree programs, as evidence for promotions and awards, and for various policy decisions. The critical areas of quality that foster satisfaction, from a student viewpoint are: responsiveness, communication and access (Douglas *et al.*, 2014). If the learning experiences and satisfaction of students is being used as a litmus for judging the success or otherwise, of the educational services rendered by higher institutions, what then are the factors affecting the learning experiences and satisfaction of students?

Factors Associated with Students' Learning Experience and Satisfaction

Student learning experience and satisfaction are affected by a myriad of factors. Some of them are encapsulated as follows. Department of Education and Training (2015) reported that some of these factors are directly related to learning and teaching, while others have to do with life beyond the class. Uduafemhe (2015) submitted that the factors that affect student learning experience and satisfaction can be classified into three main elements. These are: student characteristics (intelligence and gender), home environment (socioeconomic class), and school context (quality of instruction). Mlambo (2011) identified them as; parental background, school environment, and learner's characteristics. Whichever way

these factors are viewed, they affect the way students experience learning and influence their level of satisfaction. The factors affecting the contemporary student's experience and satisfaction include: (a). large increases in student numbers, (b). student fees and HE funding models, (c). admission standards, (d). evolving issues around equity, (e). internationalisation, and (f). blended and distance education (James, French & Kelly, 2017). Others include: school type, school facilities (Alimi, Ehinola & Alabi, 2012), school location, student attitude (Ntibi & Edoho, 2017), parent socio-economic status (Aliyu, 2016), and teacher's competence, experience and teaching performance (Asfani, Suswanto & Wibawa, 2016). In a nutshell, the factors that affects students' learning experience and satisfaction are: learning facilities, school infrastructure, quality of staff, student-teacher relationship, socio-cultural background, teacher-student ratio, admission standards, student aptitude and attitude. These factors affect students of medicine, languages, humanities, sciences, engineering and technology. This include electronics technology students.

Overview of Computer Simulation for Instructional purposes

Computer simulation started to make inroads in the Nigerian academic space recently. For instance, Oyelekan and Olorundare in 2009 developed and validated a computer instructional package for teaching electrochemistry for secondary schools in Nigeria. Udo and Etiubon (2011) investigated computer-based science simulations, guided-discovery and students' performance in chemistry. Similarly, Gambari and Yusuf (2014) developed and validated a computer instructional package on physics for secondary schools in Nigeria. The effect of computer simulation instructional package on senior secondary school mathematics students' retention in arithmetic progression in Lavun Local Government Area of Niger State, Nigeria was explored by Gimba, Falode and Bashir in 2015. A careful observation the Nigerian situation, reveals that while computer simulation is being embrace by the natural sciences, industrial and technology education, electronics technology in particular appears to be lagging behind in terms of fully harnessing the merits of computer simulation. Save for Raymond, Uduafemhe & Shuaibu who in 2016, studied the effects of computer simulation on Nigeria certificate in education students' psychomotor achievement and interest in electronics technology.

There are many simulations software that are relevant in electronics technology. According to Vogt, Hendrix and Nenzi (2018), Pannam Imaging Advances Interface Solution (2017), Microcontrollers Lab (2017), Raj (2015) and Tobin (2007), the software that are useful in electronics technology include the following: Matrix Laboratory (MATLAB), Multisim, SiMetrix, Toolkit for Interactive Network Analysis (TINA), PowerSIM, Power Simulation Programme with Integrated Circuit Emphasis (PSPICE), SmartDraw, ProfiCAD, Linear Technology Simulation Programme with Integrated Circuit Emphasis (LTSPICE), CircuitLab, EveryCircuit, DoCircuit, Easy Electronics Design Automation (EasyEDA), PartSim, Schematic, Scheme-it, Ngspice, GNU Circuit Analysis Package (GnuCAP), CircuitLogix, Top Simulation Programme with Integrated Circuit Emphasis (TopSpice), MacSpice, Power Electronics and Control Systems (PECS), Proteus, and Quite Universal Circuit Simulator (QUCS). These simulation softwares are invaluable for doing the following with ease: lossless

image compression in cameras, antenna analysis and design, circuit design calculations, gain and noise calculations in amplifier designs, circuit simulation and fault analysis, implementation of Fourier transforms, doing calculation of all complex mathematical functions, machine learning, for performing any task at a faster rate, data analysis, creation of circuit layouts, circuit analyses and simulation, exploration of breadboard in 3D before lab assignment submission and creation of printed circuit boards (PCB), power electronics systems design, alternating current and transient noise analysis, interactive simulation and animation, virtual Instruments, and local and remote measurements (Pannam Imaging Advances Interface Solution, 2017; Microcontrollers Lab, 2017; Raj, 2015).

Enhancing Students' Learning Experience and Satisfaction using Computer Simulation Software Packages

Computer simulation is the manipulation of the variables of a system on a computer by the use of a prototype of a real-life situation so that predictions about the system can be made. Computer simulation was defined by Raghuwanshi, Singh and Mokhariwale (2012) as an attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works. Simulation on a computer requires that a relevant software is developed to suit the intended purpose. Software is a generic term for organized collections of computer data and instructions, often broken into two major categories: system software that provides the basic non-task-specific functions of the computer, and application software which is used by users to accomplish specific tasks (Axelrod, 2012). The use of computer simulation software is one of the recent technological advances introduced into instructional media which has the capacity to aid students, especially at the tertiary level, to grasp new concepts faster and better in engineering related disciplines (Raymond *et al.*, 2016).

Research evidences show that the use of computer simulation software can help students grasp concepts in electronic technology faster than the use of the conventional laboratory equipment (Furo, 2015; Raymond, Uduafemhe & Shuaibu, 2016). Similarly, Fang (2012) reported that 88 percent of 304 students who were taught engineering dynamics using computer simulation and that responded to a survey indicated positive experiences with the computer simulation and animation learning module. Taher and Khan (2015) intimated computer simulation adopts a learning strategy that is based on the higher order thinking skills, and this involves three principles: (1) creating an intriguing learning environment, (2) combining visual and interactive learning experiences that help students to form mental representations, and (3) developing cognitive architecture that unifies their learning experiences.

The advantages of computer simulation software are numerous. Raymond, Uduafemhe & Shuaibu, (2016) revealed that they: can be used for teaching a variety of courses like electronics in the field of Technology, offers a faster understanding of circuits, use industry-renowned tools, can handle multiple circuits' applications at a time, can be used to teach foundational analogue, digital, and power circuits concepts, and are useful tool in research in electronics and power electronics design. In addition to these, Taher and Khan (2015) enumerated three important advantages of using computer simulations in the classroom: First,

computer simulations in the classroom provide a strong tool for dealing with strategic planning and thinking, which are often times difficult to develop. Second, the purchase, maintenance, and update of lab equipment is often more expensive than computer hardware and software. Third, computer simulations in the classroom reduces the concern for students' physical safety in the simulation-learning environment. In general, computer simulation is a powerful tool for teaching not only the content, but also thinking or reasoning skills that are necessary to solve problems in the real world.

CONCLUSION

The importance of the use of computer simulation software for enhancing the learning experiences and satisfaction of students in higher institutions has come of age globally. For this reason, students and lecturers of electronics technology in Nigeria cannot afford to be left behind. Therefore, the adoption of computer simulation software in electronics technology in the entire higher education system in Nigeria has the capacity to foster enhanced student learning experiences and satisfaction. Hence, it is important that all stakeholders in electronics technology embrace computer simulation software. If this happens, students would be further propelled towards personal study armed with a laptop computer with any electronics simulation software which would help them master the skills they are being taught.

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