

Action-Based E-Learning in Electronics Technology as a tool for Lifelong Learning and Sustainable Development in Nigeria

Aniekan Elijah Asukwo¹ and Chatramada Vincent²

^{1&2} Electrical Technology Education Department, ModibboAdama University of Technology, Yola, Adamawa State, Nigeria. Correspondence email: asukwoaniekan@yahoo.com

ABSTRACT

The growing emphasis placed on the need for the adoption of a learner-centred approach to teaching and learning in educational institutions for lifelong learning and sustainable development has made it necessary for the teachers in various disciplines, including electronics technology, to review teaching methods that strive to involve students in the learning process more directly than in other traditional methods. This development has resulted in pertinent questions being asked on how action learning with computers connected to the internet can make learning in electronics technology more efficient and effective; what kinds of software modules would it require; and how the same software would be used in several phases of the learning process. This paper describes few successful experiences in combining action learning and e-learning instructional approach aimed at enhancing the effectiveness of lesson delivery and yielding changes in participants' knowledge, while suggesting positive consequence of action-based e-learning in electronics technology, if adopted by lecturers and instructors.

Keywords: Electronics Technology, Teaching Methods, Action Learning, E-Learning, Action-Based E-Learning, Lifelong Learning, Sustainable Development

INTRODUCTION

The current National Policy on Education of the Federal Republic of Nigeria (2013) places great emphasis on technology education as an integral part of national development strategy. The policy describes the specific objectives of technology education to include: provision of courses of instruction and training in engineering, other technologies, applied sciences, business and management, leading to the production of trained manpower; and the provision of training that imparts the necessary skills for the production of technicians, technologists, and other skilled personnel who shall be enterprising and self-reliant.

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In Nigeria, tertiary institutions are tasked with the provision of technology education for the purpose of producing skilled manpower required for the nation's economic and technological development (Federal Republic of

Nigeria, 2013). One of such courses offered by tertiary institutions in Technology Education includes Electronics Technology.

The current state of recession and rate of unemployment bedeviling the country of Nigeria has become a major problem for the government who has not been able to proffer a solution as expected (Asukwo, 2018). More alarming is the number of Electronics Technology Education graduates seen roaming the streets in search of white collar job in an era where almost everything is electronic due to technological advancement. This has informed the need for the adoption of a learner-centred approach to teaching and learning in the tertiary institutions in order to remedy the situation. One of such instructional strategy suggested is the action-based e-learning approach.

CONCEPT OF LIFELONG LEARNING AND SUSTAINABLE DEVELOPMENT

A more effective teaching approach in the field of electronics technology is important for lifelong and economic development as the skills

that will be acquired during the learning process are needed for enterprise productivity and profitability as well as for national productivity and wealth creation. Lifelong learning can be described as a voluntary and self-motivated pursuit of knowledge for either personal or professional reasons, thereby not only enhancing social inclusion, active citizenship, and personal development, but also self-sustainability, as well as competitiveness and employability (Department of Education and Science, 2000; Commission of the European Communities, 2006). It also involves self-directed learning using a range of sources and tools including online applications. The Free Dictionary (2018) describes lifelong learning as the provision or use of both formal and informal learning opportunities throughout people's lives in order to foster the continuous (sustainable) development and improvement of the knowledge and skills needed for employment and personal fulfilment.

Adebola (2007) opined that sustainable development is a kind of development that can be initiated and managed properly in such a way as to give attention to continuity and preservation as people explore explicit available resources for the enlargement of their existence. Brown (2011) suggested that sustainable development may involve improvements in the quality of life for many but may necessitate a decrease in resource consumption. Furthermore, sustainable development can be seen as reduction in the levels of poverty, illiteracy, and unemployment and income inequality (Usoro, Ogbuanya and Udo, 2012).

Arogundade (2011) outlined the major essential tools for achieving sustainable development to include:

- Improving the quality of basic education
- Reorienting existing education programme to address sustainable development.
- Developing public awareness and understanding, and
- Providing training for all sectors of private and civil society.

CONCEPT OF ACTION-BASED LEARNING

According to Confucius a Chinese philosopher, "I hear and I forget, I see and I

remember, I do and I understand". Action-based learning is an approach based on doing to understand. Revans (1982) in Waddill (2006) opined that action-based learning is a means of development, intellectually, emotionally or physically that requires its subjects, through responsible involvement in some real, complex and stressful problem, to achieve an intended change to improve their observable behaviour in the problem field. In an action-based learning environment, it is assumed that the learner has the power to make decisions about problems which are usually complex and the authority to implement solutions to those problems.

The process of problem solving in an action-based learning environment involves a reflective inquiry process where participants ask questions and reflect upon the questions asked with the goal of learning, and is most successful when the problem is significant and urgent (Waddil, 2006). The process of problem solving in an action-based learning environment also expands to involve identification of a real problem that is important and critical, a diverse problem-solving team, a curious process of inquiry and reflection, a requirement that talk be converted into action that leads to a solution, and a commitment to learning. Marquardt (2004) further distilled the action-based learning process into six essential elements that include:

- a group of people, also called the action set,
- a commitment to learning,
- a problem in need of resolution,
- a commitment to the use of a questioning and reflection process,
- a commitment to taking action by one with the authority to take action, and
- a facilitator/coach to enable the process.

The merit of Marquardt's approach is the provision a workable set of actions and conditions that specify exactly how action-based learning can succeed.

Action-based learning method is one proven process for organizational, team and management development. More recently, action learning has been applied in classrooms as an instructional methodology. Action-based learning encourages the child to learn through

experimentation and exploration. The sensory experience and action make the learning better and more impactful. This leads to an exciting journey of discovery and enhanced understanding. The relevance of the use of action-based learning as an instructional method in a face-to-face classroom cannot be overemphasized (Bannan-Ritland, 2001). This is because the concept of action-based learning is supported by research showing an increase in learning when students participate in physical activities. It utilizes the natural link between the brain and the body to maximize learning. However, until recently, its efficacy as an online, instructional methodology has not been examined (Waddil, 2006).

CONCEPT OF E-LEARNING

E-learning as computer assisted learning can be viewed as student-centred and collaborative, with early developments focused on contents that are delivered digitally. Recent developments have seen e-learning become prominent, comprising all forms of electronically supported learning and teaching, whether networked or not. It can be further described as a learning process created by the interaction of students with any digitally delivered content, network-based services and/or tutoring support. Olojo, Adewumi and Ajisola (2012) described e-learning as any technologically mediated learning using computers whether from a distance or in face to face classroom setting, based on a community of learners, teachers, facilitators, and/or experts. Mayer (2001) posited that E-learning theory describes the cognitive science principles of effective multimedia learning using electronic educational technology. Olojo *et al.* (2012) also referred the use of internet technologies to deliver a broad array of solutions that enhance knowledge and performance as e-learning. Olojo *et al.* (2012) further opined that e-learning technologies offer learners control over content, learning sequence, pace of learning, time, and often media, allowing them to tailor their experiences to meet their personal learning objectives. They noted that innovations in e-learning technologies point toward a revolution in education, allowing learning to be individualized (adaptive learning), enhancing

learners' interactions with others (collaborative learning), and transforming the role of the teacher.

E-learning is particularly attractive because of its flexibility (Arbaugh and Duray, 2002), learner control of the learning process (Rossett, 2002), opportunity to reflect and provide thoughtful responses as well as to use conceptual thinking (Arbaugh and Duray, 2002), option for collaboration (Arbaugh, 2000), and cause for participants to enhance their ability to function in the e-learning and networked computer mediated environment (Meisel and Marx, 1999; Asukwo, 2018).

APPLICATION OF ACTION-BASED E-LEARNING

Action-based e-learning names a new teaching concept where the learning process is characterized by several features like computer aided learning and teaching, offering a set of tools to inspect the subject, access to multiple learning modules, a big reservoir of examples and the possibility to generate new ones, focus on correct solutions, easy action and reaction (click and watch) by using living pictures, the possibility of distance learning, multilingual descriptions, individual depth and duration, learning by doing, funny and game-like context (Uber and Wuttke, 2000). Uber and Wuttke further posited that concept of action-based e-learning offers teachers and students the possibility of free acting in the learning process and the core of such concept include some JAVA-applets (the interactive modules) running on any browser connected to the Internet.

Uber and Wuttke (2000) carried out a study on action-based learning system for teaching digital electronics and presented an action-based e-learning method that uses living pictures to deal with the fault simulation in digital circuits. The living picture included a graphic of a circuit with the facility to insert all possible faults and to watch how they change the circuit's behaviour at different input patterns or how they can be detected by test patterns. The program was written in Java 2 and could be run via network, using standard browsers like Netscape and Internet Explorer with Java 1.2 runtime plug-in, or with Java 2 applet viewer. The work window consisted of

three main parts: vector insertion panel, view panel for design schematics, and view panel for data tables and waveforms of simulated test patterns. The digital electronics and test course included topics such as fault simulation, test generation, testability analysis and design of built-in self-test architectures. After theoretical investigation of these topics, a laboratory work followed with more complex designs, where the design software (Cadence, Synopsys or Xilinx), and diagnostic software Turbo-Tester (2, 3) were used. It was therefore concluded that by the use of web-based media, we achieve the presentation of course material independent of place and time, individual learning according to the students' own needs, quick cross-referencing by hyperlinked texts, new forms of communication between teachers and students (chat, joint editing), and up-to date course material.

In a similar study, Waddill (2006) examined the impact of action learning process on the effectiveness of management level web-based instruction (WBI). A leader-led, management-level course using face-to face delivery was converted to web-based instruction where action learning was the delivery methodology. The research question for the study was to ascertain how action learning impacts the effectiveness of an online, management-level course. The unit of analysis was the individual manager within the action learning set, and were chosen as the target audience because they have the authority to implement solutions to complex business problems. The study followed a qualitative, exploratory case-study method and an existing course that was offered in a traditional classroom was modified to implement action learning as a delivery method for a web-based instruction version of the course. Its effectiveness was evaluated using Kirkpatrick's Four Levels of Evaluation. The WBI courseware was labelled action e-learning (AEL). An asynchronous technology approach was selected in order to extend the offering to a widely dispersed audience in different time zones, which implied that everyone did not have to be online at the same time. The study indicated that the asynchronous approach favoured participation by those in different time zones, with complicated schedules or both. It

also enabled reflection, a cornerstone of action learning. It was found that, though challenging to facilitate, the action learning online method was effective and yielded changes in participants' knowledge. The participants' responses demonstrated that management-level participants can learn the action learning process online, using action learning as the course methodology. The participants reacted positively to the course and their learning was thus perceived as satisfactory; their level of knowledge changed and the process had an impact on their reflective inquiry behaviour that was exhibited online. It was therefore concluded that action learning can be conducted effectively online as an instructional methodology on the individual level.

On the other hand, a practical example of the application of action-based e-learning in Nigeria was observed in the training approach adopted by past administration of Adamawa State, headed by His Excellency, Governor Murtala Nyako in cooperation with ITS - International Training & Support GmbH, Germany and TTS - Technical Training Services Ltd., Nigeria. The high standard of training gave youths the opportunity to learn, pursue a profession, and earn their own living, and with this eradicate poverty and increase living standards, security and national independence. The training was carried out in Technical Skills Acquisition Centres (TSACs) sited across the state.

The training services offered in the TSACs were delivered from a range of standard training modules designed as customised concepts and programmes by ITS experts in the fields of modern technologies, which can be ordered separately or combined in an integral solution, thus catering for the important aspects of manual skills development and the application of technical knowledge gained through classroom instruction (hands-on training). The training compendium, which includes all courses, subjects and topics to be instructed, gave an overview of the training objectives works as basis for a teach ware to be used in classroom and workshop settings. This training compendium is related to the German vocational training but took the Adamawa State government's basic conditions into consideration. One of such training compendium

used in electronics technology was the EloTrain plug-in system.

The EloTrain plug-in system combines with a multimedia experiment and training system UniTrain to create a modern and powerful learning environment for well-grounded training in the fundamentals of electrical engineering and electronics. Students are guided through experiments by clearly structured course software aided by text, graphics, animations and tests of knowledge. The experiments themselves are carried out on an Experimenter unit specially developed for UniTrain. A wide variety of virtual instruments is available so that students can make real-time measurements. The plug-in modules contain both passive and active electronic components connected via laminated plugs featuring gold-plated contacts. When inserted into the plug-in board, the laminated plugs clip the components into place mechanically as well as providing an electrical connection to the plug-in board's nodes. Cables or jumpers can be used to make connections to other nodes, components or measuring instruments. If a component requires more terminals, these are generally provided in the form of sockets on top of the component. The housings are comprised of two plastic parts clipped together. The upper part features a scratch-proof, high-contrast print of the component's circuit diagram or symbol along with a type name for the component. The transparent body is made of extremely tough see-through plastic allowing the inside of the component to be seen. The base plate is also made of containing laminated plugs and joined to the body via an easy-to-open ratchet clip for repair purposes. Experiments with the EloTrain plug-in system are always safe, even for uninitiated laymen, thanks to the use of non-hazardous safety extra-low voltage.

The benefit of this training approach as applied in Adamawa State yielded positive results as 500 potential employees, graduated in the Technical Skills Acquisition Centres (TSACs) in the area of Mechanics, Electricians, and Electronics and in the Specialized Works Trade Training Centres (SWTTCs) for the profession of carpentry and steel concrete works a job fair, offering their German standards qualified manpower to the industry of Nigeria

(International Training and Support, 2013). Furthermore, some of the graduates of the TSACs pursued their learnt profession by engaging in entrepreneurial activities, thus earning their own living and increasing their standard of living. This is corroborated by Ndamu (2017) who asserted that state government skill acquisition programme and other programmes on youths' empowerment supported youths' participation in entrepreneurial activities as was evident in graduates of the TSACs. Ndamu further opined that although the programmes to an extent achieved some of their objectives, they also faced some challenges such as lack of involvement of social partners and stakeholders; high level of corruption, policy inconsistency; and poor governance. These challenges might have led to the discontinuation of the action-based e-learning training approach by the Adamawa State Government.

BENEFITS OF ACTION-BASED E-LEARNING IF ADOPTED IN ELECTRONICS TECHNOLOGY EDUCATION

Action-based e-learning, a fairly new term in education but a concept familiar to most educators, is an approach that combines e-learning technology with traditional instructor-led action-based training, where, for example, an online tutorial/simulation is supplemented by a demonstration or students' hands-on activity. One advantage often cited of an action-based instructional technique is its effectiveness in facilitating better understanding while learning delivery is the most often cited advantage of e-learning. Other advantages include increased accessibility to information, ease in updating content, personalized instruction, ease of distribution, standardization of content, etc.

Furthermore, in light of relevant literatures already reviewed, the adoption of action-based e-learning instructional technique in electronics technology education will bear the following positive consequences:

1. Action-based e-learning instructional technique offers differentiated learning, as it does not only allow for development in competency and skills via collaboration, but

also supports sustainable development in literacy, numeracy and ICT.

2. It encourages lifelong learning as it makes provision for online lectures which would be available for free, creating an opportunity for any individual to learn on their own time table and from the comfort of their home.
3. The Coursera online platform for example, collaborates with universities and other organizations to offer online courses with quizzes, weekly exercises, peer-graded assignments, and sometimes a final project or exam. The assignments are real time examples and offer a hands-on experience to the individuals also. All these services are available any time, at any location, and at the comfort of the learner.
4. Action-based e-learning allows individuals to retain the learning material to a significantly greater degree than the traditional face-to-face instructor led classes as content delivery is consistent and can be easily repeated if needed to gain a better understanding.
5. Furthermore, unlike classroom teaching, with an action-based e-learning environment, individuals can access the content of the course module an unlimited number of times, especially at the time of revision when preparing for an exam. In traditional form of learning, if an individual cannot attend the lecture, then he/she has to prepare for that topic on his/her own; in action-based e-learning, the individual can attend the lectures and carry out the module hands-on activities whenever he/she wants with ease.
6. Action-based e-learning instructional method as an activity-based approach helps to sharpen the learners' problem solving and analytical skills. By getting the learners actively involved in their own learning, action-based e-learning encourages learners to be independent thinkers, analyse the tasks at hand, think critically and solve problems to come to the final learning, thus encouraging the learners to be more inquisitive and develop their analytical and problem-solving skills. These skills not only help the learners in their studies but come handy even outside the educational environment as the learners tend to become active investigators while striving to make sense of the world around, learn to think on their own, and derive solutions in different kind of scenarios.
7. Action-based e-learning facilitates better understanding as it allows the learners play an active role rather than the passive role in the traditional technique of learning where they are encouraged to understand by just listening to the teacher. It facilitates a better understanding of the subject by encouraging the learners to complete the tasks at hand. The supervisor – teacher or instructor, can immediately measure the learner's understanding by his/her ability to complete the tasks and take things ahead from there, rather than the traditional technique where the learner's understanding of the subject is ascertained only by their capability to reproduce their knowledge in exams in the form of answers to questions. Some theories also suggest that not every learner can succeed by simply listening to material in a lecture format.
8. It provides virtual learning worlds where learners can take part in active and creative learning with others through simulations, role-play, remote control of real-world tools and devices, online master classes, or collaboration with other education providers. Think of the EdX online platform with provisions for videos, photos, messages, and chats that are continuously shared, therefore creating an online discussion forum where learners can post and review questions and comments to each other and teaching assistants.
9. Action-based e-learning can help remove barriers to achievement, as it provides for new and creative ways of motivating and engaging learners of all abilities, enabling and inspiring everyone to attain their educational potential.
10. As a computer assisted instructional technique, updating electronic content in action-based e-learning is easier than updating printed material as e-learning technologies allow educators to revise their

content simply and quickly. Learners also tend to have control over the content, learning sequence, pace of learning, time, and, often, media, which allows them to tailor their experience to meet personal learning objectives.

11. Action-based e-learning offers a wide range of tools to enable teachers and learners to be innovative, creative and resourceful in all learning activities. Teachers and learners can easily customize digital learning resources to suit pace and level, appropriate to any learning style and ability.
12. Action-based e-learning reduces overall cost. Once developed, a course module can be run as many times, at as many locations and for as many learners. This reduces the need for universities to provide the conventional electronic tools and consumables often used for electronic laboratory tasks, thus reducing overall amount of money usually spent for the purchase of these consumables over time.

CONCLUSION

Action-based e-learning encourages learners to learn through experimentation and exploration at their own pace and convenience. The sensory experience and action involved in this instructional method, and the enabling environment teachers/instructors to get a higher degree of coverage to impart knowledge in a consistent way on their target learners tends to make the learning better and more impactful, leading to an exciting journey of discovery and enhanced understanding while ensuring that all learners receive the same type of training irrespective of geographical location. This teaching approach is therefore absolutely needed if Nigeria is to overcome her current and future challenges with respect to skill acquisition for self-reliance in electronics technology.

RECOMMENDATIONS

Government at all levels should place more emphasis on the practical aspect of electronics technology education through the provision of state of the art training modules and e-learning environment to complement other modern machines, facilities, and equipment needed for

skills acquisition in electronics technology, thereby reducing the over dependence on government for white collar jobs.

Government at all levels should partner the private sectors and industries to secure state of the art training modules and e-learning facilities to complement other modern machines and equipment, and what is secured should be a replica of what is obtainable in the industries.

Training of electronics technology lecturers and instructors should be organised regularly in order to keep them abreast of the current development and trends in active teaching methods in vocational/technical education for sustainable national development.

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