Technology-aided learning environment: An investigation into electrical/electronics students' instructional preferences, attitude and approaches to learning

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Technology-aided learning environment is replacing the popular teacher-dominated teaching-learning process. This study investigated electrical/electronics students' instructional preferences for technology-aided learning environment in relation to their approaches and attitudes to learning. A total of 339 third- and final-year electrical/electronics technology students from 18 universities participated in the study. A questionnaire package comprising of three adapted scales (students' instructional preference, approaches to learning and students' attitude) was used to collect data for the study. Results showed that students preferred teacher-directed technique, followed by knowledge construction, and finally cooperative learning. Students adopted deep approach to learning rather than strategic and surface approach. Students' attitude reflected a very good subject confidence, fairly good behavioural engagement, but poor confidence with technology, use of technology for learning, and affective engagement. There were significant relationships found between students' instructional preferences and approaches to learning; instructional preferences and students' attitude; and approaches to learning and students' attitude towards learning. The study recommends intensive use of technology facilities in the training of electrical/electronics technology students to aid their interest and participation in knowledge construction, and their relevance in the 21st century workplace.

Keywords: approaches to learning; attitude; electrical/electronics students; instructional preferences; learning environment; technology; technology-aided learning environment

Introduction

A significant change in the Nigerian education system is the ongoing transition from the conventional school environment to a technology-aided learning environment. This shift could have certain implications on university students in general and electrical/electronics technology students in particular, especially as it relates to their attitude, preferences, and approach to learning. Previously, electrical/electronics students are used to traditional classrooms with talking teachers, and hanging chalkboards. In the traditional classroom, sometimes referred to as the 'usual' classroom, teaching generally remains abstract, without use of any technology or appropriate links to practical applications of the concept being taught. This traditional teaching method often forces students into rote memorisation of the concepts taught in any of the courses in order to pass examinations. Invariably, students of programmes such as the electrical/electronics technology under technical education would not be able to link the classroom theories to the actual practice after graduation. This teaching and learning environment, which is teacher-dominated and content-driven, was criticised for its shortcoming of not being able to impart knowledge effectively (Burke, 2011; Heo, Han, Koch & Aydin, 2011). The demand for a more student-oriented learning environment had resulted in a shift to technology-supported teaching and learning, especially when it involves students in technology related areas such as electrical/electronics technology; a change which can pose a serious challenge of adjustment to electrical/electronics technology students in their course of study and as well affect their overall performance (Jethro, Grace & Thomas, 2012).

Electrical/electronics technology is one of the core areas of specialisation in the technical education programme, which prepares learners for teaching and industrial engagements, through the provision of knowledge, skills, and attitudes desirable in the world of work (Chukwuedo & Omofonmwan, 2013; Iliya, 2011). Electrical/electronics technology is a subject area that involves the teaching of some abstract concepts such as atomic structure, flow of electrons, power generation, transmission and distribution, circuit design, electromagnetism, logic gates, circuit theory, amplifiers among others. These require higher order thinking for comprehension. Electrical/electronics students most times have challenges in understanding some of these concepts and formulas, especially topics that involve complex calculations such as circuit theory, Boolean algebra etc. Hence, they devise pragmatic means of learning, one of which is memorisation, in order to succeed. The introduction of a new instructional environment, therefore, may alter existing students' learning approaches and attitude, especially when this involves learning with, and through, the new medium of technology.

Electrical/electronics technology, which is a specialised option in the technical education programmes, trains students for employment in the industrial sector or to become teachers or instructors in all electrical and electronics trade programmes, starting from the junior and senior secondary schools, technical colleges through to higher institutions, such as colleges of education and polytechnics. Since graduates of this programme would be employed as professional teachers and instructors in schools offering electrical/electronics trade programmes,

their exposure to technology-aided learning may stimulate their preference for the adoption of such strategy in their future teaching profession, more importantly after recognising its strength and importance (McAlister & Casal, 2012; Schelfhout, Dochy, Jannsens, Struyven, Gielen & Sierens, 2006; Vermunt & Verloop, 1999). Improvement on learning delivery has become vital to national development, as the new and emerging economy demands more than theoretical knowledge, but practical and innovative applications of concepts taught in the classroom (Hartley & Treagust, 2006). Hence, the learning environment ought to be such that support learning and present real work situations which students are likely to face after graduation (Van Wyk & Louw, 2008). The learning environment and learning delivery are to some extent likely determinants of the fitness level of the students in the competitive knowledge economic era. Reddy, Gastrow, Juan and Roberts (2013) established that there has been a sustained effort to measure the economic impact of advances in science and technology especially through education. This has necessitated the action of most countries, especially in Africa, to focus on trying to improve their learning delivery by ensuring usage of appropriate learning environment most especially with use of technology (Aldridge, Fraser & Ntuli, 2009; Fisher & Khine, 2006; Fraser, 2007; Khine & Fisher, 2003). The main essence of technology integration into the learning environment is to prepare a set of formidable, relevant and reliant graduates who would not only solve existing problems in society, but make meaningful contributions to the economic growth and development of their immediate society, as well as the national and international community. It would therefore be useful to carry out this study to investigate the instructional preferences, attitude, and approaches to learning among electrical/electronics students in a technology-aided learning environment.

Technology-Aided Learning Environment

Research on learning environments is gaining global attention, as it provides a number of ideas on techniques that may be valuable for effective teaching-learning activities (Fisher & Khine, 2006; Fraser, 2007; Khine & Fisher, 2003). Aldridge et al. (2009:148) argue that "Learning environment refers to the tone, ambience or atmosphere created by a teacher through the relationships developed within the classroom and the way in which instruction is delivered." The resultant effect of the interactions of the students with the learning environment is expected to impact on the student's academic achievement, satisfaction and persistence within the institution (Kongolo & Imenda, 2012:3–4). Thus, teaching and learning in the 21st century schools require advanced techniques that can bring about achievement of desired results, especially when it comes to the use of technology.

A technology aided learning environment involves adequate provision of required technology facilities which are effectively utilised for instructional facilitation both in the classroom and in the workshop (Yusuf, 2005). In this learning environment, technology facilities, including computers, projectors, internet facilities, educational software and also oscilloscope, digital multi-meters required for practical projects, are adequately available in appropriate proportion for teachers' and students' use during teaching-learning exercises to improve teaching and enhance learning. Furthermore, simulation and animations (technologies used for teaching abstract concepts) as well as practical use of electronics technology instruments, such as the oscilloscope and digital multi-meter, were used for teaching because they have characteristics that could make learning more realistic to students by bridging the gap between the theory and practice (Oliver, 2000). Students' learning in this environment become technology-based, particularly in teaching electrical/electronics concepts, unlike the traditional classroom setting where the teacher teaches theoretically without any practical link to the concepts or the actual practice. A technology-aided learning environment adequately helps students to develop interest as well as confidence towards real work situations by fostering realistic learning.

Advancement in technology has ushered in solutions to problems across different sectors, education inclusive. Kozma (1991) has emphasised the possibilities and effectiveness of technology in changing the way teachers teach and students learn. Thus, technology could offer new methods for teaching-learning activities. Pierce, Stacey and Barkatsas (2007) have ascertained that technology makes varying approaches possible in teaching and learning across the learning content and curriculum. The study further pointed out that adopting this new method may enhance learning through cognitive, metacognitive and affective mediums. However, Shavinina (2001:70) claimed that "the primary purpose of information and communication technology (ICT) includes the development of human mental resources that make people to successfully apply acquired or existing knowledge and be able to produce new insights." Therefore, the use of technologies such as computers, projectors, multicolour images, audio, text, motion and graphics, projected slides, oscilloscope and digital multi-meter among others could give students opportunity to develop capacities for high and quality learning and increase their ability for innovations (Aduwa-Ogiegbaen & Iyamu, 2005).

The use of technologies has changed the structure of the usual or traditional classroom, making it technology-aided-and-supported learning

environment. Dede (1998) reflected that learning in technology-aided environment would increase students' motivation, understanding and retention. A technology-aided learning environment is enriched with the provision of relevant and appropriate facilities, which are capable of presenting realistic information about concepts and thereby motivate and arouse students' interest. This provides opportunity for students' active involvement, which enriches their knowledge and deepens their skills, and helps in relating school experience to work activities (Heikkilä, Lonka, Nieminen & Niemivirta, 2012; Niemi, 2002; Yusuf, 2005). Technological innovation in the school setting strengthens teaching; provides strong support for theoretical concepts by presenting real examples of contents for competency and performance improvement (Oliver, 2000). In the opinion of Westera and Sloep (2001), one of the benefits of technology-aided learning environment is to provide students with a meaningful context that resembles the reality of the professional working environment in many respects. Inclusion of technology in teaching-learning process seems to bridge the gap between education and professional work, as it relates theory to practice, and knowledge to skills. Hence, the use of ICT could provide a real and meaningful learning environment that closely resembles the students' future workplaces. There is no doubt that ICT makes available productive teaching and learning to increase students' creative resources and intellectual capability especially in today's information society (Yusuf, 2005). Learning in the 21st century should take place in contexts that actually reflect the way in which knowledge would be useful in real life (Baeten, Dochy, Struyven, Parmentier & Vanderbruggen, 2016; Herrington & Oliver, 2000). Technology-aided learning environment seem to hold possibility of holistic teaching and learning for teachers and students, respectively.

However, the use of technology in teaching and learning process slightly changes the role of teachers from the sole giver of knowledge to a facilitator. Forcheri and Molfino (2000) reiterated that the use of ICT in education could foster collaborative learning, promote group problem-solving activities and articulated projects. Baeten et al. (2016) indicated that certain learning environment, such as technology-aided learning environment, could help students in stimulating knowledge construction and giving opportunity for self-regulated learning while the teacher becomes a facilitator. Thus, students play a greater role in their learning and knowledge construction than the usual traditional classroom. Mayer (2004:14) defined learning as an "active process in which learners are active sense-makers who seek to build coherent and organised knowledge." Ramorola (2010:38)

ascertained that "Integrating technology effectively into the curriculum requires planning, time, dedication, and resources." Hence, this new medium could help to clarify students' misconceptions about concepts and to identify effective solutions to learning problems (Bostock, 1998). A technology-aided learning environment, therefore, holds numerous advantages as it can also help students to link prior knowledge with new ones and build new knowledge on prior knowledge (Baeten et al., 2016). However, the rapid shift to technology-supported teaching and learning could pose a serious problem of adjustment to electrical/ electronics students who have their foundation of learning in the traditional classroom. This change may have significant effects on students' attitude to learning, approaches to learning and instructional preferences.

Instructional Preferences
The trend in research now focuses on the learning diversity that exists among the 21st-century students. Students do not have the same preferences for learning strategies and this can moderate the effectiveness of training programmes (Heikkilä, Niemivirta, Nieminen & Lonka, 2011). Cekiso, Arends and Mkabile (2015:237) noted that "within the education environment, the establishment and identification of students' instructional preferences has often been recognized [*sic*] in the education system." Research on learning preferences ascertained that identifying students' learning styles may help teachers understand student preferences of learning which could assist in selecting appropriate instructional strategies and educational options (Cekiso, 2011; Cekiso et al., 2015; Paulraj, Ali & Vetrayan 2013). Hence, educators should recognise the importance of considering individual differences in designing and selecting training environments (Heikkilä & Lonka, 2006; Towler & Dipboye, 2003; Vermunt & Vermetten, 2004). Students' learning depends on different internal inherent factors, which include interest, readiness, emotional stability, coping competence among others. These variables may influence differences in students' preferences for instructional strategies. Some students may prefer the teacher-centred learning environments because they do not want to take an active role in their teaching-learning process. As such, they may only want to pass the courses with minimum effort (Baeten et al., 2016; Beausaert, Segers & Wiltink, 2013; Trigwell, Prosser & Waterhouse, 1999). What appeals to students may differ, but learning seems to attract the attention and interest of learners when it is being facilitated with their preferred method and in essence becomes more effective (Williamson & Watson, 2007).

Instructional strategies have become a focal point of discussion and research among scholars. It

is a crucial and requisite element that intervenes in teaching/learning processes (García Ros, Pérez González & Talaya González, 2008). Gustafson and Branch (2002) identified instructional strategies as systematic procedures for guiding the implementation, control and/or evaluation of teaching and learning processes. A critical decision for teachers to make in educational practices is the choice of instructional strategies to use in facilitating students' learning (García Ros et al., 2008). On the other hand, students, who are the recipient of education, either learn or not at the end of the exercise, based on their instructional preferences (Heikkilä et al., 2011). This implies that students' instructional preferences in relation to instructional strategies employed by the teachers may determine their approach to learning. Thus, it would be useful to investigate the relationship between students' instructional preferences and approaches to learning. However, extant literature has identified the existence of different instructional strategies with distinctive and unique features, meant to achieve different instructional purposes. These include among others teacher-direction, cooperative learning, and knowledge construction, which this study focuses on, and from amongst which students may choose, based on their interest (García Ros et al., 2008; Towler & Dipboye, 2003; Wong, 2015).

In teacher-directed learning, which is by nature a passive process, teachers are crucial to the delivery of learning content in the classroom (Soliman, 2016). The features of this style of learning include a teacher presenting a lecture, students copying a teacher's notes, and the teacher performing an experiment or demonstration while the students observe (Wilson, 2011). This instructional strategy is referred to as lecture method where the teacher expounds exhaustively on the subject matter to the learners with little or no student's participation. Also, with the inclusion of technologies in the classroom, some teachers only adopt presentation technologies such as PowerPoint technology for lesson delivery without any form of students' engagement in the teaching-learning process. Evans and Waring (2006) discovered that teachers in their classes typically utilise an approach that transmits information to the students rather than allowing the students to be involved in the development of their understanding. However, it was observed that most teachers who use this method are not able to **employ** appropriate use of humour by means of a variety of strategies that are able to arouse the interest of the learners (Soliman, 2016). Many studies have emphasised the inadequacy of this teaching approach. However, some students who have always been taught using this method still prefer that a teacher provides a guide in their teaching and learning process (Heikkilä & Lonka 2006; Vermunt & Verloop,

1999). This necessitates the investigation of students' instructional preferences in electrical/electronics technology programme within a technology-aided learning environment.

In cooperative learning, students are more involved, as they are always grouped together to brainstorm and carry out certain given tasks. In this type of learning, it is very important that students find and share information based on their inquiry, an activity, which helps their learning. One major advantage of cooperative learning is that it stresses diversity of experience. All the more so, the outcome of this inquiry-based learning is characteristically unique to the group of learners involved (Alesandrini & Larson, 2002; Wilson, 2011). In a technology aided learning environment, this method of learning exposes students and allows them to explore different available technological facilities in getting assigned tasks done. It aids effective use of innovative technologies such as the internet facilities, computers, oscilloscope, and digital multi-meter among the students. Some students are very active when grouped with peers during instructional activities in the learning environment and they display more extroverted tendencies with greater attention to interpersonal relationships. These students seem to learn faster and better through this method than any other. As such they prefer that their instructional process involves learning through build-up experiences with their peers, rather than via individual learning preferences (Wilson, 2011).

In knowledge construction as an instructional method, learners independently construct their knowledge through their own personal experiences and reflections on such experiences (Goby & Lewis, 2000). Knowledge construction is an instructional approach, which is learner-centred. This instructional learning style was based on the fact that learners could creatively derive knowledge through exploration and discovery. Students have the tendency if permitted to continuously construct and reconstruct meaning for each new experience they encounter (Wilson, 2011). This instructional method experientially engages students mentally and emotionally in real-life experiences, which will help them to relate personally with information presented (Young, 2002). Learners develop their knowledge personally by interacting with different technological facilities in the technology based learning environment in relation to learned concepts, assigned projects, and ongoing research work. Knowledge construction is a learning style by means of which students are helped through reflections to develop theoretical understanding of real experiences, which guides them through the learning process and thus transforms learning from passive learning to active doing (Wilson, 2011). Some researchers concluded that knowledge construction can take place in any learning

environment (Berthold & Renkl, 2009), but some others argued that only certain learning environments could facilitate students' active knowledge construction (Loyens & Rikers, 2011). Understanding of students' preferred style of learning could positively influence teachers' training, students' orientation, curriculum design, and material development (Chang, DY 2004; Wong, 2015).

Since these three learning styles may be preferred by students at varying degrees, Guild (2001) advised that educators must abandon the singular mentality and realise the necessity of endeavouring to develop a real understanding of learning differences and striving to provide instruction that is intentionally diverse. Wong (2015:2) asserted that "teacher's awareness of the preferred learning styles of students can help understand and cope with students' course-related learning difficulties and ultimately help alleviate their frustration levels." Thus, students' learning approach is likely to be predicted, influenced or determined by the instructional method used during teaching-learning process.

Learning Approaches (Deep, Surface and Strategic)
One of the ways to describe students' learning is by means of their approaches to learning (Hess & Frantz, 2014). An approach to learning basically reflects the strategies adopted by students during learning processes and when taking up learning tasks (Biggs, Kember & Leung, 2001; Vermunt & Vermetten 2004). Conceptually, the definition of learning approach by Smith (2008) was based on the three learning dimensions: cognitive, affective, and physiological dimensions. He saw these as indicators reflecting learners' perception about, interactions with, and response to the learning environment. Basically, a learner's cognitive style involves information-processing characteristics of an individual, which include modes of thinking, perceiving, problem solving, and remembering. The affective style reflects an individual's motivational processes such as modes of arousing, directing, and sustaining behaviour. The physiological style involves an individual's modes of responses established based on differences and reactions to the physical environment. Different individual learners have different preferred approaches to their learning.

Learning approaches typically indicate adopted ways in which learners perceive, process, store, and recall what they are trying to learn (Hess & Frantz, 2014; Liew, Sidhu & Barua, 2015; Lujan & DiCarlo, 2006). Kharb, Samanta, Jindal and Singh (2013:1089) have established that "learning approaches are preferred methods of learning adopted by students in attaining, analysing and interpreting their knowledge." Cekiso et al. (2015) describe the concept as an individualism

characteristic and preferred way of gathering, organising and thinking about information. Thus, for effective teaching and learning to take place and for students to benefit from the learning opportunities, teachers should be aware of students' preference of learning styles and ability to solve problems (Cassidy, 2004; French, Cosgriff & Brown, 2007; Hess & Frantz, 2014). However, students in the same class might have different learning approaches. Researchers identified the three main approaches to learning as surface approach, deep approach and strategic approach (Baeten et al., 2016; Entwistle, Tait & McCune, 2000; Kharb et al., 2013; Liew et al., 2015). Students who prefer and adopt the deep approach to learning are referred to as learners with meaning orientations as they are motivated by an interest in the learning contents and an intention to understand (Baeten, Kyndt, Struyven & Dochy, 2010). Baeten et al. (2016:45) reported that "students adopting a deep approach use deep learning processes (e.g. relating ideas, using evidence and seeking meaning in order to reach understanding)." This learning approach involves use of evidence, relating of ideas, and comprehension learning. The deep approach to learning allows students to actively employ strategies that help to relate their own ideas to the learning principles and they are able to monitor their own level of understanding (Liew et al., 2015; Nuzhat, Salem, Mohammad & Al-Hamdan, 2011).

On the other hand, students who adopt surface approach to learning are referred to as students with reproducing orientation (Baeten et al., 2010; Williamson & Watson, 2007). Students in this category mostly learn by rote memorisation due to fear of failure (Baeten et al., 2010; Williamson & Watson, 2007). Wong (2015:2) has reported that "students are also characterized [*sic*] as rote learners under the examination-oriented education system." These students exhibit extrinsic motivation, which is accompanied by a narrow-bound syllabus attitude (Baeten et al., 2010; Williamson & Watson, 2007). In this approach, students learn by memorizing concepts and tasks because their main intention is to complete any required task and pass out of the programme (Liew et al., 2015; Nuzhat et al., 2011; Williamson & Watson, 2007).

Furthermore, some students adopt the strategic approach to learning. In this case, students are achievement-oriented. Baeten et al. (2016:46) have reported that "students with a strategic approach are stimulated by the need for achievement and are aware of the study requirements and try to accomplish them by using organised study methods." In this approach, "students aim to achieve the highest scores possible; this involves good time management and study organization [*sic*]; hence, they pay more

attention to the content as well as assessment requirements" (Liew et al., 2015:2). Entwistle (2000) found that the strategic approach is associated with improved academic performance when compared to other learning approaches.

Students studying electrical/electronics technology could wholly or partly adopt the characteristics of one or more of these learning approaches, which could impact their learning and achievement in school. Gadelrab (2011) found a relationship between approaches to learning and measures of student learning (e.g. grade), which could be used as evidence of the predictive validity of the approaches to learning instruments. Biggs et al. (2001) found a relationship between students' quality of learning and approaches to learning in higher education. Biggs et al. (2001) reported that a deep approach to learning is related to high quality of students' learning, while surface learning is associated with poor learning outcomes. Studies found positive correlations between strategic approach and students' achievement (Byrne, Flood & Willis, 2002) but a negative correlation between the surface approach and achievement (Booth, Luckett & Mladenovic, 1999).

Among the three approaches to learning, a deep approach is predicted to be most suitable for learning in a technology-aided learning environment, due to the possibility of student's participation in facilitating their own knowledge and the level of interactivity, which the method provides. Baeten et al. (2016:46) reported that "deep approach was positively associated with a preference for teaching that facilitated learning, such as open questions in examinations and discussions in tutorials." Mostly "students with deep approach preferred interactive teaching methods, small-group tutorials and discussion groups" (Baeten et al., 2016:46; Chamorro-Premuzic, Furnham, Christopher, Garwood & Martin, 2008). Other studies found that deep approach is related to preference for teaching methods that enhance interactivity and learning facilitation (Chamorro-Premuzic et al., 2008), and support clear understanding (Byrne, Flood & Willis, 2004). Also, certain studies, which focused on the relationship between instructional preferences and approaches to learning, indicated a positive and strong relationship between deep approach and preference for teaching styles which support and facilitate understanding (Baeten et al., 2016; Byrne et al., 2004; Papinczak, 2009). However, adoption of any of the three approaches to learning could be influenced by students' interest and or attitude to learning especially when a new medium such as technology is being used for instructional delivery.

Students' Attitude to Learning with Technology

Students' attitude and perception is a very important factor, which could, to a large extent, determine whether a student will learn or not. Baeten et al. (2016:46) established that "the way in which students perceive a learning environment influences their approach to learning and their learning outcomes more than the learning environment itself." Thus, the testing of hypotheses on the relationship between students' instructional preferences and attitudes towards technology-aided learning environment would be useful along with the relationship between students' approaches to learning and their attitudes towards technology-aided learning environment. Investigation into students' instructional preferences could help in explaining students' learning in the technology-aided learning environment.

The emergence of a new learning environment with technology could interfere with students' established learning preferences and approaches and their usual learning environments. There is a tendency for a new attitude to be formed in the learners. Students' attitudes have been studied in various ways. Some studies collected data on students' attitude through questionnaire, which has become a standardised instrument for measuring attitude while others conducted interviews and observational studies (Crocker & Algina, 2008; Lovelace & Brickman, 2013; Pierce et al., 2007). Students' attitudes vary from one factor to another. These include attitude towards the technology-aided learning environment, the subject, teaching technique used, the general learning environment, the teacher among other things (Vale & Leder, 2004).

In relation to a technology-aided learning environment, Vale and Leder (2004) describe students' attitude towards use of technology for learning as the degree to which students perceived that the use of computers and other technologies in the subject provides relevant information, aids their learning and contributes to their achievement in the subject. Similarly, in explaining students' confidence with technology, Vale and Leder (2004) described their attitudes as a perception of their self-efficacy and aspiration to achieve in their disciplines. This points to the fact that the students involved will require and use a variety of technology in their subject areas. Based on subject confidence, Vale and Leder (2004) described students' attitudes as the perceptions of their aspiration to achieve in the disciplines. However, Pierce et al. (2007) have restricted the meaning of the term 'subject confidence' to students' perception of their ability to attain good results and their assurance that they can handle difficulties in the subject.

Review of students' affective and behavioural engagements has revealed that such engagement is multifaceted with three components, which include behavioural engagement, emotional engagement, and cognitive engagement (Fredricks, Blumenfeld & Paris, 2004). Behavioural engagement describes students' conduct at school, their involvement in learning tasks, and participation in all school-based activities. Emotional engagement involves affective reaction of students to school and classroom activities. These include happiness or boredom, and sense of belonging. Cognitive engagement involves psychological investment in learning or cognition and strategic learning (Heikkilä & Lonka, 2006; Heikkilä et al., 2011).

Our study focused on student learning of the subject matter, and instructional engagements, which are cognitive-inclined. The study was intended to measure how electrical/electronics technology students feel about the subject (affective engagement) and how they behave during the learning process (behavioural engagement). This is in line with the instrument adopted for data collection in the study, developed by Pierce et al. (2007). Students' attitude could be measured through their performance, which is a function of their attitude as well as that of their instructional preferences and approaches to learning. Pierce et al. (2007), while developing students' attitude scale towards technology, carefully identified and analysed the various aspects of students' attitude which include students' attitudes towards the subject, confidence with technology, use of technology for learning, affective and behavioural engagements.

Finally, the relationship between the variables of this study was investigated in a technology-aided learning environment. Tempelaar, Rienties, Van der Loeff and Giesbers (2010) and Vermunt and Vermetten (2004) have revealed that studies are still ongoing in examining students' learning styles and preferences in different learning environments, such as a blended-learning environment and student-centred environment. However, this study intended to improve literature on the subject by examining the variables in a technology-aided learning environment among electrical/electronics technology students in Nigeria.

Research Questions and Hypotheses

The background to the study established the necessity for investigating students' instructional preferences and approaches to learning, specifically in a technology-aided learning environment. Continuous improvement in students' learning environment may have effect on their choice of learning preferences and a new approach may be adopted due to the newness of the learning environment. The imperatives of investigating the approach students adopted whether it suits the demands of a technology-aided learning environment forms the basis for this study. More importantly, the interrelationship between the variables under study defines the purpose of the study. The relationship between specific instructional preferences and approaches to learning in this study would help in justifying why all learners would not prefer the same learning environment. Thus, the main purpose of this study was to determine electrical/electronics students' instructional preferences, attitude and approaches to learning in a technology-aided learning environment and the following questions guided the study:

1. What are the instructional preferences of electrical/electronics students in a technology-aided learning environment?
2. What are electrical/electronics students' approaches to learning in a technology-aided learning environment?
3. What attitudes do electrical/electronic students' exhibit towards learning in a technology-aided learning environment?

Hypotheses tested are threefold:
1. There is no significant relationship between students' instructional preferences and approaches to learning in a technology-aided learning environment.
2. There is no significant relationship between students' instructional preferences and their attitudes towards learning in a technology-aided learning environment.
3. There is no significant relationship between students' approaches to learning and their attitudes towards learning in a technology-aided learning environment.

Method
Participants
The participants were 339 third- and final-year students of electrical/electronics technology programme from 18 universities across the country. In Nigeria, there are 18 universities that offer electrical/electronics technology as an option in the technical education programme, which is a teacher education programme. Students who are in the third and final year of the programme are 366 among which 339 (92.62%) responded to the instrument administered for data collection during the study. The programme being a professional teacher education programme, the students in the third year ($n = 192$; 56.64%) have been trained to participate in the regular teaching practice exercise at the end of the session; while those in their final year (147; 43.36%) have just resumed from the teaching practice exercise (see Table 1). Table 1 shows that most of the participants are in the third year of the programme (300 Level: $n = 192$, 56.64%; 400 Level: $n = 147$, 43.36%) and that the study had more male ($n = 282$; 83.2%) participants than females ($n = 57$; 16.8%). More male participation may be due to the effect of the general belief that electrical/electronics technology being an engineering/technology-based programme should be male-dominated, hence, more male students

enrolled for the programme. Most of the students in the programme fall within the age range of 20–25 years (n = 196, 57.8%), followed by 26 years and above (*n* = 84, 24.8%); while others are below 20 years (*n* = 59, 17.4%). The income status analysis revealed that parents of most of these students have monthly income level of about 26,000 naira. The sample in the study is representative, as only few students on the programme in the country did not participate. The participation of the students was both voluntary and anonymous.

Table 1 Demographic information of electrical/electronics technology students

Characteristics	Classification	*f*	Percentage (%)
Level	300	192	56.64
	400	147	43.36
Gender	Male	282	83.2
	Female	57	16.8
Age range	Below 20 years	59	17.4
	20–25 years	196	57.8
	26 years/above	84	24.8
Income status of parents in Naira (#)	Below 18,000	44	13.0
	18,000–25,000	36	10.6
	26,000–50,000	150	44.2
	51,000/above	109	32.2

Design

The study is a cross-sectional study. Third and final year electrical/electronics technology students were involved. A questionnaire package containing three different scales (instructional preference question-naire, questionnaire on approaches to learning and students' attitude questionnaires) was administered to the participants on the same spot at the same time.

Instrument

The instructional preference scale used in this study was extracted from the final version of the Learning Style Orientation Inventory developed by Towler and Dipboye (2003). Three out of the five assessment and instructional methods from the scale were adapted for the study. These include discovery as teacher direction, group as cooperative learning, and experiential as knowledge con-struction. The adapted instructional preference scale consists of 26 items rated on a four-point scale ranging from strongly agree to strongly disagree (scored from 4 to 1). The items were rephrased to suit instructional preference measure-ment in a technology-aided learning environment. A reliability coefficient of 0.76 was obtained through Cronbach's alpha technique during determination of the internal consistency of the instrument.

The instrument used for measuring app-roaches to learning is the most recent revision of Approaches and Study Skills Inventory for Students (ASSIST) developed by Entwistle (2000) and adopted by Gadelrab (2011). The questionnaire identifies the deep, surface and strategic approaches for learning among which students could adopt. The instrument possesses appropriate psychometric properties for the three-factor struc-ture. The instrument was structured on a four-point scale ranging from strongly agree to strongly disagree (scored from 4 to 1). The internal consistency of the instrument was established with a Cronbach alpha reliability coefficient of 0.79.

The instrument used for measuring students' attitude towards learning in a technology-aided learning environment was adapted from the developed scale by Pierce et al. (2007). The instrument consisted of 27 items developed around five subscales. These scales include subject confidence, confidence with technology, attitude to learning with technology, affective engagement, and behavioural engagement. The instrument was a five-point Likert type scale which range from always to hardly ever (scored from 5 to 1). A reliability coefficient of 0.91 establishes the internal consistency of the instrument in measuring the construct.

Students indicated their level of agreement and occurrences of different behaviours as provided in the questionnaire for the study. These three instruments were used in determining electrical/ electronics students' instructional preferences, attitude and approaches to learning in a technology-aided learning environment in Nigeria.

Results

Research Questions: What are the Instructional Preferences, Approaches to Learning and Attitudes of Electrical/Electronics Students Towards Learning in a Technology-Aided Learning Environment?

Table 2 presents the descriptive statistics of students' instructional preferences, approaches to learning and attitude towards learning in a tech-nology-aided learning environment. The table shows that students in electrical/electronics technology programme most prefer teacher-di-rection learning. Students' preference for knowledge construction is next, while preference for cooperative learning is the least. Higher preference for teacher-directed learning may be due to the fact that students are used to this teaching style, having been taught the same way right from

their primary school days, and have therefore been acquainted with the method. However, a very small mean difference between the three instructional preferences may suggest students' gradual adjustment to new learning preferences which may be considered more suitable for learning in a technology-aided learning environment. Based on approaches to learning, Table 2 shows that students highly prefer and adopt deep approach to learning. The next preferred approach to learning is the strategic approach while students' preference for surface approach is the least. With regard to

students' attitudes towards learning in a technology-aided learning environment, Table 2 shows that students rated subject confidence highest, followed by behavioural engagement. However, students scored lowest on confidence with technology, use of technology for learning and affective engagement. The table apparently shows that students are relatively unfamiliar with the use of technology in the classroom, which seems to negatively affect their attitude towards its application to teaching and learning activities.

Table 2 Descriptive statistical analysis of students' instructional preferences, approaches to learning and attitude towards technology-aided learning environment

	Overall	Level		Gender	
Scale	*M/SD*	Third (*M/SD*)	Final (*M/SD*)	Male (*M/SD*)	Female (*M/SD*)
Teacher direction	3.05 (.98)	2.98 (1.06)	3.09 (.92)	3.10 (1.00)	3.00 (.96)
Knowledge construction	2.97 (.93)	2.91 (.97)	3.00 (.87)	2.95 (.95)	3.02 (.90)
Cooperative learning	2.91 (1.06)	2.94 (1.07)	2.85 (1.10)	2.94 (1.09)	2.89 (1.03)
Deep approach	3.20 (.91)	3.14 (.92)	3.25 (.90)	3.33 (.95)	3.07 (.89)
Strategic approach	3.06 (1.01)	3.08 (1.05)	3.03 (.98)	3.09 (1.30)	3.03 (1.00)
Surface approach	3.05 (1.02)	3.09 (1.00)	3.02 (1.04)	2.99 (1.02)	3.11 (1.03)
Subject confidence (SC)	3.50 (1.57)	3.44 (1.67)	3.56 (1.49)	3.67 (1.55)	3.44 (1.58)
Behavioural engagement (BE)	3.02 (1.46)	3.04 (1.48)	3.01 (1.44)	3.04 (1.43)	2.99 (1.50)
Use of technology for learning (UTL)	2.82 (1.47)	2.78 (1.55)	2.86 (1.38)	2.82 (1.41)	2.82 (1.53)
Affective engagement (AE)	2.73 (1.45)	2.68 (1.40)	2.78 (1.50)	2.76 (1.49)	2.71 (1.41)
Confidence with technology (TC)	2.69 (1.46)	2.69 (1.47)	2.70 (1.45)	2.80 (1.54)	2.61 (1.38)

Table 3 Pearson correlation between instructional preferences and approaches to learning

Instructional preferences	Correlation with approaches to learning		
	Surface	Deep	Strategic
Teacher direction	.59**	.46**	.65**
Cooperative learning	.43**	.63**	.58**
Knowledge construction	.46**	.66**	.44**

Note. **$p < 0.01$ (2-tailed).

There is No Significant Relationship Between Students' Instructional Preferences and Approaches to Learning in a Technology-Aided Learning Environment

Table 3 presents the correlation analysis of students' instructional preferences and approaches to learning. Table 3 shows a significant relationship between students' instructional preferences and approaches to learning. Students who adopted a surface approach have a higher degree of preference for teacher-directed learning, but a lower degree of preference for cooperative learning and knowledge construction. However, students who adopted a deep approach to learning have a stronger degree of preference for knowledge construction and cooperative learning; but a lower degree of preference for teacher-directed learning. This indicates a reverse relationship between adoption of deep approach and surface approach to learning. Furthermore, students who adopted a strategic approach to learning have a stronger preference for teacher direction and cooperative

learning, but a lower preference for knowledge construction. Hence, H_1 was rejected. Thus, there is a significant relationship between students' instructional preferences and approaches to learning in a technology-aided learning environment.

There is No Significant Relationship Between Students' Instructional Preferences and Their Attitudes Towards Learning in a Technology-Aided Learning Environment

Table 4 presents the correlation analysis of instructional preferences and attitude towards learning. Table 4 shows a significant relationship between students' instructional preferences and attitude towards learning. Students with the three instructional preferences exhibited very low subject confidence especially with knowledge construction. Students with a preference for cooperative learning and teacher-directed learning score higher in confidence with technology except those who have preference for knowledge construction. Moreover, students with a preference for cooperative learning

and teacher-directed learning score higher in the use of technology for learning, affective engagement, and behavioural engagement, with the exception of those students with preference for knowledge construction who score low in all. Hence, H_2 was rejected. Thus, there is a significant relationship between students' instructional preferences and their attitudes towards learning in a technology-aided learning environment.

There is No Significant Relationship Between Students' Approaches to Learning and Their Attitudes Towards Learning in a Technology-Aided Learning Environment

Table 5 presents the correlation analysis of approaches to learning and attitude towards learning. Table 5 shows a significant relationship between students' approaches to learning and attitude towards learning. Students with strategic and deep approach have better subject confidence than those with surface approach. Also, students with strategic approach have better confidence with technology than others. Students with the three instructional approaches do not have better attitude towards the use of technology for learning. On the other hand, students with a strategic approach had better affective engagement, while students with surface and deep approaches to learning have lower affective engagement. Finally, students who adopt a strategic and surface approach have better behavioural engagement than those with deep approach. Hence, H_3 was rejected. Thus, there is a significant relationship between students' approaches to learning and their attitudes towards learning in a technology-aided learning environment.

Table 4 Pearson correlation between instructional preferences and attitude towards learning

Instructional preferences	Correlation with attitude to learning				
	Subject confidence	Confidence with technology	Use of technology for learning	Affective engagement	Behavioural engagement
Teacher direction	.38**	.52**	.50**	.54**	.64**
Cooperative learning	.34**	.68**	.60**	.61**	.62**
Knowledge construction	.17**	.35**	.25**	.35**	.32**

Note. **$p < 0.01$ (2-tailed).

Table 5 Pearson correlation between approaches to learning and attitude towards learning

Approaches to learning	Correlation with attitude to learning				
	Subject confidence	Confidence with technology	Use of technology for learning	Affective engagement	Behavioural engagement
Surface	.39**	.47**	.36**	.43**	.50**
Deep	.55**	.36**	.32**	.49**	.46**
Strategic	.58**	.53**	.49**	.64**	.67**

Note. **$p < 0.01$ (2-tailed).

Discussion

This study focused on determining and understanding electrical/electronics students' instructional preferences, approaches to learning and attitude to learning in a technology-aided learning environment. The finding of this study on instructional preferences revealed students' higher preference for teacher-directed learning. This simply shows that students still require teachers' assistance and some level of support in their learning process. In support of this, Baeten et al. (2016:56) found that "student teachers themselves still preferred teacher direction (e.g. a teacher summarising the basic thoughts at the end of a theme or chapter or teaches learning strategies that contribute to understanding the subject matter)." In further corroboration, Soliman (2016) reported that teachers are crucial to the delivery of learning content in the classroom. Also in agreement, Wilson (2011) submitted that students would prefer teacher-oriented learning where important points are presented in a lecture, they copy teachers' notes, and the teacher performs experiments, or

demonstrate for them to observe. Also, Evans and Waring (2006) submitted that teachers mostly use an approach, which basically transmits information to their students. Thus, most students seem to be used to a teaching method where teachers expound on the subject matter. This being the case, teachers could be engaged to a greater extent in the learning facilitation in a technology-aided learning environment to provide support, structure, and guidance. However, students' existing – though lower degree of preference – for knowledge construction and cooperative learning supports the findings of De Corte (2000) and Mayer (2004), who have argued that students want to be actively involved in their learning according to constructivist approach which allows students to participate in their education process. Furthermore, B Chang and Chen (2010) and Furrer, Skinner and Pitzer (2014) have demonstrated support for students' interest in a learning environment, which features personal knowledge construction and cooperative learning. Since teachers and teacher educators are considered key factors in promoting active learning (Niemi,

2002), Heikkilä et al. (2012) implied that teachers who are working in new activating learning environments ought to learn how to actively regulate their own learning and be able to support students' learning and also foster students' self-regulatory skills.

Students adopted a deep approach to learning ahead of strategic and surface approach. The features of the technology-based learning environment may have facilitated the adoption of this approach to learning in such environment. In line with this, Baeten et al. (2016) also found that students adopted a deep approach to learning. Gijbels, Van de Watering, Dochy and Van den Bossche (2005) showed that second-year law school students had slightly higher scores for deep approach than for surface approach to learning. Aside from the adoption of the deep approach, Baeten et al. (2016) found as well that students also adopt other methods. This agrees with the views of Hess and Frantz (2014), and Lujan and DiCarlo (2006), that students' choice of learning approach is dependent on the ways in which the learners perceive, process, store and recall what they are trying to learn. Also, Kharb et al. (2013) and Liew et al. (2015) have accepted that students adopt learning approaches for attaining, analysing and interpreting their knowledge. However, Biggs et al. (2001) revealed that an individual student's approach to learning reflects the intention of such student when starting a task and the learning processes and strategies used to carry out the task.

The attitude of students to learning in a technology-aided learning environment shows good subject confidence, and fairly good behavioural engagement, but poor confidence with technology, use of technology for learning, and affective engagement. In this regard, Vale and Leder (2004) submitted that attitude towards the use of technology for learning depends on the extent to which students believe that its use in the subject will provide relevant information, support learning, and aid achievement in the subject. Moreover, Fredricks et al. (2004) reflected students' attitude based on behavioural engagement as school conducts, learning involvements, participation in school-related activities, and academic tasks; while affective engagement involves reaction to all school activities including interest, happiness, or boredom, and feelings of belongingness; all of which may determine student's readiness for learning, even with the use of technology. Covington (2000) affirmed the main factors influencing learning and achievement in courses to be attitude and motivation. Many researchers have established the effect of students' attitudes on learning (Adeyemo, 2012; Busari, 2006; Osborne, 1976; Schibeci, 1989; Schibeci & Riley, 1986; Weaver, Houneshell & Coble, 1979). However,

these studies maintain that attitudinal change is related to learning and achievement.

There are significant relationships between students' instructional preferences and approaches to learning. In this regard, Gadelrab (2011) found a relationship between approaches to learning and measures of student learning which is as a result of learning preference. Biggs et al. (2001) found a relationship between approaches to learning in higher education and quality of student learning, where a deep approach was found to be associated with high quality student learning; whereas surface learning was found to be related to poor learning outcomes. Also, positive correlations between a strategic approach and achievement have been found (Byrne et al., 2002), as well as negative ones between the surface approach and achievement (Booth et al., 1999). In this study, students who adopted a surface approach with higher preference for teacher-directed learning may simply not be interested in getting more information than provided by the teacher; while students who adopted a deep approach to learning with stronger preference for knowledge construction and cooperative learning may reflect a need for more information about each concept been taught. However, students who adopted a strategic approach to learning with a stronger preference for teacher direction and cooperative learning may be a way of getting assistance and appropriate information from every available quarter to improve their academic achievement rather than depending on personal knowledge development.

There are significant relationships between students' instructional preferences and attitude towards learning and also between students' approaches to learning and attitude towards learning. The analysis of Gijbels et al. (2005) shows that students' attitude to some extent explains their preferences and approaches to learning when it involves understanding of concepts; principles that link concepts; linking of concepts and principles; and application conditions and procedures. The correlation analysis of Gijbels et al. (2005) showed a significant relationship between students' approaches to learning and attitude. The study of Adeyemo (2012) revealed that learning environment influences students' attitude with a significant relationship established between students' approaches to learning and attitude to learning. In this study, students' low subject confidence especially with knowledge construction seem to explain the inability of students to effectively handle and utilise technologies in the new learning environment to establish new knowledge. Students with a preference for cooperative learning and teacher-directed learning who scored higher in confidence with technology may be a function of cooperative brainstorming on

how to navigate and utilise those available technologies, as well as the dependence on the teachers for a guide on the applications of those technologies for learning. This may influence their use of technology for learning, affective engagement and behavioural engagement. Furthermore, students with strategic and deep approach, who have better subject confidence than those with surface approach, may result from the improved effort for better academic achievement, and deeper knowledge of the subject, respectively. However, students with the three instructional approaches who do not have better attitude towards the use of technology for learning may be as a result of the newness of the approach to students for carrying out teaching and learning activities.

The results on learning environments and students' preferences, approaches and attitude to learning involved associations between students' cognitive and affective learning outcomes and their perceptions of psychosocial characteristics of their classroom environments (Aldridge et al., 2009). Moreover, this is in line with the emerging world economy, schools are required to present learners with realistic learning outcomes, which will facilitate easy integration into the present economic dispensation (Aldridge et al., 2009; Fisher & Khine, 2006; Fraser, 2007; Khine & Fisher, 2003). In essence, both school management and teachers should go beyond imparting knowledge which is not applicable to the present competitive economic practices, which rendered past graduates jobless (Kongolo & Imenda, 2012). The new world economy requires innovative and creative human resources that can use technological applications optimally for productive advancement of the economy at all levels apart from identifying problems and creatively providing solutions to them (Hartley & Treagust, 2006). Thus, the expectation of society when it comes to higher education institutions is to produce graduates who would participate in, resuscitate and improve the dwindling and unstable national economy. Hence, teachers need to improve on learning delivery system by ascertaining and identifying students' learning styles, which may enhance the selection of appropriate instructional methods and educational options, and thereby improve students' attitude towards learning (Cekiso, 2011; Cekiso et al., 2015; Paulraj et al., 2013).

Conclusion
The study concluded that students have greater preference for teacher-directed learning than others, and adopted a deep approach to learning. However, their attitude towards learning in a technology-aided learning environment seems to be influenced by technology with reference to subject confidence, confidence with technology, use of technology for learning, and affective and behavioural engage-

ments. Furthermore, there exists relationships between students' instructional preferences and approaches to learning; instructional preferences and students' attitudes towards learning; and students' approaches to learning and attitudes towards learning in a technology-aided learning environment. These results have implications for students' instructors as well as the students. Instructors would be aware of students' preferred learning preferences and attitudes, and so could package and facilitate students' learning using styles or strategies that appeal to their interests. These will aide effective teaching, maximum learning and improved academic achievement, and hence, the achievement of learning objectives. Meanwhile, students, for their own part, would identify and understand their choice of learning preferences, which could assist them in determining and selecting the best suitable learning strategy. Thus, they would be actively involved in enhancing their learning in a more efficient and effective learning environment such as a technology-aided learning environment.

Recommendations
Based on the findings of this study, it was recommended that:
1. Full integration and use of technological facilities should be adopted for teaching in higher institutions, especially those who are involved in training prospective teachers to promote technology-aided learning environment.
2. A deep approach to learning should be encouraged among students to allow appropriate understanding of learning contents.
3. Learning strategies employed by teachers should promote students' active involvement in their learning process by engaging the learners as well.
4. Extensive use of appropriate and relevant technological facilities should be ensured in the training of prospective electrical/electronics technology teachers, most importantly to make the lessons more realistic such that they may adopt the same while practicing their career later in life.
5. Technology should be used in aiding students' interest and improving their attitudes towards learning.

Note

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