



Enhancing Pre-Service Teachers' Acceptance and Deployment of Computer Assisted Instruction using Intelligent Tutors in Electrical Technology Education: A Litmus Test of Technology Acceptance Model

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ABSTRACT

This paper surveyed the acceptability of Computer Assisted Instruction (CAI) among pre-service teachers in Colleges of Education (Technical) in North East, Nigeria. The aim is to ascertain the compliance and sustenance of usage of CAI in classroom instruction among the pre-service teachers, who would in turn become the implementers of the dream of transforming the nation to the computer compliant one. The study adopted a Quasi-experimental research design. The population of the study was 66 NCE III 2021/2022 students and Electrical and Electronics Programme in Federal College of Education (Technical) Potiskum and Federal College of Education (Technical) Gombe. Three research questions and three null hypotheses guided the study. The instrument, Achievement Test for Electrical Machines (ATEM), was then incorporated into the CAI using an Intelligent Tutor (IT). Data collected from the trial test of the Intelligent Tutor was analyzed using two-tail z-test for test of significance between the responses of Electrical/Electronic students taught Electrical Machines using Intelligent Tutor and those taught with conventional method. The findings of the study showed the Intelligent Tutor group outperformed the conventional method group among others. It was recommended among others that, since the Intelligent Tutor group has better achievements than the conventional method group, lecturers from Colleges of Education should make adjustment and employ the use the CAI in their lessons.

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INTRODUCTION

Computer-Aided Instruction (CAI) has come to stay as a means of assisting instructional delivery, education in general and technical education. Currently, most students get instructional information via electronic gadgets. The use of computer in instruction is one of the

popular ways of learning today. Computer Aided Instruction according to Tabassum (2004) is an interactive technique whereby a computer is used to present the instructional material and track down learning that takes place. CAI uses a combination of text, graphics, sound and video in the learning process.

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Nwoji (2013), defined CAI as an instructional strategy that can be integrated into a particular subject with respect to the pedagogical areas of learning where other strategies are failing to achieve. To perform a task that is done by human beings requires intelligence in the form of a software application which is typically provided by a rule-based expert system.

A software application or package is a set of related programs that achieve a particular task, such as Microsoft Office (word processor), Statistical Package for Social Sciences (SPSS), word star, spreadsheet, graphic package, Matlab or a web application program which are sold and used as a single unit program. According to Sarrafzadeh, Alexander, Dadgaster and Bingdeli (2008), programs are developed in the form of a collection of instructions that control the functionality of the computer to achieve a single purpose in learning. The software that can achieve instructional delivery with little or no involvement of the teacher is known as Intelligent Tutor (IT), Hassan, 2018.

Intelligent Tutor lessons are presented to the students in the order specified by the teacher in the instruction module (Schiaffino, Garcia & Amandi 2008). An instructional module is inbuilt in a program in the form of artificial intelligence system. According to D'Mello, Olney, Williams and Hays (2012), an Intelligence Tutoring System (ITS) is a software that consists of four component-based models, namely, domain, student, tutor, and user interface models such as waterfall model. A user interface provides communication between the student and the website using typing and reading from the screen. This is

necessary because most programmes use non-verbal techniques (that is, typing, clicking on buttons, and reading from the screen). Machines that can converse with students are clearly more flexible than those supporting more restrictive interaction modules. The intelligent tutoring system of instruction is obtainable in Web-Based Instruction.

Web-Based Instruction (WBI) encompasses the integrated design and delivery of instructional resources via the World Wide Web and promotes student engagement with text-based, hypermedia, multimedia, and collaborative resources for teaching and learning (Huang Yu, Hang, Tsai, Lee & Kuo, 2014). As Web technologies have evolved, the possible approaches to design and delivery have also expanded considerably. Edem (2012), stated that Web Based Instruction (WBI) can be used to perform basic support functions, such as the provision of a repository of student resources, including a course syllabus, assignments, and instructor notes. Noyes (2005), posited that when a client requests a static page, the server reads the request and finds the right page. The server then sends the requested page back to the client. The dynamic web pages led to a system program called application server. The application server reads the code on the page and finishes the page according to the instructions in the code. To DeMichillie (2015), the web server then sends this page back to the requesting browser. The instructions do not communicate directly with the database as a student is making a request. It uses a catalog driver that acts as an interpreter to receive information from the database (Mu, 2013). The main advantage of a web-

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based solution is that it is centralized, easy to update and deployment to the web application is platform independent. The only requirement is to have an internet connection. The ultimate test of a good technical skill is not how much factual information students can remember, but what technical skills they possess or can perform in a technical field of employment (Ogbuanya & Abdullahi, 2014). Even though the IT could improve students' understanding, it may not give them the full opportunity to manipulate and master the use of working tools and instruments such as multimeter, oscilloscope and other equipment which are involved in the real life troubleshooting, maintenance and repair of Electrical Machines. The IT can therefore be augmented with Think-Pair-Share (TPS) learning process for more effective understanding of Electrical Machines troubleshooting, maintenance and repair.

Research Questions

1. What is the mean achievement of students taught Principles of Operation in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor?
2. What is the mean achievement of students taught Troubleshooting in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor?
3. What is the mean achievement of students taught Repair and Maintenance in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor?

Research Hypotheses

- HO₁:** There is no significant difference between the achievement of students taught Principles of Operation in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor.
- HO₂:** There is no significant difference between the achievement of students taught Troubleshooting in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor.
- HO₃:** There is no significant difference between the achievement of students taught Repair and Maintenance in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor.

THEORETICAL FRAMEWORK

Technology Acceptance Model (TAM)

Technology Acceptance Model states that there are two factors that determine whether a computer system will be accepted by its potential users: (1) perceived usefulness, and (2) perceived ease of use. The key feature of this model is its emphasis on the perceptions of the potential user. That is, while the creator of a given technology product may believe the product is useful and user-friendly, it will not be accepted by its potential users unless the users share those beliefs. Technology Acceptance Model (TAM) is theory majorly in the information system. It focuses on modeling computer users and showing them on how they can accept and adopt a new technology. It was designed to predict the technology adoption decisions of users. The main aim of this model is

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that it emphasizes the potentials of the users. In other words, it underscores, for example, when a developer of a given technology believes that his/her system is friendly to the users.

Inversely, the system will not be accepted by the users unless the developers share the benefits and advantages of the technology system (Surendran, 2012).

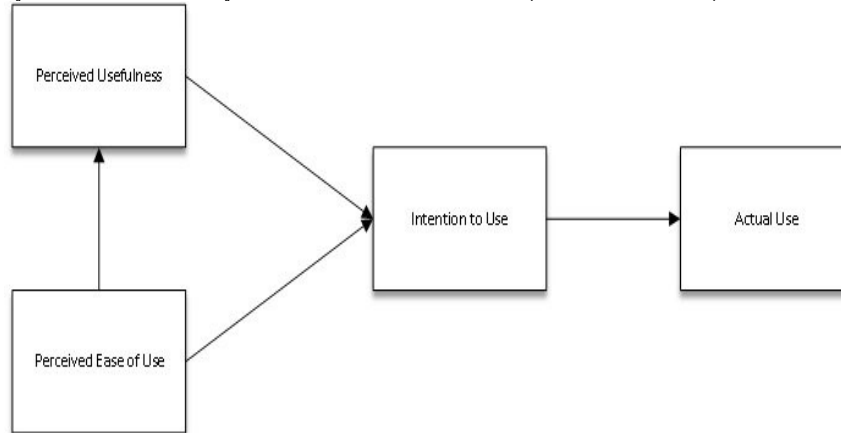


Figure 1: Technology Acceptance Model by Davis, 1993

The perceived usefulness component in Technology Acceptance Model is the degree to which a computer system user believes that using a particular computer system will enhance his or her performance (Yaacob & Saad, 2020). It usually refers to consumers' perceptions based on the outcome of their experience. The existence of perceived usefulness has significantly been recognized in many businesses, primarily in the banking sector, for example. In other occurrences, it is regarded and taken as a determinant of actual behavior whereby a user is encouraged to use an innovative and user-friendly self-service technology to improve and establish greater autonomy in performing some activities.

METHODOLOGY

The study adopted a Quasi-experimental research design. This study was carried out in North East Nigeria which consists of six states namely: Adamawa, Bauchi, Borno,

Gombe, Taraba and Yobe States. The region lies between longitudes longitude 4.92° North of the equator and latitude 6.26° East on the equator. The population of the study was 66 NCE III students of Electrical/Electronic Programme, 38 students from Federal College of Education (Technical) Potiskum and 28 students from Federal College of Education (Technical) Gombe, intact classes were used. The study employed the use of Achievement Test for Electrical Machines (ATEM).

The instrument was subjected to face and content validation by four (4) experts in the Colleges of Education. To establish the reliability of the instruments, ATEM was trial tested on NCE III students of Federal College of Education (Technical), Bichi, Kano State, which is not part of the study area. The data from the trial-test was computed using Pearson Product Moment Correlation, and a reliability index of 0.81 was achieved by the instrument.

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The pre-test instrument was a 30-item multiple choice question. The instrument was constructed by the researcher in accordance with the following selected topics based on the Nigerian Commission for Colleges of Education (NCCE, 2012) Minimum Standard: Principles of Operation of Electrical Machines, Troubleshooting of Electrical Machines, Repair and Maintenance of Electrical Machines.

The post-test was administered to the participants who had undergone treatment for the period of six weeks and the control group. The instrument carried the same questions as the pre-test instrument but the

numbering of the questions in the post-test instrument was reshuffled to avoid memorization of the answers by students and it was administered a week after the treatment.

The data for the study was collected and analyzed using Statistical Package for Social Sciences (SPSS) version 26. Mean and Standard deviation were used to answer the research questions.

RESULTS

Research Question One: What is the mean achievement of students taught principles of operation in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor?

Table 1: The mean achievement of students taught principles of operation in Electrical Machines using Intelligent Tutor and those in the Conventional Method Group

| Treatment group | N | Pretest mean | SD ₁ | Posttest mean | SD ₂ | Mean gain |
|-------------------|----|--------------|-----------------|---------------|-----------------|-----------|
| Intelligent Tutor | 28 | 35.89 | 4.44 | 72.32 | 13.50 | 36.43 |
| Conventional | 38 | 26.32 | 2.37 | 50.13 | 9.83 | 23.82 |

SD₁ = Standard Deviation for the pretest SD₂ = Standard Deviation for post-test

Table 1 shows that the treatment group that used the Intelligent Tutor in principles of operation of Electrical Machines had a pre-test mean score of 22.16 with Standard Deviation 4.44 and the post-test mean score of 73.80 with Standard Deviation of 7.50 making pre-test/post-test mean gain of up to 51.64. The group used the conventional class with a lecturer as a tutor had a pre-test mean score of 25.74 and standard deviation of 2.37

and post-test 43.85 with a standard deviation of 4.79 of mean gain 18.11. The treatment group was effective in improving students' achievement in learning principles of operation in Electrical Machines.

Research Question Two: What is the mean achievement of students taught troubleshooting in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor?



Table 2: The mean achievement of students taught troubleshooting in Electrical Machines using Intelligent Tutor and those in the Conventional Method Group

| Treatment group | N | Pretest mean | SD ₁ | Posttest mean | SD ₂ | Mean Gain |
|-------------------|----|--------------|-----------------|---------------|-----------------|-----------|
| Intelligent Tutor | 28 | 34.82 | 5.36 | 73.21 | 11.56 | 38.39 |
| Conventional | 38 | 26.84 | 4.20 | 46.45 | 7.25 | 19.61 |

SD₁ =Standard Deviation for the pretest SD₂ = Standard Deviation for post-test

Table 2 shows that the treatment group that were taught using the Intelligent Tutor in learning of troubleshooting of Electrical Machines had a pre-test mean score of 37.35 with Standard Deviation 5.36 and the post-test mean score of 79.97 with Standard Deviation of 13.00 making pre-test/post-test mean gain of up to 42.62. The group used the conventional class with a lecturer as a tutor had a pre-test mean score of 43.16 and standard deviation of 4.20 and post-test 76.35 with a standard

deviation of 7.10 and mean gain of 33.19. The experimental group was more effective in improving students' achievement in learning of troubleshooting in Electrical Machines.

Research Question Three: What is the mean achievement of students taught Repair and Maintenance in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor?

Table 3: The mean achievement of students taught Repair and Maintenance in Electrical Machines using Intelligent Tutor and those in the Conventional Method Group

| Experimental group | N | Pretest mean | SD ₁ | Posttest mean | SD ₂ | Mean Gain |
|--------------------|----|--------------|-----------------|---------------|-----------------|-----------|
| Intelligent Tutor | 28 | 33.75 | 5.36 | 75.71 | 15.85 | 41.96 |
| Conventional | 38 | 26.97 | 4.20 | 47.24 | 7.77 | 20.26 |

SD₁ =Standard Deviation for the pretest SD₂ = Standard Deviation for post-test

Table 3 shows that the Experimental group that used the Intelligent Tutor in learning of Repair and Maintenance of Electrical Machines had a pre-test mean score of 40.25 with Standard Deviation 5.36 and the post-test mean score of 78.33 with Standard Deviation of 9.00 making pre-test/post-test mean gain of up to 40.25. The group that used the

conventional class with a lecturer as a tutor had a pre-test mean score of 41.68 and standard deviation of 4.20 and post-test 54.25 with a standard deviation of 7.10 and a mean gain 12.57. The Experimental group was more effective in improving students' achievement in learning of Repair and Maintenance of Electrical Machines.

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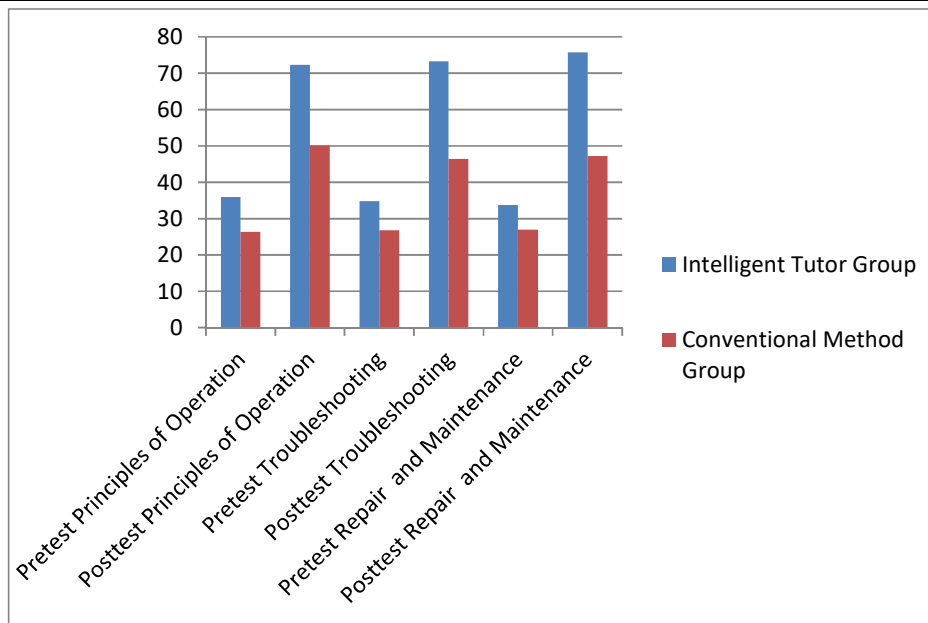


Figure 2: The Mean of Pre-test and Post-test of the Intelligent Tutor Group and the Conventional Method Group

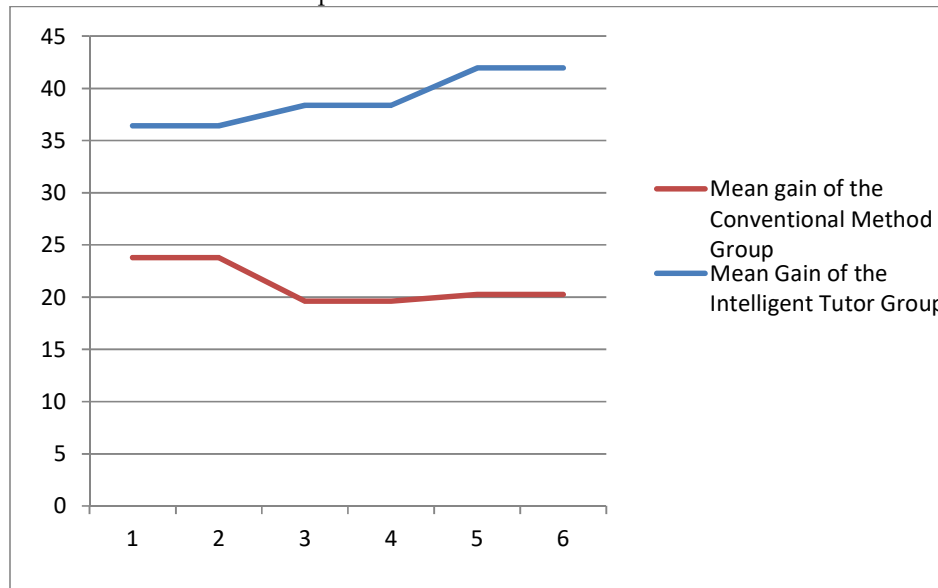


Figure 3: The Difference in Achievement between the Intelligent Tutor Group and the Conventional Method Group

Hypothesis One: There is no significant difference between the achievement of students taught Principles of Operation in Electrical Machines using Intelligent Tutor and

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those taught without the Intelligent Tutor.

Table 4: Two-tail z-test of difference between the Intelligent Tutor Group and Conventional Method Group on Principles of Operation of Electrical Machines

| Respondents | N | \bar{X} | SD | z-cal | z-crit | Decision |
|-------------------------|----|-----------|------|-------|--------|----------|
| Intelligent Tutor Group | 28 | 72.32 | 13.5 | 7.37 | ±1.96 | Rejected |
| Conventional Method | 38 | 50.13 | 9.83 | | | |

*Significant at z-crit ±1.96

From the result presented in Table 4, the Intelligent Tutor group has a mean 72.32 while its counterpart the Conventional Method group has 50.13, the z-calculated is 7.37 indicating significant difference between the two groups since the z-calculated is greater than the z-crit (±1.96). Thus, the null hypothesis is rejected and the alternate hypothesis which implies that a significant

difference existed between the two groups.

Hypothesis two: There is no significant difference between the mean achievement of students taught Troubleshooting in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor.

Table 5: Two-tail z-test of difference between the Intelligent Tutor Group and Conventional Method Group on Troubleshooting of Electrical Machines

| Respondents | N | \bar{X} | SD | z-cal | z-crit | Decision |
|---------------------------|----|-----------|-------|-------|--------|----------|
| Intelligent Tutor Group | 28 | 73.21 | 11.56 | 10.78 | ±1.96 | Rejected |
| Conventional Method Group | 38 | 46.44 | 7.25 | | | |

*Significant at z-crit ±1.96

From the Table 5 above, the Intelligent Tutor group has a mean 73.31 while its counterpart the Conventional Method group has 46.44, the z-calculated is 10.78 indicating significant difference between the two groups since the z-calculated is greater than the z-crit (±1.96). Thus, the null hypothesis is rejected and the alternate hypothesis which implies that a significant

difference existed between the two groups.

Hypothesis Three: There is no significant difference between the mean achievement of students taught Repair and Maintenance in Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor.

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Table 6: Two-tail z-test of difference between the Intelligent Tutor Group and Conventional Method Group on Repair and Maintenance of Electrical Machines

| Respondents | N | \bar{X} | SD | z-cal | z-crit | Decision |
|----------------------------------|----|-----------|-------|-------|--------|----------|
| Intelligent Tutor Group | 28 | 75.71 | 15.85 | | | |
| Conventional Method Group | 38 | 47.23 | 7.77 | 8.76 | ±1.96 | Rejected |

*Significant at z-crit ±1.96

From the result presented in Table 6, the Intelligent Tutor group has a mean 75.71 while its counterpart the Conventional Method group has 47.23, the z-calculated is 8.76 indicating significant difference between the two groups since the z-calculated is greater than the z-crit (±1.96). Thus, the null hypothesis is rejected and the alternate hypothesis which implies that a significant difference existed between the two groups.

FINDINGS OF THE STUDY

The following findings emerged based on the data collected and analysed:

1. Both the Intelligent Tutor and conventional method groups are effective in enhancing Think-Pair-Share in learning of Principles of Operation Electrical Machines, but the effect of that of the Intelligent Tutor is greater than that of conventional method.
2. Both the Intelligent Tutor and conventional method groups are effective in enhancing Think-Pair-Share in learning of Troubleshooting of Electrical Machines, but the effect of that of the Intelligent Tutor is greater than that of conventional method.

3. Both the Intelligent Tutor and conventional method groups are effective in enhancing Think-Pair-Share in learning of Repair and Maintenance of Electrical Machines, but the effect of that of the Intelligent Tutor is greater than that of conventional method.
4. There is a significant difference between the mean achievement of students taught Principles of Operation of Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor.
5. There is a significant difference between the mean achievement of students taught Troubleshooting of Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor.
6. There is a significant difference between the mean achievement of students taught Repair and Maintenance of Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor.

DISCUSSION OF FINDINGS

The discussions of the findings of the study were in accordance with the questions raised for the research. The findings to research question one revealed that

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the mean achievement of students taught Principles of Operation of Electrical Machines using Intelligent Tutor and those taught without the Intelligent Tutor, the result analysed on Table 1 showed that: a mean gain of 36.43 is achieved by the students taught principles of operation in Electrical Machines using Intelligent Tutor as in contrast with a mean gain of 23.82 by the students taught without the Intelligent Tutor and this affirmed the claim of Technology Acceptance Model of Fred Davis (1989), which is stated based on the two factors that determine whether a computer system will be accepted by its potential users. These factors are: (1) perceived usefulness, and (2) perceived ease of use. The key feature of this model is its emphasis on the perceptions of the potential user. That is, while the creator of a given technology product may believe the product is useful and user-friendly, it will not be accepted by its potential users unless the users share those beliefs. Technology Acceptance Model (TAM) is theory that focuses on modeling computer users and showing them on how they can accept and adopt a new technology. It was designed to predict the technology adoption decisions of users. Therefore, TAM's prediction of perceived usefulness and perceived ease of use is confirmed as seen in figure 3, the steady achievement increased by the students who were taught using the Intelligent Tutor as revealed by their pre-test/post-test result, meanwhile, the achievement of the Conventional Method Group attenuates at some points.

Finding on research question two revealed that the mean achievement of students taught Troubleshooting of Electrical

Machines using the Intelligent Tutor and those taught without the Intelligent Tutor, the result displayed on Table 2 showed that: a mean gain of 38.39 is achieved by the students taught troubleshooting of Electrical Machines using the Intelligent Tutor as in contrast with a mean gain of 19.61 by the students taught without the Intelligent Tutor.

Finding on research question three indicated that the mean achievement of students taught Repair and Maintenance in Electrical Machines using Intelligent Tutor and those in the Conventional Method Group, the result analysed on Table 3 showed that: a mean gain of 41.96 is achieved by the students taught Repair and Maintenance of Electrical Machines using Intelligent Tutor as in contrast with a mean gain of 20.26 by the students taught without the Intelligent Tutor. Based on the findings discussed, it was concluded that the Intelligent Tutor which was complemented with Think-Pair-Share cooperative learning process combining text, pictures, videos, external source (online) and pair discussions and group discussions is a reliable method for enhancing electrical/electronic students' learning of principles of operation, troubleshooting, repair and maintenance of Electrical Machines in colleges of Education (Technical) in North East, Nigeria knowledge which is vital for employment in post covid19 period, the era of "the new normal".

CONCLUSION

The study adopted a Quasi-experimental research design. The area of the study was North East, Nigeria. The population for this study comprises of 66 electrical/electronic

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NCE III students. The Instruments used for data collection were: Achievement Test for Electrical Machines (ATEM) with 30 multiple questions, three distracters were used alongside the right answer (A-D). The instruments were face and content validated by experts from universities, colleges of Education and Industries. The instruments were subjected to face and content validation by one (1) expert in the Department of Electrical Technology Education, Modibbo Adama University, Yola, and one (1) expert from the Department of Electrical Technology Education, Abubakar Tafawa Balewa University, Bauchi and two (2) experts from Federal College of Education (Technical) Potiskum. Data collected were analyzed using descriptive and inferential statistics. The mean gains were computed to determine the effectiveness of the tutor on the achievement test. Two-tail z-test was used to test the null hypotheses 1 to 3 at 0.05 levels of significance.

Conclusively, the rapid evolvement of emergencies ranging from man-made to natural disasters, electrical technology pre-service teachers needs to keep a pace with daily challenges so as to give their learners up to date knowledge and provide the country with the middle level skilled man power needed. Electrical/Electronic Technology, NCE graduates are facing enormous challenges and the best way to address these challenges is to equip them with a multiple means of engagement, multiple means of presentations and multiple means of expression and action which the IT is opt for. Various efforts were made towards improving electrical/electronic students' Electrical Machines skills however,

conventional efforts alone which are lacking in the utilisation of new instructional media, are only resulting to a mediocre outcomes. The present study experimented a Computer Assisted Instructional package in form of an Intelligent Tutor for enhancing TPS in learning of Electrical Machines. The findings revealed that both the Intelligent Tutor and conventional classroom method enhanced TPS in leaning of Electrical Machines, but the effect of the developed Intelligent Tutor package is greater than that of conventional classroom in terms of principles of operations, troubleshooting and repair and maintenance. Based on these findings, conclusion was drawn that the Intelligent Tutor which was complimented with TPS learning process combining text, pictures, animations, videos, pair and plenary sessions is a reliable method for enhancing students' achievement in learning of Electrical Machines which is necessary for employment in the era of competency based education and in turn development.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

1. Since the Intelligent Tutor group has outperformed the conventional method group, Electrical/Electronic lecturers from Colleges of Education in North East, Nigeria should make adjustment and employ the use of the Intelligent Tutor for their lessons. Research grants such as TETFund NRF, Bench-work and PTFDF should give priorities to scholars working on Intelligent Tutors and Artificial Intelligences in general to allow equal access

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- for learners from all angles of the country which would in turn harnesses the untapped resourcefulness of the citizens.
2. An intervention in form of Academic Staff Training/Development programme should be initiated by the Colleges of Education (Technical) in the North East, Nigeria to train existing Electrical/Electronic on the use of the Intelligent Tutor for enhancing TPS in learning of Principles of Operation, Troubleshooting, Repair and Maintenance of Electrical Machines.
 3. General usability of Intelligent Tutor in practical Electrical Machines troubleshooting, maintenance and repair should be undertaken by the Colleges of Education (Technical) in North East, Nigeria.

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