Effects of Innovative and Traditional Teaching Methods on Technical College Students’ Achievement in Computer Craft Practices

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Abstract
Recently, global trends in technological development have brought about innovations in educational paradigms, thus giving rise to significant adoption of learner-centered and problem-centered approaches with greater potential to impart the next generation of learners compared to a more dominant teacher-centered approach. In view of this, this study presents result of the effects of innovative pedagogy integration in computer craft practices among technical college students in Enugu State, Nigeria. Result shows that innovative pedagogies applied in teaching and learning of computer craft practices were more effective in enhancing learning outcomes than the conventional teaching method. Based on this, the study concludes that computing teachers should become more creative in their day-to-day teaching activities by adopting innovative teaching approaches that can make teaching and learning of computing studies more engaging to learners.

Keywords pedagogical issues, active learning strategies, interactive learning environments, improving classroom teaching, innovative teaching

Introduction
In today’s changing world, the teaching process continues to witness a paradigm shift from the traditional mode of teaching and learning to a more active but learner-centered approach capable of addressing learners’ 21st-century skill needs (Schleicher, 2012). According to Hoffmann and Koifman (2013), this shift places huge expectations on educators in possessing innovative teaching skills required to enable them to participate actively in the learning process. Perhaps, this accounts for the reason why the quality of teaching and learning is seen to be dependent on, to a large extent, the competence of the teacher which is measured in terms of theoretical and practical knowledge, pedagogical abilities possessed in using new and emerging information and communication technologies (African Union, 2007). Recent studies argued that there are newer innovative teaching approaches that could be added to the teaching repertoire, which could be used to enhance or complement the traditional teaching method (Bakare & Orji, 2019; Dhir et al., 2013; Naz & Murad, 2017; Olelewe et al., 2020; Orji, 2015; Orji & Ogbuanya, 2018, 2020; Rebecca et al., 2019).

Therefore, innovative pedagogy is perceived as a proactive approach to integrating teaching strategies and methods into classroom learning in more creative ways. The essence is to ensure that learners take full responsibility for their learning and actively pursuing their learning objectives. At the same time, the teacher acts as a facilitator toward achieving the stated learning objectives. According to Mandula et al. (2012), innovative pedagogy is a creative use of the right teaching methods and learning materials for students’ benefit. To achieve this implies effectively combining the right teaching and learning methodologies with materials to facilitate active technique that helps teachers develop students’ learning abilities. Innovative teaching practices is characterized by student-centered classroom, industry-based learning, project-based learning, facilitated peer-tutoring,
integrated studies, mind maps, role playing, audience response systems, and application of technology to promote 21st-century skills, among others (Dodewar, 2012; Neo & Neo, 2001; Sachou, 2014). Innovative pedagogy can be applied in a skill-oriented classroom setting in various ways, particularly in learning situations where technology is not readily available and schools lack sufficient teachers and instructional facilities required for skills learning.

According to Naz and Murad (2017), “the focus of innovative pedagogy is based on the trust that every learner has the capacity to learn and be successful” (p. 2). Hence, teachers should perceive each student as having unique personality characteristics that can be more polished by using innovative teaching strategies. Studies by Santos et al. (2019) have shown that innovative pedagogy increases students’ engagement, motivation, and critical thinking, thus giving them the reason to stay in school and complete their academic training. Perhaps, it can be argued that effective utilization of innovative teaching is key to achieving increased learner engagement and interest in the skills learning subjects such as computer craft and reducing incidence of school dropouts, truancy, and poor academic performance.

In Nigeria, computer education is offered at all levels of education. However, there are subtle differences with respect to the nomenclature associated with these levels of education. For instance, at primary and post primary school (conventional secondary schools) level, it is called computer studies whereas at technical college level it is offered as computer craft while at the tertiary level it is either offered as computer science or computer education. Computing education is therefore one of the vocational subjects which seek to equip the students with right skills and competencies required to use computers as an important office tool (FGN, 2004). According to Independent School Parent (n.d.), “the curriculum of computing education as a school subject encompasses three major strands namely information technology, digital literacy and computer science” (p. 1). Information technology focuses on processes involving the assembling of computer and its configuration to meet the user’s needs. On the contrary, digital literacy, according to The Royal Society (2012, p. 17), emphasizes “the skill or ability to use a computer effectively including the ability to use various application software packages such as word processors, email and presentation software, and the ability to use a web browser and internet search engines.” Digital literacy also includes understanding the morality and ethics of the personal and societal implications of digital technologies. As a study program, the focus is teaching students about computers without specializing in a specific area, such as computer programming, hardware maintenance, software development; web designs, data security, and networking. This will offer students a myriad of opportunities for career making with limitless job potentials. Effective teaching and learning of computer craft help develop computer literacy skills, communication skills, critical thinking, problem-solving skills, troubleshooting among other information and technology skills in technical college students, and essential work skills for the 21st century.

Unfortunately, graduates of Nigerian technical colleges do not possess the right computing skills required to secure jobs upon graduation, thus perceived as a possible contributing factor to the rising youth unemployment in the absence of a more detailed analysis of youth unemployment in Nigeria. One possible reason adduced for this anomaly is the teaching methods employed in teaching and learning of computer craft at college level (Olelewe & Agomuo, 2016; Rasaki, 2012). As computer studies is a practically oriented course, the inability to use innovative teaching methods will continue to create enormous bottlenecks for effective program implementation. This study seeks to determine the effects of innovative pedagogy in computer craft practices in technical colleges in Enugu State. This objective will help achieve access to education, relevance, and quality teaching and learning of computing skills for gainful or self-employment, which is identified in goal 4 of sustainable development goals (SDGs) (United Nations Educational, Scientific and Cultural Organization, 2016). SDG otherwise called global goals is a blueprint to achieve better and sustainable future for all. For example, target 4.4 proposed that by 2030, there would be a substantial increase in the number of youth and adults with relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship. Also, target 4.5 ensures equal access for all women and men to affordable and quality technical, vocational, and tertiary education (SDG, 2015). With the increasing realization that quality secondary and technical education is vital to providing relevant skills training and competencies required for sustainable livelihood, addressing issues bothering on actualization of innovative teaching of computing skills is warranted. Arguably, an improvement in skills training that addresses students’ employment needs can only be realized if there is an improvement in the quality, effectiveness, and relevance of teaching methods to which innovative pedagogy is the key. This is because innovative pedagogy can directly affect the quality of teaching and learning, improve learners’ engagement and motivation which leads to deep learning, and may address issues of mismatch between training institutions and the industry toward meeting the changing need of learners and the labor market.

Most disturbing is that irrespective of emphasis on the need to adopt learner-centered approaches by teachers, technical vocational education and training (TVET) teachers in Nigeria are seen to be predominantly akin to using the traditional teaching methods characterized by passive learning. Thus, the inability of computer teachers to adapt to flexible but innovative instructional delivery approaches in their classroom teaching has contributed to indicators of decline in the quality of computer graduates at secondary level of education in Nigeria thus given rise to poor performance in
internal and external examinations, high rate of school dropouts, and unemployment in view of many other factors influencing educational outcomes. In view of this, it is therefore pertinent that this study be carried out to determine the effects of innovative pedagogy in teaching and learning of computer studies in technical colleges in Enugu State with a view to ascertain the efficacy of innovative teaching approach that can be effectively utilized by teachers to enhance students learning outcomes.

**Purpose of the Study**

This study’s main purpose is to determine the effects of innovative pedagogy integration on students’ academic achievement in computer craft practices in technical colleges in Enugu State. Specifically, the study sought to determine:

1. The main effects of innovative pedagogy utilization on college students’ academic achievement in computer craft practices in technical colleges in Enugu State.
2. Determine the interaction effect of pretest and treatment on the mean achievement score of computer craft practices students taught using innovative pedagogy and those taught without it.

**Hypotheses**

**Hypothesis 1:** There is a significant difference between the mean performance of college students taught computer craft practices using innovative pedagogy and those taught using traditional method in technical colleges in Enugu State.

**Hypothesis 2:** There is a significant interaction effect between pretest and treatment in the mean achievement scores among computer craft practices students taught using innovative pedagogy in technical colleges in Enugu State.

**Literature Review**

**Traditional Teaching Approaches Applied in Computer Studies**

Teaching method is the process by which the teacher meets the learner at their level, starting with their interest and problems, and then establishing conditions that will enable them to proceed to their set goal in the most possibly effective manner. According to Faraday et al. (2011), “teaching methods are prescribed structured sequence which are designed to elicit a particular type of thinking or responses to achieve specific learning outcomes” (p. 10). Hence, the authors argue that the choice and use of the appropriate teaching method or a combination of methods can be influenced by the type of learning objective, the nature of the learner, as well as other factors such as the repertoire of teaching strategies available and skills of the teacher (Faraday et al., 2011, p. 31). Studies have shown that the quality of teaching and learning as well as learners’ achievement can be influenced by the use of certain teaching methods (Department for Education and Skills [DfES], 2004; Faraday et al., 2011; Hattie, 2009; Marzano, 1998).

Moreover, it is practically “difficult to discern a single teaching model that can be applied to a whole session” (Zhang ji-ping & Collis, 1995, p. 31). Thus, effective teaching of computer craft requires that teachers use a combination of teaching methods and strategies within a single lesson so as to achieve the lesson objectives. This is because the students’ needs and problems differ from one another; as a result of this, no single method can be best for all students in a single class. According to DfES (2004), some of the teaching methods that are particularly effective in helping learners to learn new skills include direct interactive teaching, modeling, and demonstration. Direct teaching method is particularly effective in enabling learners to acquire skills. It is a very structured approach to teaching involving a high level of teacher-directed interactivity, thus involving direct communication with a class. In this study, the following are some of the traditional teaching methods used in teaching computer studies.

Discussion method is “effective in getting the students or trainees to think constructively while interacting with the rest of the group” (Integrated Publishing, n.d. p. 55). Discussion can be conducted in a large or small group. However, it is easier to maintain control and direction in a small group setting than in a large one. The author posits that “to use this method, the teacher lays a suitable foundation for the discussion by posing thought provoking questions, and then stimulates the trainees or students to discuss the basic questions, and finally guide the discussion to a logical conclusion” (p. 55). In the directed discussion, the teacher can only act as a moderator. As a result of the teachers’ questions, answers, and suggestions of the trainees during the session, the class becomes genuinely interested in exploiting all possible alternatives toward solving the problem. The use of this approach in teaching computer studies demands that teachers focus students’ attention to a problem area that can be covered in a reasonable length of time.

Similarly, demonstration as a method of instructional delivery is one of the very effective methods applied by computer studies teachers to achieve the objective of learning in real-life situations (Akinbobola & Ikitde, 2011; Nwachukwu, 2006). It is “a process of teaching learners how to do something in a step-by-step process” (Integrated Publishing, n.d., p. 56). Thus, demonstration or “doing” method is predominantly used to teach skills-related topics or concepts. For example, boot a computer system, load an application package, save a document in external drives, and debug and run a program for possible results that can be documented for further use, among others. Demonstration method can be used...
for both large and small groups of learners. This is because the greater the degree of learners’ participation or involvement in the learning activity, the more effective learning is likely to become. As an instructional method, it “challenges students to work cooperatively in groups to seek solutions to real world problems” (Alexander et al., 2005, p. 109). This method is considered effective in teaching of vocational subjects because all the three educational domains (cognitive, affective, and psychomotor) are all involved at the same time (Bloom et al., 1956; Hoque, 2016), hence making learners’ active participant in the learning process.

**Innovative Pedagogy in Teaching and Learning of Computer Crafts**

Innovative pedagogy in this study aims to create a learning environment that is capable of inspiring technical college students. In view of this, innovative teaching is perceived to mean a proactive approach to integrate new teaching strategies and methods in the classroom in more creative ways. According to Mandula et al. (2012), “innovative pedagogy is a creative use of right teaching methods and learning materials for the benefit of students” (p. 2). This implies effective combination of teaching and learning materials with methodologies that facilitate the use of active teaching techniques that help teachers develop their students’ learning abilities. Innovative teaching practices are characterized by student-centered classrooms, project-based learning, integrated studies, and use of technology to promote 21st-century skills.

According to Naz and Murad (2017, p. 3), “there are many teaching strategies such as personalization, small group learning, student advisories, peer-tutoring, peer instruction, team teaching, industry-based method, coaching, simulation, among others which can be used by teachers at different levels of education” to make learning innovative. For example, peer-tutoring method is an instructional method that “consists of student partnerships, linking high achieving students with low-achieving students or those with comparable achievement, for structured reading and study sessions” (Adekoya & Olatoye, 2011, p. 321). According to Rohrbeck et al. (2003, p. 240), “peer-tutoring is a systematic, peer-mediated teaching method.” Peer-tutoring relationships often have less rigid characteristics than teacher–student interactions in a school setting. According to Adekoya and Olatoye (2011, p. 321), “peer tutoring and demonstration method have been demonstrated to be successful in promoting the academic and social skills of general education as well as special education students” including students who were identified as “low learners” (Nazzal, 2002). Furthermore, the authors posit that peer-tutoring is an instructional method that “actively engages learners in the learning process and promotes mastery, accuracy and fluency in content learning” (p. 321). Research has shown that peer-tutoring has a positive impact on learning outcomes such as reading (Adekoya & Olatoye, 2011, p. 321; Fuchs et al., 2001).

Also, industry-based method is another effective approach for teaching computer craft as a skills subject. This approach helps to combine classroom learning and on-the-job learning in preparing learners for immediate productive employment. Industry-based learning is an “educational strategy that provides students with real-life work experiences where they can apply theoretical and technical skills towards developing their employability skills” (www.ipprentice: 1). It is a format that integrates workplace experience within the school curriculum to create a different learning paradigm. According to Raelin (1997, p. 564), “industry-based learning deliberately merges theory with practice and acknowledges the intersection of explicit and tacit forms of knowing.” Hence, this model builds on the principle that practice may be acquired in concert with theory. In this method, “the curriculum are more responsible to industry needs and provide the students with skills for employment and positive work values needed to meet the demands of the changing industry and global environment” (Manivannan & Suseendran, 2017, p. 106).

Studies have identified the benefits of innovative teaching to include development of globally competitive learners, creation of lifelong learners, maintaining of learners’ motivation to learn, and encouraging deeper learning compared to surface learning, among others (Lunde & Wilhite, 1996; Teo & Wong, 2000). According to Naifeld and Simon (2017), innovative teaching takes place in different spaces within and outside the classroom; it involves definition of a problem and the search for information to resolve the problem, collecting data and analyses, team work, interpersonal skills, critical thinking, creative problem-solving and effective communication. (p. 16)

It aims to “equip learners with 21st century skills to enable them cope with the current lack of certainty, be able to assimilate and become creative and innovative” (Amar & David, 2018, p. 591). Innovative pedagogy further aims to find and define ways that are needed to teach and learn about the change (Kawasaki, 2015). In view of this, The Finnish National Board of Education (2011) opined that “the school system should make more investments in harnessing the development of learners’ thinking skills and interaction skills as well as the knowledge of self and responsibility which are barely acquired in an orthodox pedagogy” (p. 1). Thus, innovative pedagogy, according to Hsia et al. (2017), is needed to “inspire computer studies teachers in general to engage in new teaching paradigms that will help to advance students’ future development” (p. 3). In this regard, the lesson’s content and delivery should no longer be confined to textbooks, and the role of the teacher is not the controller of knowledge delivery; rather an innovative pedagogy must...
merge the educational content with issues that matter to learners in their lives, thus giving teachers opportunities to act as mentors, facilitators, coaches who ignite meaningful discussion in classrooms by encouraging students to ask open-ended questions with appropriate interventions. (Hsia et al., 2017, p. 2)

Based on the above discussions, the researchers applied innovative pedagogy by combining facilitated peer-tutoring and industry-based approach with the view to actively engage technical college students in the learning process of computer crafts. For example, the industry-based approach provides appropriate interventions in situation where instructional materials and industrial skills expertise are either inadequate or lacking in the college; facilitated peer-tutoring allows the learning to be easily facilitated by the learners themselves with the teacher acting as the guide in teaching process. So, in consideration of the inherent advantages associated with innovative pedagogies, the researchers deem it pertinent to determine the effects of innovative pedagogy integration on students’ academic achievement in computer craft practices in technical colleges in Enugu State.

Method

This study adopted a randomized Solomon Four-Group Design. Solomon four-group design is a standard pretest–posttest two-group design and a posttest only control design. This design contains two extra control groups. The various combinations of “pretested and un-pretested groups with treatment and control groups allow the researcher to ensure that confounding variables and extraneous factors have not influenced the results” (Helmstader, 1970; Solomon, 1949, p. 147). The central feature of Solomon four-group design is that participants are randomly assigned (R) to either receive or not to receive a pretest (O1, O3) and then randomly assigned to either a treatment (X) or a comparison group as shown in Tables 1 and 2. In this study, the researchers achieved this fit by randomizing the students into the different class streams based on already existing structure in the schools. This design is considered appropriate for this study because it provides the “best control of the threats to internal validity” (Fraenkel et al., 2011, p. 281).

Participants

The population of this study is the entire 364 Senior Secondary (SSII) technical college students drawn from the 21 technical colleges in Enugu State. Specifically, 133 SSII Computer Craft students were purposively sampled for the study. Thus, total population sampling technique was employed because the study involved intact classes. However, the researchers through balloting assigned control and treatment groups to the technical colleges offering computer craft as shown in Table 3.

Table 1. The Solomon Four-Group Design for the Study.

| Group | Pretest | Treatment | Posttest |
|-------|---------|-----------|----------|
| 1 R   | O1      | X         | O1       |
| 2 R   | O4      |           | O4       |
| 3 R   |         | X         | O5       |
| 4 R   |         |           | O6       |

Note. O = outcome measure; X = treatment; R = randomization; Group 1 and 2 = pre- and posttest control group, while Groups 3 and 4 posttest only control design.

Instrument

The instrument used for the study is Computer Studies/Internet Achievement Test (CSiAT). CSiAT is a 20-item multiple-choice test developed by the researchers to measure students’ academic achievement in Computer Craft. Each question has four options of A to D. For example, “______ is a piece of hardware that allows computers to communicate over a computer network. (A) Network card (B) Switch (C) Fiber Optics (D) WWW” (see Online Appendix A). The instrument covers the content area of the topics selected for the study namely computer networks, topology, internet, electronic mail, browsers, and so on.

Validation

The instrument was subjected to expert consensus validation which was done by a team of computer studies subject teachers drawn from all the technical colleges in Enugu State. The experts were requested to use their expertise to determine the suitability of the instrument items for data collection. Their inputs were used to improve the quality of the instruments. Content validation was sought because “content validity is the most important and appropriate validity for any achievement tests” (Okwo, 2001, p. 117).

Reliability

The reliability of the instrument was established using Kuder-Richardson K-R 20 test. A total of 35 SSII students from Government Technical College Owerri which is outside the study area were used for the pilot study. The data collected were analyzed for internal consistency using Kuder-Richardson K-R 20 and yielded a reliability index of .93 which is high. The closer the alpha value is to 1, the higher the internal consistency. According to guidelines by Sekaran (2003, p. 311), “a coefficient of .6 is considered to be poor, .7 is acceptable while over .8 is good.” The choice of K-R 20 is based on “the assumption that all items in the scale have no equal difficulty levels i.e. no equal proportions of ‘successes’ on the items and therefore is generally considered to be a better reliability estimate than K-R 21” (Lord & Novick, 1968, p. 212; Traub, 1994). This method was adopted because it ascertains the internal consistency of the instrument.
To avoid experimental bias, seven computer studies teachers drawn from the participating technical colleges in Enugu State were used to teach their students. The researchers were not involved directly in the administration of the instrument. The computer craft subject teachers administered the instrument having been trained for 3 days by the researchers for both the experimental and control groups to ensure the homogeneity of instruction across the groups. During the 3-day training, detailed explanations on the aim of innovative teaching as well as how to utilize them prior to the treatment were taught by the researchers as shown in Table 4. For example, they were taught how to use discussion and demonstration for in-class activities. They were also guided on how to assign students into small groups with established rules to guide the class in achieving the objective of peer-tutoring. The subject teachers were also trained on how to do task analysis of the lesson content to determine facilities and skills requirement of the topics as contained in the computer studies curriculum. This enabled them to identify and choose a related industry closer to their school to engage the students in real work experience under the supervision of the industry experts. Furthermore, they were guided on how to assist the industry experts with lesson notes that guided them in their teaching based on the curriculum of computer craft practice.

The respective lesson notes used and the achievement test were prepared by the researchers and each subject teacher that participated in the experiment were made to teach an equivalent group using the lesson notes prior to the experiment and supervised by the researchers. This was aimed at arriving at a standardized mode of presentation among the computer subject teachers that were involved in administering the instrument and thus eliminate the teacher variability factor extraneous to the study. The researchers obtained written consent from the school Principals and teachers involved in the study while college students’ informed consent was obtained from their parents since they are less than 18 years of age. These students were selected because they met the inclusion criteria such as having passed the promotion examination in Computer Studies; registered for the new term, and able to present a copy of the informed consent form signed by their parents. As each of the schools do not have both experimental and control groups, four different schools were used as an experimental group while the remaining three were used as the control group.

The experimental group was taught with innovative pedagogical approach that is combination of industry-based and facilitated peer-tutoring methods while the control group was taught with traditional approach (discussion and demonstration methods). The use of ballot was adopted to randomly select the schools for treatment and the control group. Prior to the treatment, the pretest which is the achievement test (CSiAT) was administered to the two groups. The pretest was administered in the first week of school resumption to all the groups. The treatment lasted for a period of 8 weeks. After the treatment, the posttest was administered to the two groups within the 9th and 10th week. The same questions used for the pretest was also used for the posttest for the two groups. However, the questions were re-assigned in terms of numbering and key to ensure that the students do not discover that the same questions were used for the pretest and posttest.

The researchers used SPSS version 23 to analyze data collected for the study. The data collected were analyzed using mean and standard deviation for the research questions while
the hypotheses formulated for the study were tested at .05 level of significance using analysis of variance (ANOVA). As students in their intact classes participated in this experiment, ANOVA was deemed suitable for analyzing the difference between the main effects of the treatment on the dependent variable. If the significance of F-ratio is less than 0.05, the hypothesis should be rejected otherwise the hypothesis should not be rejected.

Data Analysis and Results

In Solomon four-group design, treatment and pretest are the two independent variables and the set of posttest scores is the dependent variable. Similarly, variable treatment has two levels: experimental and control and the variable pretest have two levels: pretested and un-pretested.

Determining of Main Effect

The mean marks obtained from the posttest by the four groups for the four possible conditions as shown in Table 5 shows the two main effects for the treatment and pretest.

The researchers conducted ANOVA to test the hypothesis that there is a significant main effect of innovative pedagogy on students’ achievement in CSiAT. As shown in Table 5, there were no baseline differences in CSiAT scores between participants in the two groups, $F(1,124) = 1.018$, 95% confidence interval (CI) $= [3.69, 4.70]$, $p = .317$. At posttreatment, the pretested group results indicated a significant mean difference between the experimental and control groups, $F(1, 60) = 175.287$, 95% CI $= [13.50, 15.23]$, $p < .000$. Similarly, the un-pretested group also showed a significant change over the same period, $F(1, 61) = 120.317$, 95% CI $= [13.09, 14.96]$, $p < .001$, between the experimental and control groups in favor of the innovative pedagogy.

Furthermore, to determine if there is a significant interaction effect of pretest and innovative pedagogy on students’ achievement in CSiAT, ANOVA was conducted as shown in Table 6. As the significance level corresponding to Treatment $\times$ Pretest is .889 which is more than the .05, there is no interaction effect of pretest and innovative pedagogy. In addition, Figure 1 shows a graphical representation of the mean scores of experimental and control groups with and without pretest. The parallel lines indicate that there is no interaction effect. In other words, the treatment or the posttest scores are unaffected by the pretest. Therefore, there is a main effect of innovative pedagogy (i.e., experimental group has performed significantly better than the control group).

Table 4. Summary of Innovative Teaching Procedure.

| Level               | Time frame       | Session                          | Activities                                                                 |
|---------------------|------------------|----------------------------------|-----------------------------------------------------------------------------|
| Preintervention     | Week 1           | Initial session                  | - School and industry approval                                              |
|                     |                  |                                  | - Signing of consent form                                                  |
|                     |                  |                                  | - Training of subject teachers                                             |
|                     |                  |                                  | - Baseline assessment                                                      |
| Intervention        | Week 2–9 (two    | Session 1 (Student orientation   | - General principles on how to facilitate group learning and how to give    |
|                     | sessions per     | and introduction)                | feedback.                                                                  |
|                     | week)            |                                  | - Providing rules that guide the tutoring procedures.                     |
|                     |                  |                                  | - Grouping and appointment of tutors                                       |
|                     |                  |                                  | - Tutoring demonstration                                                  |
|                     |                  | Session 2: Introduction to       | - The teacher determines the teaching and learning resources and set        |
|                     |                  | computer networks                | objectives for tutoring.                                                   |
|                     |                  | Sessions 5–6: Network topology   | - The tutor facilitates the group toward achieving the learning objectives.|
|                     |                  | Sessions 9–10: Internet and      | - The tutees makes useful contributions toward goal attainment (dialogue    |
|                     |                  | browsers                         | and criticisms).                                                           |
|                     |                  | Sessions 13–14: Electronic mail  | - The teacher supervises the tutoring by monitoring the sessions and       |
|                     |                  | (Group Presentation)             | reinforces the group for following the procedures accordingly.            |
|                     |                  |                                  | - Presentation of groups activity by the tutors                           |
|                     |                  |                                  | - Group comments and suggestions                                          |
|                     |                  |                                  | - The teacher gives necessary corrections and comments for further        |
|                     |                  |                                  | improvement.                                                               |
|                     |                  |                                  | - The teacher encourages the less performing groups for their attempts.   |
|                     |                  | Session 3, 7, 11, and 15         | - Visit to the selected industry for practical experience.                 |
|                     |                  |                                  | - Practical demonstrations based on previous sessions (2, 5–6, 9–10,       |
|                     |                  | (Group Presentation)             | and 13–14).                                                                |
|                     |                  |                                  | - Presentation of group project.                                           |
|                     |                  |                                  | - Feedback from the master craftsman.                                     |
| Postintervention    | Week 10          | Final session                    | - Posttest assessment                                                      |
|                     |                  |                                  | - School and industry approval                                             |
|                     |                  |                                  | - Signing of consent form                                                  |
|                     |                  |                                  | - Training of subject teachers                                             |
|                     |                  |                                  | - Baseline assessment                                                      |
|                     |                  |                                  | - General principles on how to facilitate group learning and how to give   |
|                     |                  |                                  | feedback.                                                                  |
|                     |                  |                                  | - Providing rules that guide the tutoring procedures.                     |
|                     |                  |                                  | - Grouping and appointment of tutors                                       |
|                     |                  |                                  | - Tutoring demonstration                                                  |
|                     |                  |                                  | - The teacher determines the teaching and learning resources and set        |
|                     |                  |                                  | objectives for tutoring.                                                   |
|                     |                  |                                  | - The tutor facilitates the group toward achieving the learning objectives.|
|                     |                  |                                  | - The tutees makes useful contributions toward goal attainment (dialogue    |
|                     |                  |                                  | and criticisms).                                                           |
|                     |                  |                                  | - The teacher supervises the tutoring by monitoring the sessions and       |
|                     |                  |                                  | reinforces the group for following the procedures accordingly.            |
|                     |                  |                                  | - Presentation of groups activity by the tutors                           |
|                     |                  |                                  | - Group comments and suggestions                                          |
|                     |                  |                                  | - The teacher gives necessary corrections and comments for further        |
|                     |                  |                                  | improvement.                                                               |
|                     |                  |                                  | - The teacher encourages the less performing groups for their attempts.   |
|                     |                  | Session 4, 8, 12, and 16         | - Visit to the selected industry for practical experience.                 |
|                     |                  | (Industry-based)                 | - Practical demonstrations based on previous sessions (2, 5–6, 9–10,       |
|                     |                  |                                  | and 13–14).                                                                |
|                     |                  |                                  | - Presentation of group project.                                           |
|                     |                  |                                  | - Feedback from the master craftsman.                                     |
The results of this study suggest that majority of the technical college students taught using innovative teaching approach significantly benefited from the interventions exposed to. Quasi-experimental comparisons of two cases of innovative teaching practices (facilitated peer-tutoring with industry-based method) indicated no overall decline when compared with the conventional teaching method as shown in the achievement means for the entire sample. The findings on Tables 5 and 6 revealed that there is a significant difference between the mean achievement scores of students taught computer craft using innovative teaching method and those taught using discussion and demonstration method.

### Table 5. Summary of Mean and ANOVA Results of Test Scores by Pretest and Treatment for Computer Craft Practices.

| Measure       | Test type and interaction | Expt. group (n = 81) | Control group (n = 44) | 95% CL   | df     | F      | Significance |
|---------------|---------------------------|----------------------|------------------------|----------|--------|--------|--------------|
|               |                           | M ± SD               | M ± SD                 |          |        |        |              |
| CSiAT         | Baseline                  | 4.20 ± 1.60          | 3.81 ± 1.824           | [3.69, 4.70] | 124    | 1.018  | .317         |
|               | Pretested                 | 14.37 ± 2.75         | 5.71 ± 1.65            | [13.50, 15.23] | 60     | 175.287 | .000         |
|               | Un-pretested              | 14.02 ± 3.01         | 6.00 ± 2.07            | [13.09, 14.96] | 61     | 120.317 | .000         |

Note. ANOVA = analysis of variance; CSiAT = Computer Studies/Internet Achievement Test.

\[ R^2 = .317 \text{ (Adjusted } R^2 = .312) \text{. Computed using alpha } .05. \]

### Table 6. Tests of Between-Subjects Effects (ANOVA) for Computer Craft Practice.

| Source                  | Type III sum of squares | df | Mean square   | F      | Significance | \( \eta^2 \) |
|-------------------------|-------------------------|----|---------------|--------|--------------|--------------|
| Corrected model         | 2,028.030\(^a\)         | 14 | 144.859       | 21.956 | .000         | .736         |
| Intercept               | 3,048.329               | 1  | 3,048.329     | 462.020| .000         | .808         |
| Treatment               | 843.292                 | 1  | 843.292       | 127.814| .000         | .537         |
| Pretest                 | 21.161                  | 8  | 2.645         | 0.401  | .918         | .028         |
| Treatment × Pretest     | 11.147                  | 5  | 2.229         | 0.338  | .889         | .015         |
| Error                   | 725.762                 | 110 | 6.598        |        |              |              |
| Total                   | 18,976.000              | 125 |              |        |              |              |
| Corrected total         | 2,753.792               | 124 |              |        |              |              |

Note. ANOVA = analysis of variance.

\[ R^2 = .736 \text{ (Adjusted } R^2 = .703) \text{. Computed using alpha } .05. \]

### Figure 1. Interaction plot of pretest and treatment conditions.

**Discussion**

The results of this study suggest that majority of the technical college students taught using innovative teaching approach significantly benefited from the interventions exposed to. Quasi-experimental comparisons of two cases of innovative teaching practices (facilitated peer-tutoring with industry-based method) indicated no overall decline when compared with the conventional teaching method as shown in the achievement means for the entire sample. The findings on Tables 5 and 6 revealed that there is a significant difference between the mean achievement scores of students taught computer craft using innovative teaching method and those taught using discussion and demonstration method.
Equally, the result of the ANOVA used to test the corresponding null hypothesis as shown in Tables 4 and 5 confirms that there is difference between the main effect of control and experimental groups and also between pretested and un-pretested groups, hence indicating that there is no interaction effect. The findings of this study are in line with the findings of Woodward and Baxter (1997) who found that innovative teaching method in mathematics was viable for students with average and above average academic abilities as well as students with learning disabilities. Also, the findings of this study further support Naz and Murad (2017) who found that the use of innovating teaching method significantly reduced the impact of diversity on students’ performance. These findings point to the efficacy of innovative pedagogical approach in teaching and learning of vocational and technical subjects considering that college students exposed to facilitated peer-tutoring and industry-based approaches were better motivated; better engaged in problem solving and self-directed learners compared to their counterparts taught using only conventional teaching method where students receive information from the class teachers with little opportunities given to collectively reflect on their learning experiences.

Furthermore, this finding is in line with Butler (1992) who opined that students who are actively involved in any learning activity tend to learn more than students who are passive recipients of knowledge. Perhaps treatment group’s high performance in the subject could be attributed to renewed interest and curiosity to learn as well as greater involvement in the learning process thus help in simplifying the subject matter. Perhaps, this supports the notion that predominant use of traditional teaching method supports surface learning (passive level) rather than deep (active level) learning (Marton & Säljö, 1976; Must et al., 1992; Naz & Murad, 2017).

Based on this, several studies suggested that a combination of traditional teaching methods with other methods such as problem-based learning (PBL), video lectures, peer-tutoring, couching, and work-based learning, among others could be an effective way of teaching theory and practical skills (Azer, 2005; Pappanna et al., 2013). The implication of this finding is that the adoption of innovative pedagogy in teaching and learning of computer craft will help to create learning environments that will not only promote active learning techniques, encourage monitoring of learners progress, and promote group learning but also provide interventions for resource inadequacies in most technical colleges in Enugu State. Another obvious implication of the findings of this study is persistent exposure of learners to real-life working environment so as to acquire the desired work habits and competencies needed to enter the world of work and progress successfully.

**Limitations of the Study**

It is important to state that the authors’ intention in this study is to determine the impact of innovative teaching on students’ achievement in computer studies in view of the fact that not much is known about its effectiveness in making teaching and learning of computer studies more engaging in Nigerian technical colleges. One limitation of this study is that only seven technical schools were involved out of the 21 technical schools in Enugu State, and this might affect the generalizability of the result. Another significant limitation emanating from the use of quasi experimental design involving intact classes did not allow the researchers to randomize the study participants; hence, the imbalance in sample size between the treatment and control groups might be a source of bias to the result. Therefore, the study recommends that future studies aimed at determining the efficacy of innovative pedagogies should consider larger sample size by involving all the technical colleges in Enugu State to verify the findings of the study. Finally, future studies can involve a more robust research design such as mixed method to verify the findings of this study.

**Conclusion**

The purpose of using innovative teaching techniques in this study was to find better ways of keeping technical college students actively engaged in the teaching and learning of computer studies so as to motivate them to learn, facilitate enhanced skills training and increase students’ performance. With respect to the results presented in Tables 5 and 6, the strength of the relationship between the innovative teaching methods (facilitated peer-tutoring and industry-based method) combined with traditional method and learning outcome (students’ performance) in the computer studies increased significantly from pretest to posttest, thus indicating that instructional techniques applied in teaching and learning of computer studies is a determining factor in improving students’ performance. From the analysis of posttest, the researchers conclude that given the limited sample size tested, there is evidence suggesting that teaching method is a predictor of learning outcomes. Thus, computer teachers are encouraged to employ innovative teaching approaches that effectively combines facilitated peer-tutoring and industry-based method with traditional teaching method (demonstration and discussion) so as to achieve inclusive learning across vocational and technical subjects at secondary level of education in Nigeria.

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References
Adekoya, Y. M., & Olatoye, R. A. (2011). Effect of demonstration, peer-tutoring, and lecture teaching strategies on senior secondary school students’ achievement in an aspect of agricultural science. Pacific Journal of Science and Technology, 12, 320–332. http://www.akmauniversity.us/PJST12_1_320.pdf on 20/05/2018

African Union. (2007, May 29–31). Strategy to revitalise technical and vocational education and training (TVET) in Africa. Meeting of the Bureau of the Conference of Ministers of Education of the African Union (COMEDAF II+). African Union.

Akinbobola, A. O., & Ikide, G. A. (2011). Strategies for teaching mineral resources to Nigeria secondary school science students. African Journal of Social Research and Development, 3(2), 130–138. https://www.iiste.org/Journals/index.php/APTA/article/viewFile/20455/20874

Alexander, J. G., McDaniel, G. S., & Baldwin, M. S. (2005). If we teach them to fish: Solving real nursing problem through problem-based learning. In M. H. Oermann (Ed.), Annual review of nursing education (Vol. 3, pp. 109–124). Springer.

Amar, S., & David, N. B. (2018). Adapted learning environments for future education systems. American Journal of Educational Science, 4(4), 100–114. https://pdfs.semanticscholar.org/e4ab/aed13aabdfed97914a76a95948431fcd7pdf

Azer, S. A. (2005). The qualities of a good teacher: How can they be acquired and sustained? Journal of the Royal Society of Medicine, 98, 67–69. https://doi.org/10.1258/jrsm.98.2.67

Bakare, J., & Orji, C. T. (2019). Effects of reciprocal peer tutoring and direct learning environment on sophomore's academic achievement in electronic and computer fundamentals. Education and Information Technologies, 24(2), 1035–1055.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain. David McKay.

Butler, J. A. (1992). Use of teaching methods within the lecture format. Medical Teacher, 14, 11–25. https://pubmed.ncbi.nlm.nih.gov/1376853/

Department for Education and Skills. (2004). Pedagogy and practice: Teaching and learning in secondary schools Unit 2: teaching models. https://www.stem.org.uk/elibrary/resource/36892

Dhir, A., Gahwaji, N. M., & Nyman, G. (2013). The role of the iPad in the hands of the learner. Journal of Universal Computer Science, 19(5), 706–727. http://www.jucs.org/jucs_19_5/the_role_of_the_jucs_19_05_0706_0727_dhir.pdf

Dodewar, A. G. (2012, February 24–25). Innovative techniques in English language teaching for enhancing learner’s ability. Confluence. www.tgpcet.com

Faraday, S., Overton, C., & Cooper, S. (2011). Effective teaching and learning in vocational education. www.lsnlearning.og.uk

Federal Government of Nigeria. (2004). National policy on education (4th ed.). Abuja: Nigerian Educational Research and Development Council (NERDC).

The Finnish National Board of Education. (2011). Perusopetus. http://www.oph.fi/koulutus_ja_tutkimnot/perusopetus

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2011). How to design and evaluate research in education. McGraw-Hill Humanities/Social Sciences/Languages.

Fuchs, L. S., Fuchs, D., & Kams, K. (2001). Enhancing kindergartners’ mathematical development: Effects of peer-assisted learning strategies. The Elementary School Journal, 101(5), 495–510. https://doi.org/10.1086/496684 on 4/11/2016

Hattie, J. A. C. (2009). Visible learning: A synthesis of over 800 meta-analyses relating to achievement. Routledge.

Helmstadter, G. C. (1970). Research concepts in human behavior: Education, psychology, Sociology. https://www.worldcat.org/title/research-concepts-in-human-behavior-education-psychology-sociology/oclc/872514079

Hoffmann, L. M. A., & Koifman, L. (2013). The supervisory view from the perspective of the activation of change processes. Physiol: Journal of Collective Health, 23, 573–587.

Hoque, M. E. (2016). Three domains of learning: Cognitive, affective and psychomotor. The Journal of EFL Education and Research, 2(2), 45–52. www.edrc-jefler.org

Hsia, H., Ho, S. S., & Chen, R. J. (2017). Innovative pedagogy: A case study—The Culinary Arts College in Taiwan. International Dialogues on Education: Past and Present: IDE-Online Journal. https://www.ide-journal.org/article/2017-volume-4-number-3-innovative-pedagogy-a-case-study-the-culinary-arts-college-in-taiwan/

Independent School Parent. (n.d.). Introducing computing to the curriculum. https://www.indepedntschoollparent.com/school/introducing-computing-curriculum/

Integrated Publishing. (n.d.). Instructional methods and techniques. http://navyadvancement.tpub.com/12045/css/Discussion-METHOD-69.htm

Kawasaki, G. (2015). The art of the start 2.0. The time-tested, battle-hardened guide for anyone starting anything. Portfolio Penguin. https://www.penguin.co.uk/books/280/280044/the-art-of-the-start-2-0-9780241187265.html

Lord, F. M., & Novick, M. R. (1968). Statistical theories of mental test scores. Addison-Wesley.

Lunde, J. P., & Wilhite, M. S. (1996). Taxonomy of instructional methods and techniques. Integrated Publishing. (n.d.). Instructional methods and techniques. http://navyadvancement.tpub.com/12045/css/Discussion-METHOD-69.htm

Manivannan, M., & Suseendran, G. (2017). Design an industry based curriculum for education and research. International Journal of Innovative Research in Applied Sciences and
