



EXPLORING CULTURO-TECHNO-CONTEXTUAL APPROACH AND COOPERATIVE LEARNING IN COMPUTER STUDIES: A PATHWAY TO OVERCOMING HURDLES IN COMPLEX CONCEPTS

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Abstract

Africa needs to rewrite how science content is being delivered in classrooms in ways that will not only enhance meaningful learning but also attract the younger ones to study science. Several methods of delivering computer studies have been explored, but these approaches have failed to turn the fortunes of students' performance in school and public examinations around in the positive direction. This study sought to find out; (a) If there will be a statistically significant difference in the achievement of students taught computer networking using the CTCA, cooperative learning and those taught using the lecture method? (b) What are the perceptions of students on the use of CTCA? The study adopted an explanatory sequential mixed method whereby quantitative and qualitative data were gathered. The experimental class 1 (CTCA) had 62 subjects, experimental class 2 (Cooperative learning) had 60 subjects while the control class had 57 subjects of junior secondary school 1 computer studies students in Lagos, Nigeria. The ANCOVA result shows a statistically significant difference in the achievement of students taught computer networking using culturo-techno-contextual approach, cooperative learning and lecture method [$F(2, 175) = 16.83; p < .05$]. Recommendations were made for improving the teaching and learning of computer studies.

Keywords:

Culturo-Techno-Contextual Approach, Cooperative Learning, Complex concepts

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Subject/Problem

This study sought to explore the potency of culturo-techno-contextual approach and cooperative learning on the achievement of students in computer networking. Very sparse research attention has been paid to this critical issue of curriculum content, especially the topics students perceive to be difficult and how they can be made easy to learn. This line of inquiry is significant to provide much-needed insight into why students' performance in school and public examinations in computer studies has not observed a significant hike over the last eight years. The persistently poor achievement of senior secondary school students in ICT in Nigeria has been of concern to stakeholders. This concern is borne out of the increasing importance of computer technology in a world that is increasingly dominated by ICT.

Over two decades, the desire to promote meaningful learning of computer studies concepts has directed considerable attention towards understanding how learners learn and how to help them to learn. For students to learn they must be interested in what they want to learn, otherwise, meaningful learning might not take place. If students underperform in computer studies, the chances of attaining national goals requiring the services of computer programmers, analysts, scientists, and engineers will be drastically reduced. African teachers have implemented several teaching strategies in the classroom to improve students learning of concepts in computer studies. Despite the use of these strategies, poor attitude to learning and lack of interest persist, indicating the pervasiveness of underachievement in the learning of complex computer studies concepts such as computer networking.

Ineffective instructional methods are one of the factors that causes students' to become passive and have less interaction with one another while performing tasks in the classroom. When a teacher shifts his teaching style to a more interactive one, students' anxiety levels decreases. Since the mid-19th century, the quest for more potent methods of bolstering students' performance has become unstoppable and irresistible. Such methods as use of concept mapping, demonstration, using analogies and metaphors and methods with constructivist flavours have populated the literature. Yet, despite the deployment of some of these methods in classrooms, the literatures in the second decade of the 21st century is replete with reports of lackluster performance of students in many countries (Canning, Harackiewicz, Priniski, Hecht, Tibbetts, & Hyde, 2018; d'Aguiar, & Harrison, 2016; Ejiwale, 2013; Hoeg&Bencze, 2017; Smith, Cech, Metz, Huntoon, & Moyer, 2014; Watkins & Mazur, 2013).

In attempting to proffer a solution to this challenge, most education literature on different strategies that could be used to solve this anomaly has failed to recognize that culture, context, and group discussion play significant roles in promoting meaningful learning of computer studies. This is the undergirding principle of the culturo-techno-contextual approach (CTCA) and cooperative learning method experimented with in this study. If science concepts are tackled via linkage with indigenous knowledge and cultural practices, the chances are bright that the 'genie of poor performance in STEM will be thrown progressively back into the bottle' (Okebukola et al 2012, 2020).

CTCA being tested in this study, is an amalgam, drawing on the power of three frameworks- (a) cultural context in which all learners are immersed; (b) technology-mediation to which teachers and learners are increasingly dependent; and (c) location context which is a unique identity of



every school and which plays a strong role in the examples and local case studies for science lessons. The culturo-techno-conceptual approach espouses that, for students to easily understand a concept under study, their culture, available technology, their immediate environment (contextual) must be taken into account. Okebukola (2012) theory has been proven to be effective in several works within the African region.

The conduct of this study was guided by the following questions:

1. Will there be a statistically significant difference in the achievement of students taught computer networking using the CTC Approach, cooperative learning and those taught using the lecture method?

2. What are the perceptions of students on the use of CTCA?

The null hypothesis the study tested was; there is no statistically significant difference in the achievement of students taught computer networking using the CTCA, co-operative learning and lecture method.

Model, Philosophy and Theoretical Framework

This study was premised on Vygotsky's Theory of Social Constructivism (1962) and Ausubel's theory of advance organizer and subsumption theory. Vygotsky's theory states that knowledge is co-constructed and that individuals learn from one another. He described the Zone of Proximal Development (ZPD) as the difference between what a learner can do without help and what he or she can do with help. Scaffolding helps students learn more by working with a teacher or a more advanced student to achieve their learning goals. The theory behind instructional scaffolding is that, compared to learning independently, students learn more when collaborating with others who have a wider range of skills and knowledge than the student currently does. These teachers or peers are the "scaffolding" who help the student expand learning boundaries and learn more than would be able to on his/her own (this can be seen in step 2 of CTCA implementation).

To use ZPD and scaffolding techniques successfully, it is important to know students' current level of knowledge. This is the thrust of the pre-lesson activities of CTCA. If we look at the steps involved in implementing the culturo-techno-contextual approach (see www.ctcapproach.com), this fits well because the learner seeks information on culturally related knowledge from their parents in association with the topic before coming to class, then they interact with their peers or classmates to share their knowledge in groups about their findings which is a social process. Then the teacher creates an organized learning environment to enable the student to interact and engage with the learning material as well as guide their cultural knowledge to make it compatible with the concept being taught which is the socio-cultural aspect of the theory.

In Ausubel's theory of meaningful verbal learning, an advance organizer is a statement preceding a lesson that is designed to preview the material to be learned and link it to content already existing in the learner's schemata. It can be defined as a tool used to introduce the lesson topic and illustrate the relationship between what the students are about to learn and the information they have already learned. This makes up CTCA steps 1 and 2.

In all aspects of life, effective learning requires teamwork and cooperation to enhance productivity of individuals. According to Dallmer (2007), learning institutions also operate the same way. So adopting cooperative learning would enable students to learn from each other; and gain interpersonal skills through group participation (Davidson & Major, 2014). In furtherance to

this, cooperative learning enables students to have broader understanding of the subjects since they are able to collaborate in the learning process. This affirms that students who adopt jigsaw strategy are able to perform better academically compared with their counterparts who are taught through teacher-centered strategy (Robyn, 2014).

In cooperative learning, group discussions enhance higher understanding comparatively to traditional or conventional teaching that heavily depends on teachers as resources. This implies that academic excellence is based on team work (You, 2014). Hence cooperative learning could be classified among ways of embracing teamwork in academics. Many college students would be willing to learn, share skills and competencies with their colleagues, and also develop leadership and other important aspects of teamwork (Davidson & Major, 2014). Therefore, cooperative learning motivates students' critical thinking and helps them clarify ideas through debate and discussion with their peers.

Slavin (2011) presented four major theoretical perspectives of cooperative learning as:

- (i) Motivational perspective focused primarily on the reward or goal structures under which students operate. From this perspective, cooperative incentive structures create a situation in which the only way group members can attain their own personal goals is if all the members of the group are successful.
- (ii) In social cohesion perspective, theorists emphasized the idea that students help their group mates learn because they care about the group. This theory is relevant when each individual's goals are accomplished under the influence of the actions of others (Johnson & Johnson, 2005). This perspective holds that students help each other learn because they care about the group and its members, and come to derive self-identity benefits from group membership (Slavin, 2011). Findings from research Johnson and Johnson (2009) show that the positive outcomes of social interdependence are identified as: effort to achieve, positive relationships and social support, and psychological health and self-esteem.
- (iii) In developmental perspective, the theorists' assumed that interaction among children around appropriate tasks increases their mastery of critical concepts. Damon (1984) supports the viewpoint of cognitive development, and proposes a theoretical paradigm which combines the perspectives of Piaget and Vygotsky into peer co-operation, which explains why cooperative learning can improve student learning and achievement. T
- (iv) The cognitive elaboration perspective arose from the work of Piaget (1926) and Vygotsky (1978). A basic assumption of the cognitive development perspective driven by their theories, together with those of their colleagues, is that reciprocal interaction among children around suitable academic tasks creates growth in the knowledge of concepts and critical skills (Slavin, 2011). Piaget (1926) supports the cognitive developmental perspective, and argues that knowledge, values, regulations, morals and systems of symbols may only be learned effectively through interaction among participants. This viewpoint stresses the effectiveness of elaboration in the process of learning and thinking, and that elaboration prepares the individual for cognitive re-structure and rehearsal in order to enhance learning tasks (Slavin, 2011). Webb (1989) discovered that students achieve more knowledge and skills from engaging in cooperative activities when they offer more explanations to others

Methodology

This study adopted an explanatory sequential mixed method whereby quantitative and qualitative data were gathered. It had two intact class groups. Simple random sampling technique was

employed in the selection of junior secondary school two classes with sample of 62 students for the CTCA group (experimental 1) and 60 students for the cooperative learning group (experimental 2) located in a different local government from the control class on account of the students in each group not interacting with one another. The control group had 57 respondents of junior secondary school 1 (equivalent of 7th grade) computer studies students in Lagos State, Nigeria. Quantitative data were collected through the computer networking achievement test with respectable instrument measures. The experimental and control groups were given a pretest to determine the entry level of the students. The treatment was implemented after the pretest which lasted for three weeks.

Students in the experimental group 1 were taught computer networking using CTCA. Every week, each lesson lasted for 80 minutes. The teacher followed the five-step CTCA procedure (see ctcapproach.com) highlighted below;

The students were informed of the topic (computer networking) before the class and asked to reflect on indigenous knowledge or cultural practices and beliefs associated with the concept, asking them to watch YouTube videos and search the web for ideas as well as using their mobile phones or internet-enabled devices, and ask their parents or people in their community about indigenous knowledge related to computer networking.

At the beginning of the next class, the students were grouped into mixed ability, mixed-sex groups of five to eight depending on the population of the class and were allowed to interact within 10 minutes on individual knowledge concerning the (a) the indigenous knowledge and cultural practices related to computer networking (b) summaries of idea obtained from web resources, all cultural and web-based reflections are documented and presented to the whole class by their group leaders within 5 minutes. The teacher wraps up by sharing her indigenous knowledge and cultural practices associated with computer networking.

Examples of indigenous knowledge and cultural practices associated with computer networking

First, let us view the term computer networking from Yoruba culture where we have the Oba (King) and his subjects (the people he governs). If the Oba has vital information that needs to be passed across to the whole village, he simply authorizes the town crier (a messenger) to share the information. In computer networking, the King is referred to as the server while the people are called the clients. Since information is shared by the King to the people, this means that the network (connection or link) between the King and the people enables information sharing.



It is not only information that can be shared on a network; resources can also be shared. For instance, Farmer A has a yam and cassava plantation and Farmer B has a rice and beans plantation. If Farmer A wishes to eat rice or corn and Farmer B needs yam or cassava, Farmer A

can ask for the produce of Farmer B in exchange for his own produce. If there is no link or connection between these two farmers, then the exchange will be impossible. Here the rice, beans, cassava, and yam serve as the resources. In networking, these resources can be printers, modems, and CD-ROMs.



The lesson progresses as the teacher draws more examples from the student's day-to-day activities and their immediate environment; this is the context flavour of the approach, with the interaction between the students and teachers with some content-specific humour. At the close of the lesson, the teacher sends a maximum 320-character summary of the lesson (two pages) via WhatsApp to all students. After the first lesson, the group leaders send such messages. This is another of the technology flavours of the approach. The control class had the same learning experience as the experimental class but was exclusive of the elements of CTCA for three weeks also. Both experimental and control classes were subjected to posttest using the same achievement and anxiety measures.

Experimental group 2 students were exposed to learning experiences on "computer networking" using the cooperative learning - student team achievement division (STAD) for three weeks. The learning experience using STAD, students were assigned to 5-member heterogeneous groups. A four-step cycle was initiated after the assignment was done: (i) teach, (ii) team study, (iii) test and (iv) recognition.

1. In the teaching stage, the teacher presented the lesson outline to the students in a lecture-discussion format. Students were taught the meaning of networking, computer networking, types of computer networks, and network topologies.
2. Team study: Group members work cooperatively with teacher-provided lesson outline
3. Test: Each student individually takes a test. The teacher grades the test and notes the current scores as well as the improvement over previous test.
4. Recognition: Each team receives recognition awards depending on the average scores of each team. Teams with 7 to 9 points receive a GOOD TEAM verbal reinforcement, teams with 10 to 17 points receive a GREAT TEAM verbal reinforcement, and teams with 18 to 20 improvement points receive a SUPER TEAM verbal reinforcement.

The control class had the same learning experience as the experimental classes-exclusive of the elements of CTCA and cooperative learning. The following procedures were adopted in teaching the control group;

1. The teacher introduces the topic "computer networking" to the students by stating its meaning.
2. The teacher mentioned the types of computer networks
3. The teacher described the sub-topic "network topology" to the students
4. The teacher mentioned the types of network topologies
5. The teacher summarises the lesson by laying emphasis on the areas not clear to the students.

Analyses and Findings

The first research question sought to find out if there is any statistically significant difference in the achievement of students taught computer networking using the CTCA, cooperative learning and those taught using the lecture method. The mean score for the CTCA group is 15.97, cooperative learning is 13.93 while for the lecture method group is 12.23. The ANCOVA result shows a statistically significant difference in the achievement of students taught computer networking using culture-techno-contextual approach, cooperative learning and lecture method [$F(2, 175) = 16.83; p < .05$]. The null hypothesis which states that there is no statistically significant difference in the achievement of students taught computer networking using the CTCA, co-operative learning and lecture method is rejected.

We hypothesized three factors that could be responsible for the better performance of the experimental group on the concepts of computer networking. These are related to the unique nature of CTCA model as it is an amalgam, drawing on the power of three frameworks - (a) cultural context in which all learners are immersed; (b) technology and (c) locational context of the school. In implementing the cultural aspect of the CTCA, the teacher asked students to document indigenous knowledge associated with the topic. In doing so, the students were able to easily relate with the difficult concepts as they were able to link most of these concepts to their indigenous knowledge thereby enhancing meaningful learning to take place.

Results from this study were found to be in agreement with Peter (2020); Agbanimu (2020); and Oladejo (2020). In this previous literature, the researchers found CTCA to promote meaningful learning of concepts in computer studies and other science-related subjects. Learners understand better when they find out about concepts within their immediate environs by asking elders, family, tribesmen, and friends.

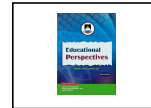
We also found another interesting factor within the components of CTCA that is deserving of our attention. Lev Vygotsky's theory of social constructivism emphasizes on the effect of culture and social interactions in contributing to cognitive development. The indigenous knowledge that students brought to the class were obtained from the interaction with parents, their colleagues and community members. This interaction was also observed during the execution of the CTCA model in the classroom. This improved social interaction according to Lev Vygotsky is necessary for meaningful learning to take place.

When students were interviewed after been taught computer networking using CTCA, randomly selected unnamed students had the following to report on what makes them understand the concept better:

Blessing (pseudo name) Female, 14 years said "The cultural examples the teacher cited made it easier for me to understand to the computer networking better"

Elijah (pseudo name) Male, 15 years "watching some YouTube videos on computer networking on my phone made me have knowledge of the topic before coming to class".

Gabriel (pseudo name) Male, 14 years "Listening to my parents tell me our cultural practices was fun"



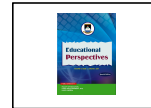
Conclusion and Recommendations

The findings of this study furnish computer studies teachers with new ideas that will aid them in science teaching in a manner that will enhance students understanding of difficult concepts. The results of this study provide teachers with the required wherewithal to aid their students to connect learning to culturally relevant issues and building learning from the personal, social, and cultural knowledge of the learners. The cultural component of the study encourages science teachers to use a teaching model that draws from the students' traditional backgrounds to aid teaching. Establishing a strong sense of respect towards other cultures among students from an early age is a necessity for today's pluralistic Nigerians and African society.

Through CTCA activities in the classroom, students can learn about each other's different cultures and learn to respect and value their differences. Having access to other information outside of their culture and books gives students different ways to learn a concept. With technology in CTCA, teachers can come up with creative ways to teach their students and keep them engaged. This study ensures that students were grouped into mixed ability, mixed-sex groups which are in support of the Sustainable Development Goals (SDGs). This study is presented in a way that will be meaningful to the education community at large. It will provide policymakers with informed knowledge on how to make decisions when formulating policies or drafting the curriculum because building on students' culture to construct the classroom curriculum helps prepare students to become respectful citizens of today's global community.

Based on the findings, the following recommendations were made:

1. Students should imbibe the culture of working together cooperatively in order to gain science skills and knowledge. The ability to work with others within a group and to develop interpersonal skills may be justification for using CTCA and cooperative learning strategies.
2. Teachers need to take account of students' cultural background to identify different indigenous beliefs attached to ICT concepts and use it as a guide during the teaching-learning process to ease students' understanding.
3. With technology in CTCA, teachers can come up with creative ways to teach their students and keep them engaged especially during this post-Covid era.
4. CTCA and cooperative learning strategies should be integrated into the curriculum of ICT and other STEM subjects to improve students' achievement.
5. Further studies on the potency of CTCA in the field and laboratory may be carried out.



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