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From Silence to Strength: Leveraging CTCA and Gbeleyi 1.0 to Tackle Gender Dynamics and Student Anxiety in Secondary Schools

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A B S T R A C T

Anxiety and critical thinking skills are crucial factors influencing students' academic performance and learning outcomes, particularly in subjects perceived as difficult. This study attempted find out the relative effectiveness of CTCA, Gbeleyi 1.0 and the lecture method on students' anxiety, and critical thinking skills to logic gate. A mixed-method design was adopted for data collection. The study population comprises of 213 (JS) two students who at the time of the study had not taken the (BECE) to ascertain the level of potency of the methods in question. The selected schools were randomly selected, 131 and 81 males. A pretest and posttest consisting of the anxiety test, and the critical thinking skill task were administered to the groups. The Critical Thinking Skill Task (CTST), Students' Anxiety Scale Test (SAST) and Students' Interview Guide (SIG) were the instruments developed for this study. A respectable reliability coefficient of 0.78 and 0.74 was obtained from the respectively. Data collection took six weeks, and the analysis was conducted using IBM SPSS version 23. The collected data underwent multivariate analysis of covariance. The results revealed a significant difference in the methods used, univariate ANOVA on anxiety [$F(3, 209) = 13.38$; $p<0.05$]. However, gender does not have a statistically significant effect ($F = 0.842$, $p = .360$), nor does the interaction between method and gender ($F = 2.262$, $p = .134$), suggesting that the impact of methods on post-anxiety does not vary significantly by gender.

1. Introduction

This study begins with an overview of Africa, then Nigeria the country where the study took place, its economy, Nigeria educational system, overview of Nigeria economy, its educational system, science and technology in Nigeria, integrating ICT education in schools, improving science and technology in Nigeria, concept difficulty in computer studies. It goes on to give the problem statement, purpose,

objectives, research questions, hypothesis, significance, scope of the study and limitations to the study.

The Federal Ministry of Education oversees education in Nigeria. The local authorities take responsibility for implementing state-controlled policy regarding public education and state schools. The education system is divided into kindergarten, primary education, secondary education and tertiary education. Nigeria's central government has been dominated by instability since declaring independence from Britain. Regional differences in quality, curriculum, and funding characterize the education system in Nigeria. Currently, Nigeria possesses the largest population of out-of-school students in the world Banko, et al (2023).

Science and Technology Education in Nigeria

In Nigeria, attention has recently been paid to the progressive development of science and technology, especially at the secondary school level. Government's deliberately policy on liberalisation of scholarships for undergraduate science courses, free technology education at the polytechnics and colleges of technology and free pre-service teacher training courses at the University and colleges of education, are examples of articulated efforts to prepare the country's soil to germinate and nurture science and technology as a basis for socio-economic development (Margaret, 2021).

Studies on Gbeleyi 1.0

Gbeleyi 1.0, invented by Gbeleyi O.A. in 2021, is an innovative educational tool designed to enhance learning through a learner-centered approach. It combines visual aids, animations, and culturally relevant music to engage students in learning complex concepts. The inclusion of cooperative learning strategies fosters collaboration among students, making the learning process more interactive and relatable (Gbeleyi, 2021). By incorporating elements of local culture, Gbeleyi 1.0 aligns with the cognitive and emotional needs of learners, helping them to grasp difficult topics more easily.

Gbeleyi (2021) reported a study titled Relative Effectiveness of Culturo-Techno-Contextual Approach and Gbeleyi 1.0 on Students' Achievement, Attitude, and Critical Thinking Skills to Logic Gate which analysed the statistical difference between the CTCA, Gbeleyi 1.0 and lecture method in learning of logic gate. Findings from the study revealed that there was a statistically significant difference in the achievement of student taught logic gate using CTCA, Gbeleyi 1.0 and those taught with lecture method.

Gbeleyi 1.0: It is an innovative educational tool designed to enhance learning through a learner-centered approach. It utilises animations, music, and cooperative learning strategies to help students engage with complex concepts, particularly in subjects like logic gates. By combining visual aids with culturally relevant music, it makes the learning experience more relatable and interactive, aligning with your goal of using local music to make knowledge easier to grasp. This app encourages

students to work in small, diverse groups, where they share their ideas, discuss, and learn from one another, thus promoting critical thinking and teamwork.

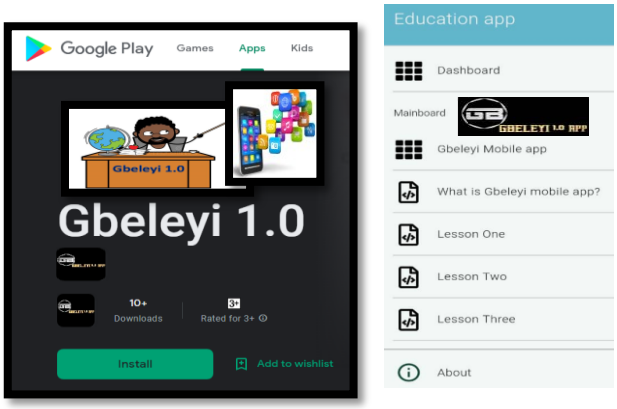

Figure 1. Administration of the Gbeleyi 1.0 (Treatment)

Culturo-techno-contextual approach (CTCA)

The culturo-techno-contextual approach (CTCA) was invented and formally launched in 2015. It is a teaching approach equips the student with the ability to meaningfully learn science in digital environment, not as an abstract concept, but as a body of knowledge that exist in his or her environment within his or her culture and relate to his or her daily life activities. Culturo-Techno-Contextual Approach is built on a three-legged stool of culture, technology, and context. It is a synthesis of the cultural environment in which students are immersed, technology-mediated communication on which teachers and students are increasingly reliant and locational context, which is a unique identity of each school and significant for citing local instances that the students can easily understand (Oladejo et al, 2021).

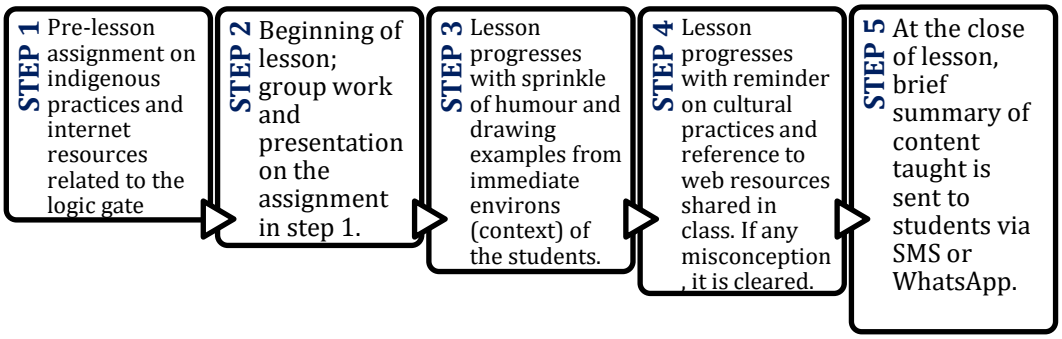

Figure 2. CTCA Implementation steps

The culturo-techno-contextual approach places a premium on culturally and contextually localization as a basis for comprehending human behavior and fostering meaningful leaning of scientific idea (Okebukola et al, 2016). Cultural and environmental context play a major role in the effective teaching and meaningful leaning of science. But then, it has been noticed that their roles have been underplayed in science education (Adebayo, 2021; Oladejo, 2020).

Anxiety

Anxiety is a psychological and physical response to treat a self-concept characterized by subjective, consciously perceived feelings of tension (Spielberger, 1983). Anxious students have experience of cognitive deficits like misapprehension of information or blocking of memory and recall. Speilberger reported two forms of anxiety: state anxiety – a response to a particular stimulation or set of circumstances, and trait anxiety – an intrinsic characteristic of the person. Previous anxiety research suggests that there are roughly two types that can be experienced at different psychological levels (Collins, 2025). Hancock concludes that students with high level anxiety show significantly less motivation in classrooms perceived as highly evaluative compared to students with low level anxiety (Hancock, 2001). Study anxiety is not only due to the lack of study motivation or to insufficient skills, but is also due to misperception about courses and negative experiences in previous study classes. High level anxiety is more closely associated with lowered performance in low-ability students than in high-ability counterparts (Hembree, 1998). At the global level, anxiety is viewed as a permanent trait, as some people are predisposed to be anxious. Previous studies found regarding anxiety disorders among students such exam anxiety, but no studies about potential sources of study anxiety among university student. Generally, study anxiety aimed individual perceive any anxiety symptoms because of difficult situation while study process.

Gender

Defining gender is both highly important and complex. Hegarty (2001) suggests that the quantitative researcher should address this definition from a performative perspective to de-construct the gender concept. In this way, gender is a non-essential category which instead is repeatedly performed based on societal norms (Morgenroth and Ryan, 2018). As the division of gender is ‘culturally and historically specific, internally contradictory, and amenable to change’ (Hegarty, Ansara, and Barker, 2018), quantitative research could support constructive arguments (Hegarty & Pratto, 2004). The construction of gender as binary is performed in, for example, social sciences when it is treated as a binary category (Morgenroth & Ryan, 2018). Such performance is completed, every time a researcher formulates an item in a survey or questionnaire where gender is assessed as dichotomous variable with only two (mutually exclusive) response options, because the notion of gender as binary is thereby maintained. Instead, we suggest operationalising gender as consisting of several aspects, which can be divided into the four main facets of: (a) physiological/ bodily aspects (sex); (b) gender identity or self-defined gender; (c) legal gender; and (d) social gender in terms of norm-related behaviours and gender expressions (the American Psychological Association refers to this aspect as ‘sex role’; APA, 2015).

Statement of the Problem

It is a commonly held view among students that science is difficult to learn (Okebukola, 2011). Readiness, motivation, cognitive preference orientation and general attitude to work are some attributes of the learner that pose barriers to

meaningful learning of science. Several studies (see reviews by Okebukola and Jegede, 1988; Okebukola, 2011) have provided evidence that many Nigerian children at the primary and secondary levels are not cognitively ready for the type of science that teachers present. These researchers and others, that teachers are presenting formal-operational concepts in science to students who are predominantly concrete operators have established it. This been described as cognitive mismatch rather than capacity deficit in explaining students' underachievement in science.

In spite of the importance of computer studies in national development, researchers have observed average achievement among computer studies students in senior secondary school certificate examinations. Chief examiner's report of 2017-2023 indicated average performance of computer studies students in WASSCE. The average performance of students in computer studies has been blamed on the teacher, learner, instructional method / strategy and learning environment (Antherson, 2013).

Table 1. Performance of Students in Computer Studies at SSCE level from 2018 to 2023

Year	No of Students Present	No of Students Pass	No of Students Fail	% Pass	% Fail
2022	182659	39125	143534	21	79
2021	228953	80355	148598	35	65
2020	250099	86150	163949	34	66
2019	289520	84520	205000	29	71
2018	326541	98215	228326	30	70
2017	367562	120560	247002	33	67

WASSCE: 2023.

Computer Studies is a subject that has positive impact on life-long human development as well as national development. The subject therefore requires competent teachers who can guide students towards achieving the desired educational goal. In spite of that, there is a serious decline in students‟ achievement in computer studies since its inclusion external examination from 2013 until date. According to Gbeleyi (2025), ineffective teaching practices may stem from a persistent reliance on outdated instructional approaches, not aligning with the context of the learners, and the use of big vocabularies with the topic. This aligns with Johnbosco (2019), who attributes poor teaching methods to the continuous use of the conventional lecture method in classrooms.

In other words, the concern of this study therefore is to investigate whether the use of the CTCA and Gbeleyi 1.0 App could enhance students' gender and anxiety in computer studies at the junior secondary school level, and to determine the effects in the study.

The following questions were raised to guide the enquiry:

1. Will there be any statistically significant difference on students' anxiety in logic gate on the teaching methods, (CTCA), and Gbeleyi 1.0?

2. Will there be a statistically significant interaction effect of method and gender on students' critical thinking skills in logic gate?
   And the null hypotheses (H0) were formulated from the research question above and tested at an alpha level of 0.05.

Theoretical and Philosophical Frameworks of the Study

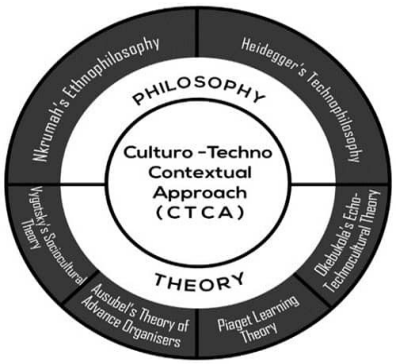

Figure 3. Theoretical Framework of the Study. (Source: Okebukola, 2019).

Figure 4. Indigenous Knowledge Illustrations used in Teaching Logic Gate – Gbeleyi (2025).

Data Analysis and Findings

IBM-SPSS Version 23 was used to analyse the data generated from the questionnaires. After the initial raw analysis of the three-point scale of not difficult, moderately difficult and very difficult and the four-point scale of strongly agree, agree, disagree and strongly disagree, for parsimony, clustering into difficult or not difficult and yes or no were achieved via data transformation. In the data coding process, not difficult was scored 1, moderately difficult=2, very difficult=3. For each respondent, it was then possible to get a difficulty score which ranged between 1 and 3. The mean rank method (Okebukola, 1986; 1987) was used to answer the main research question of the study.

2. Methodology

The quasi-experimental phase adopted the mixed methods design with quantitative and qualitative components interplaying on a pretest, treatment, posttest framework. Logic gate was selected for this phase having seen as one of the most difficult topics elicited from the first phase by the students.

Study Population

The population of the study comprises of all the junior secondary school students in Lagos State, in the 2024/2025 academic year. This population was used because the subject of course computer studies is a subject offered by all students in the State. The subject is offered at the JS-level of their program and it must be passed before graduation to the next level SS. The quasi-experimental phase had 213 junior secondary class 2 students in the sample. About 62% of the respondents were females while about 38% were males. While the schools were purposively selected, the students were in intact classes.

Instrumentations

The following instruments were developed and used for data collection:
1. Difficult Concepts in Computer Studies Questionnaire, and
2. Okebukola's Science Anxiety Scale Test (OSAST).

Ranking of difficult concepts in senior secondary computer studies (N = 1,501)

S/N	Topics	Mean score	Rank
1	Flowcharting	2.12	1st
2	Algorithm	2.07	2nd
3	Problem solving skills	2.00	3rd
4	Program development cycle	1.96	4th
5	Machine language	1.91	5th
6	Computer Ethics and human issues	1.84	6th
7	Logic circuit	1.82	7th
8	Computer fundamentals and evolution	1.81	8th
9	Networking	1.77	9th
10	Arithmetic logic unit	1.74	10th
11	Managing computer files	1.73	11th
12	BASIC programming	1.65	12th
13	Computer applications	1.55	13th
14	Booting	1.53	14th
15	Telecommunication	1.53	14th
16	Basic computer operations	1.49	16th
17	Binary numbers	1.45	17th
18	Operating system	1.44	18th
19	Components of a computer system	1.35	19th

Figure 5. Findings from the Survey Phase

Procedure for Data Collection

The researcher obtained a letter of introduction from the ACEITSE centre of the Lagos State University authority which will be presented to the secondary school

authorities of the sample schools for permission to carry out the research in their schools. After seeking clearance from relevant authorities, the researcher with the help of research assistants calmed the students in preparation for the pretest after which a pilot study was done in a different school with similar characteristics. The objectives of the study were explained to the students to make them feel relaxed and know that they do not need to spy on what another is doing.

Procedure for Data Analysis

The quantitative data generated was analysed using IBM-SPSS Version 23. All data collected were first be coded according to ensure all parameters are available for the analysis. Normality test: Normality of population test was conducted using IBM-SPSS version 23 in other to ensure that the population is not different from normal. Shapiro-Wilk's test, Q-Q plot and the normal curve histogram will be reported. For the population not to be different from normal it must not be significant at $p<0.05$ level of significance.

Table 2. Student anxiety scale (Okebukola, 2015)

Happy	Relaxed	Eager	Afraid
Uncomfortable	Upset	Scared	Alarmed
Overjoyed	Delighted	Cool	Satisfied
Excited	discouraged	Calm	Jubilant
Sorrowful	Bored	Anxious	Sad

Data Analysis and Results

Research Question 1

Will there be any statistically significant difference on students' anxiety in logic gate on the teaching methods, (CTCA), and Gbeleyi 1.0?

Table 3. Descriptive Statistics

Dependent Variable: Post_Anxiety

Methods	Mean	Std. Deviation	N
CTCA	28.80	2.09	46
Gbeleyi 1.0	28.57	2.22	72
Lecture Method	26.91	3.60	95
Total	27.88	3.02	213

Table 4. Ancova Result Tests of between-subjects Effects

Tests of Between-Subjects Effects
Dependent Variable: Post_Anxiety

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	311.12[a]	3	103.71	13.38	.000	.16
Intercept	4228.09	1	4228.08	545.57	.000	.72
Pre_Anxiety	147.33	1	147.33	19.01	.000	.08
Methods	111.83	2	55.92	7.22	.001	.07

Error	1619.71	209	7.75			
Total	167470.00	213				
Corrected Total	1930.83	212				

a. R Squared = .161 (Adjusted R Squared = .149)

The ANCOVA results indicate that the overall model significantly predicts post-anxiety scores, F (3, 209) = 13.38, p < .001, with approximately 16.1% of the variance explained (Adjusted R^2 = .149). Both pre-anxiety and the type of intervention method had significant effects on post-anxiety. Pre-anxiety was a strong predictor (F = 19.01, p < .001, partial η^2 = .08), indicating that initial anxiety levels significantly influenced outcomes. Importantly, the method of intervention also had a significant effect on post-anxiety scores (F = 7.22, p = .001, partial η^2 = .07), suggesting that different methods resulted in varying levels of anxiety reduction, even after accounting for baseline anxiety. These findings support the effectiveness of the intervention methods and highlight the importance of considering pre-intervention anxiety levels when evaluating treatment outcomes.

Research Question 2

2. Will there be a statistically significant interaction effect of method and gender on students' critical thinking skills in logic gate?

Table 5. Tests of Between-Subjects Effects

Dependent Variable: Post_Anxiety						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	330.042[a]	5	66.008	8.536	.000	.171
Intercept	4160.083	1	4160.083	537.947	.000	.722
Pre_Anxiety	159.440	1	159.440	20.617	.000	.091
Methods	112.765	2	56.382	7.291	.001	.066
Gender	6.512	1	6.512	.842	.360	.004
Methods * Gender	17.491	1	17.491	2.262	.134	.011
Error	1600.785	207	7.733			
Total	167470.000	213				
Corrected Total	1930.826	212				

a. R Squared = .171 (Adjusted R Squared = .151)

The ANCOVA results indicate that the overall model significantly predicts post-anxiety levels, F (5, 207) = 8.536, p < .001, with 17.1% of the variance explained. Pre-anxiety levels significantly affect post-anxiety (p < .001), suggesting that initial anxiety plays a notable role in post-treatment outcomes. Teaching methods also show a significant effect (p = .001), indicating that different methods influence post-anxiety differently. However, gender (p = .360) and the interaction between method and gender (p = .134) are not significant, implying that gender alone or in combination with teaching method does not significantly impact post-anxiety. Overall, pre-anxiety and teaching method are the primary contributors to differences in post-anxiety levels.

3. Results and Discussion

Research Question 1

Is there statistically significant difference in the (a) achievement, and (b) critical thinking skills of students taught logic gate using CTCA, Gbeleyi 1.0, and the lecture method? And the hypothesis stated that there will be no statistically significant difference in the (a) achievement, and (b) critical thinking skills of students taught logic gate using CTCA, Gbeleyi 1.0, and the lecture method.

Findings

Mancova analysis revealed that there was a statistically significant difference in the Critical thinking skills scores of students taught logic gate using methods.

Discussion of Results, Research Question 1

The finding in table 4.1 shows that students that were taught logic gate using the concept of CTCA outperformed than those who were taught using the traditional method. This significant difference must have resulted from the different levels of cultural related concepts related to the topic in the classroom teaching and on the field exposure of the treatment. Another major forecaster of students' academic performance and CTS could be attributed mixed-ability grouping in the CTC approach set-up, the teacher specifically mentioned the excitement and change of attitude among the students. Earlier conducted Saanu (2015) investigated the efficacy of the CTCA on the achievement and attitude of students in logic gate. He sought to establish whether (a) the use of the CTCA will enhance the achievement of students in logic gate (b) the use of the CTCA will enhance the attitude of students to logic gate. Using a purposive sample of an intact class of thirty students of mixed-sex, the results of his study showed a statistically significant difference between CTCA and lecture method in students' achievement in logic gate [$F(1, 59) = 15.261$; $p<0.05$].

Also, Funa, & Prudente, (2021), on the efficacy of problem-based learning (PBL) on students' achievement in learning of science: The Meta-Analysis findings had shown that PBL, as a method to teaching& learning science, had a large and positive effect (ES = .871) on the achievement of secondary students. However, score levels and various scientific disciplines did not influence students' learning achievement. In-line with this, Ugwuanyi (2018) employed a quasi-experimental design, specifically the pre-test, post-test non-equivalent control group design. Two research questions and two hypotheses guided the study. The results revealed that students taught geometry using ICT tools performed better than students taught using conventional method; male and female students performed equally when taught geometry using IT tools.

Research Question 2

Will there be any statistically significant difference on students' anxiety in logic gate between the teaching methods
There will be no statistically significant difference on students' anxiety in logic gate between the teaching methods.

Findings

The ancova analysis revealed that there is a statistically significant difference in the anxiety of students taught logic gate using CTCA, Gbeleyi 1.0, and lecture method on the intended career in the senior class.

Discussion of Results, Research Question 2

The finding is consistent with the works of Yusuf and Balogun (2018) that gender influence on their competence and attitude was also examined. Findings revealed that majority of the student-teachers have positive attitude towards the use of ICT and they are competent in the use of few basic ICT tools. Overall, no significant difference was established between male and female student-teachers' attitudes and use of ICT. The implication is that the student-teachers lacked the necessary competence in the full integration of ICT in the curriculum.

Contrariwise, Arifah, (2021) in a study that aims to find mathematics critical thinking skill patterns based on gender and learning styles: visual, auditory, and kinesthetic. The findings concluded that male and female students' mathematics critical thinking skills with visual, auditory, and kinesthetic styles were varied. There were found male and female students with visual, auditory, and kinesthetic styles whose different critical thinking skills in interpreting, analyzing, evaluating, concluding with excellent, sufficiently excellent, and poor categories.

Summary, Conclusion and Recommendations

Summary of the Study

This study is organised into six chapters. In chapter one, the introduction and overview of the study was provided. Included were the background to the study, problem statement, and objectives of the study. In chapter two, the related theoretical and empirical literatures were reviewed. In chapter three, the research methodology employed, which includes model formulation, data collection and measurement, theoretical underpinning and estimation techniques were looked at. Chapter four covered findings from the study, chapter five is preoccupied with the discussion of the results and chapter six the summary, conclusion, and recommendations.

4. Conclusion

The study highlights the relative effectiveness of culturo-techno-contextual approach (CTCA) and Gbeleyi 1.0 on students' achievement, anxiety, attitude and

critical thinking skills to logic gate. In chapter one, the study traces indigenous knowledge system from the African perspective before the advent of western civilisation drawing from the all part of the country Nigeria. Also, a brief attempt at examining public administration post-colonial Africa and Nigeria is has been captured as part of the introductory phase of this study, with a review of definitions of the course be earlier writers. The initial chapter also focuses specifically on the Culturo-Techno Contextual Approach (CTCA) which is the model tested for computer studies with some literature on the agenda 2063 explained to emphasis the need for indigenous knowledge systems in the teaching of computer science.

The second chapter reviewed literature on indigenous knowledge systems, African Association for the study of indigenous knowledge systems and the national association for research in science teaching to establish the premises for the main theory for the study. The CTCA is subsequently reviewed with an outline of factors affecting the implementation of CTCA explained. Relationships between gender and other variables in the study of computer science has also been captured with further literature on ICT from indigenous perspectives explained. The third chapter presented the sequence of activities in the methodology of the study from sampling through instrumentation and procedure to data analysis. While chapter four, highlighted the findings of the results and experimental studies undertaking in this study.

The study concludes within the scope and limitations of this study, it is tentatively recommended that: Seminars and workshops should be organized by the ministry of education and other educational offices for teachers in the field of science and technology to be acquainted with the teaching of scientific concepts using CTCA; Curriculum planners and developers should adopt CTCA and create more time for the teaching of computer studies since the usual allotted time is inadequate for the effective implementation of CTCA in instructional delivery; Interested researchers should carry out further studies so as to extend investigation on the effects of CTCA in other areas; and well-equipped computer laboratories & internet-enabled devices should be made available to students.

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