



Impact of Computer Aided Learning on Conceptual Change: Nigeria Teacher Education Students' Perception

Musa Muhammad Ndagie^{a*}, Ayeduso Janet Oloruntimilehin^b, Awoniyi Ruth Bola^c, Ajinuhi Samuel Adebola^d

^aDepartment of Computer Science, Fed. College of Education, PMB 39 Kontagora, Niger State, Nigeria

^{b,c,d}Department of Business Education, Fed. College of Education, PMB 39 Kontagora, Niger State, Nigeria

^aEmail: mmuhammadu@yahoo.com, ^bEmail: jayeduso@yahoo.com

^cEmail: rbawoniyi@yahoo.com, ^dEmail: ajinuhisamuel@yahoo.com

Abstract

Increased reliance on ICT for our works today has motivated students' use of Computers, mobile devices, and other Information and Communication Technology (ICT) tools for learning purposes. Use of ICT by students is on the rise in Nigerian Colleges of Education. Conceptual change is crucial in knowledge acquisition, especially in Technical, Vocational and Science Education (TVS), where students often struggle with proper mastery of scientific concepts that contrast with their extant knowledge. Conceptual change is often required in learning process to enable proper mastery of scientific concepts. Computer Aided Learning (CAL) is a kind of technology that enable students to learn through use of Computers. This study examines the influence of computer assisted learning on Conceptual Change among Teacher Education students. It surveyed Business and Computer students of four Colleges of Education in the North-Central zone of Nigeria to discern their perception on how CAL affects Conceptual Change. 182 students responded to 26-item questionnaire on students' perception of CAL's effect on Conceptual Change. Mean, Standard deviation, t-test, and one-way ANOVA statistics were used to analyze the data. Results indicate that the Teacher Students perceive that CAL usage impacts positively on Conceptual Change. This research has helped in showing that usage of CAL by the students supports Conceptual Change.

* Corresponding author.

Among recommendations made is that: Colleges of Education should be better positioned and well equipped to enable use of CAL and other ICT tools by students in order to promote conceptual change for enhanced learning.

Keywords: Conceptual change; Computer Aided Learning; Computer Aided Instruction; ICT in Education.

1. Introduction

Colleges of Education are the third tier of Nigerian higher education institutions, taking after Universities and Polytechnics. These Colleges are teacher-training institutions which were established with mandate to train and equip teachers for the Universal Basic Education Programme of Nigeria. The Colleges generally run three (3) year courses of study in diverse disciplines and award the National Certificate in Education (NCE). Graduates of Colleges of education constitute the major source of manpower for Primary and Junior Secondary schools teaching positions in Nigeria. Students of Colleges of Education, also called NCE students, occupy a crucial position in the country's education system – being potential source of Nigeria's Basic Education manpower. The quality of Education and training they receive determine, to a great extent, the quality of education that is provided in Pre-primary, Primary and Junior Secondary Schools. This implies that education and training needs of NCE students deserve utmost attention at all times. In other words it is imperative that the quality of teaching and learning that takes place in Colleges of Education be maximized at all times given the strategic role they play in the society. Recent innovations in Technology, Vocation and Science (TVS) has promoted and widened the scope of educational technology. The combined use of Computer and the Internet resources are now common education technology that are used in and outside the class today to enhance the quality of teaching and learning. ICT awareness and its adoption in Education and other sectors is on the rise in Nigeria. Although the Nigerian Education system is yet to record significant alignment with developed countries in terms of computer and ICT usage literature indicates that there is good level of awareness and usage of ICT in Nigerian schools and colleges [1, 2, 3, 4]. This research surveyed NCE students of two different departments: Business Education and Computer Science Education departments, of four Colleges of Education in North-Central Nigeria. The outcome of this research has helped in unveiling the positive effects that use of CAL (and ICT in general) in education impacts on Conceptual change for Teacher education students in Nigeria. The use of Computers and indeed ICT in education has been a priority in many countries including Nigeria, even though progress has been uneven. ICT has impacted the education sector considerably both in aspect of organization as well as that of teaching and learning methods. The author of [5] submits that considerable differences exist in ICT expenditure levels within and between countries, as well as between institutions within countries. Schools in some countries have embedded ICT into the curriculum, and demonstrate high levels of effective ICT use to support teaching and learning, while in other countries, schools are still in the early stage of its adoption. These have climaxed into important enhancements of the learning process [5]. The Nigerian Education sector is still trailing behind the developed countries in terms of computer and ICT usage. However, literature indicates that there is appreciable level of awareness and usage of computer and ICT in Nigerian schools and colleges [1, 2, 3, and 4]. The authors of [3] examined Students' perception on CAL usage in Mathematics in 6 Secondary Schools in Nigeria. Results indicate majority of students had positive perception on the use of Computer Aided Instruction for studying Mathematics. Authors of [6] studied medical students' perception of computer assisted teaching

and learning of anatomy in a scenario where cadavers (corpses) are lacking. Results indicate that medical students perceive the use of CAL in teaching of anatomy as good and useful for supplementary purpose only. In a quasi-experimental study, authors of [4] examined the “Effects of Computer Assisted Instruction (CAI) on Secondary School Students’ Performance in Biology” and arrived at findings, which show that students that are exposed to Computer aided instruction (CAI) performed better than their counterparts that were taught using conventional classroom instruction. Also, [1] found that CAI usage by secondary school students in study of Economics helped in enhancing learning and making performance better. Conceptual change has been playing a great role in Technology, Vocation and Science (TVS) teaching and learning. Conceptual change or the process of replacing a misconception with the correct one is so paramount for proper understanding of concepts and effective teaching and learning that Literature is replete with research works on it. Prominent among these include authors of [7, 8, 9, 10, 11]. Although research abounds, which has proved that conceptual change affects students’ learning, but research investigating the impact of Computer Aided Learning (CAL) on conceptual change is scarce, especially in the Nigeria setting. Consequently this research aims to find out the impact of computer assisted learning on conceptual change. As the curiosity of this work borders on determining the impact of Computer assisted learning (CAL) on Conceptual change experienced by students we proceed, hereunder, to review these two concepts in greater details.

1.1. Concept of Computer Assisted Learning (CAL)

Computer-assisted learning (CAL) is any use of computers to aid or support the education or training of people, [12]. According to [13], CAL is the use of electronic devices/computers to provide educational instruction and to learn. Other terms used to describe this application of computers include computer-aided instruction (CAI), computer-based learning (CBL) and computer-managed instruction (CMI). It is the use of instructional tools presented and managed by a computer. Computer-assisted learning is similar to the experiential model of learning. Learning occurs when we immerse ourselves in a situation in which we are forced to perform. We receive feedback from the computer output and then adjust our thinking-process if needed. CAL forces the learner to learn by doing, failing, and practicing until he/she does it right. Many research works in recent years have reported the benefits and advantages of computer usage in the teaching and learning process at all levels of education. The author of [14] studied the effectiveness of Computer Assisted Language Learning (CALL) in English language learning and findings showed that majority of learners found CALL system helpful in improving their language skills. CAL increases Learning Efficiency, with CAL students pick up concepts or skills faster and with ease and also retain what they have learned longer [13]. CAL brings positive effects on users by increasing their knowledge in a far better and joyful ways [15]. CAL forces active participation of students, which contrasts with the more passive role in reading a book or attending a lecture [16]. Self-paced learning, self-directed learning, use of various senses and media variety are some of the potential benefits of CAL [3].

1.2. Concept of Conceptual Change

Conceptual change has been defined in various ways. In the view of [7], conceptual change involves going through a process of accommodation, which results to schema change when learners are exposed to new

information that does not fit with their existing conceptions. It is a process that changes or replaces an existing conception with a new conception [17]. In their Dynamic Model for Conceptual Change (DMCC) work authors of [9] posit that conceptual change is equivalent to building on an existing conception to form a new explanation while retaining explanation of the original extant conception. In the view of [8], conceptual change is simply a change or restructuring of a personal “theory”. Going by the foregoing definitions it is easy to see that Conceptual Change is the process of replacing a misconception with correct and scientifically acceptable conception. It is a common phenomenon in TVS education. Oftentimes students do come to school with their own conceptions, beliefs, or naïve explanations of natural phenomena, which in most cases are incorrect, and therefore, are required to be replaced or suppressed with correct science-backed explanation or conception. The process of transition from misinformation or inaccurate knowledge to correct conception is what conceptual change entails.

1.3. Role of Computers in Conceptual Change

In addition to the benefits and advantages of computer usage in the teaching and learning process at all levels of education CAL also has the potential to enhance conceptual change. Recent studies aimed at using computers in enhancing learning have successfully developed the computer as a cognitive tool for facilitating teaching and learning. Consequently, there emerge studies and technologies of using the computer as a tool to foster conceptual development and conceptual change in classroom. In [17] the following three major roles of the computer as a cognitive tool in enhancing conceptual change and thereby promoting good education were highlighted.

- Computer simulations
- Agent technology
- Intelligent System as Assessment Method

These cognitive technologies were designed to transform computers to effective and intelligible tools that provoke reasoning and comprehension skills. In conjunction with educators’ aid, these cognitive tools would catalyze promotion and enhancement of learning experience and students’ conceptual change.

1.4. Purpose of the study

This study is intended to gain knowledge of NCE students’ perception on the impact of computer assisted learning (CAL) on conceptual change. The study was designed to assess (NCE) students’ opinion on how CAL usage in education impacts conceptual change.

1.5. Research Questions

- I. In what way do (NCE) students feel that Computer Assisted Learning impacts conceptual change?
- II. Are there differences in (NCE) students’ perception of CAL’s impact on Conceptual change based on college differences?
- III. Are there differences between male and female students’ perception of CAL’s impact on Conceptual

change?

- IV. Are there differences Business and Computer students' perception of CAL's impact on Conceptual change?

1.6. Research Hypothesis

- I. There is no significant difference between (NCE) students' perception of CAL's impact on Conceptual change based on College differences.
- II. There is no significant difference between male and female students' perception of CAL's impact on Conceptual change.
- III. There is no significant difference between Business and Computer students' perception of CAL's impact on Conceptual change.

2. Materials and Methods

2.1. Research Type

Survey method is used in this research to enable a reliable assessment of students' perception of CAL's impact on conceptual change. Data was collected on 26-item questionnaire from target population in the four Colleges of Education.

2.2. Research instrument

The researchers developed an anonymous questionnaire for this research. The questionnaire was pilot tested on different groups of students in one of the colleges and the data collected was successfully tested for internal consistency using Cronbach's alpha method prior to its adoption for the survey proper. This is described in the instrument validation section below.

2.3. Instrument Validation

Cronbach's alpha coefficient was used to test the internal consistency of the data as a way of validation. Microsoft Excel program was the platform upon which the data was analyzed. Excel software has rich set of statistical tools and resources, thereby making it easy and efficient to do statistical tests and calculations on the collected data including the cronbach alpha. The cronbach alpha value of data from our 26 item questionnaire is 0.77. As a rule of thumb, literature posits that the cronbach alpha value of an internally consistent questionnaire should be equal to or greater than 0.7, [18].

2.4. Data Sample

Computer Education (CSC) and Business Education (BED) students of four Colleges of Education in the North-Central zone of Nigeria made up the population for this study. Random sampling technique was used to administer questionnaire to the students. A total of 280 copies of questionnaires were administered by the researchers themselves - 70 copies per college. Care was taken to ensure even distribution among students of the

target departments in each college with respect to gender ratio disparity. A total of 225 completed questionnaires were returned of which 45 were adjudged unacceptable by the researchers and were, therefore, not used. Data collected from the remaining 182 samples whose distribution is shown in table 1 were analyzed.

Table 1: Study sample distribution

S/N	College	Business Students			Computer Students			All Students		
		Male	Female	Sum	Male	Female	Sum	Male	Female	Sum
1	College1	4	20	24	16	22	38	20	42	62
2	College2	7	15	22	6	17	23	13	32	45
3	College3	8	8	16	7	9	16	15	17	32
4	College4	17	10	27	10	6	16	27	16	43
	TOTAL	36	53	89	39	54	93	75	107	182
		40.5%	59.5%		42.0%	58.0%		41.2%	58.8%	100%

3. Results

The method of [3] was adopted to provide answer to the research question one in this study. The questionnaire contains 26 items as shown in table 2. Each item mean (X) and the criterion mean (3.00) were calculated and used to measure the level of agreement and or disagreement. It was agreed that if the item mean (X) is greater than criterion mean (3.00), the option is positively rated (agree); if otherwise, the option is rated negatively (Disagree).

3.1. Answering Research question I

In what way do (NCE) students feel that Computer Assisted Learning impacts conceptual change?

Results of data analysis in **Table 2** below answers this question as explained hereunder.

Table 2, shows that more than 50% of respondents perceive that CAL positively impacts conceptual change. This can be seen from the nature of their responses to over 90% of the positive statements (1 - 8, 10, 13, 16, 17, 20, 21, 23 & 24). It can be seen that higher proportion of students feel and believe that: they have high level of computer competence (67%); their academic progress is attributable to their computer competency level (64%); learning is faster with ICT tools (58%); academic progress correlates with computer literacy level (67%); students that use Computer Aided Instruction perform better than those who do not (57%); all students have comparable proficiency in CAL usage (61%); they enjoy using Computer facilities to learn (77%); computer literacy aids in learning new concepts (73%) and quick learning (69%); computer students are at advantage in terms of CAL usage (70%); new concepts are better taught with CAL (55%); ICT use has positive impact on students' learning (62%); CAL is easy to use, fun, and lively (71%); they would rather study with use of CAL only (47%); and that CAL use is better in pure science classes (44%).

Table 2: Number and percentage of NCE students' attitude on computer-assisted learning

S/N	STATEMENT	SD	D	U	A	SA	Mean
1	My level of computer competence (SD=very low... SA=very high)	8 (4.40%)	14 (7.69%)	38 (20.88%)	60 (32.97%)	62 (34.07%)	3.85
2	I can attribute my academic performance to my computer usage competence level	12 (6.59%)	16 (8.79%)	37 (20.33%)	55 (30.22%)	62 (34.07%)	3.76
3	I assimilate faster when taught with ICT resources	12 (6.59%)	22 (12.09%)	42 (23.08%)	38 (20.88%)	68 (37.36%)	3.70
4	There is a strong relationship between my comp. literacy and my academic success	11 (6.04%)	18 (9.89%)	31 (17.03%)	48 (26.37%)	74 (40.66%)	3.86
5	Students exposed to CAI activities do better in academics	22 (12.09%)	16 (8.79%)	39 (21.43%)	50 (27.47%)	55 (30.22%)	3.55
6	Business Education students will not differ from computer students in understanding when they learn using computer	24 (13.19%)	12 (6.59%)	34 (18.68%)	39 (21.43%)	73 (40.11%)	3.69
7	Business student do better on the key board than computer students	44 (24.18%)	27 (14.84%)	26 (14.29%)	24 (13.19%)	61 (33.52%)	3.17
8	I enjoyed learning by using computer facility	7 (3.85%)	10 (5.49%)	24 (13.19%)	31 (17.03%)	110 (60.44%)	4.25
9	Computer aided instruction facilitates better learning in computer class than in business education class	9 (4.95%)	21 (11.54%)	31 (17.03%)	50 (27.47%)	71 (39.01%)	3.84
10	My understanding of computer has been of advantage in understanding of new concepts	9 (4.95%)	12 (6.59%)	28 (15.38%)	51 (28.02%)	82 (45.05%)	4.02
11	Computer aided instruction makes learning cumbersome and uninteresting	60 (32.97%)	18 (9.89%)	49 (26.92%)	31 (17.03%)	24 (13.19%)	2.68
12	I can excel in my academics without CAI	50 (27.47%)	27 (14.84%)	26 (14.29%)	36 (19.78%)	43 (23.63%)	2.97
13	My understanding of computer has been of advantage in my ability to learn faster	10 (5.49%)	20 (10.99%)	25 (13.74%)	36 (19.78%)	91 (50.00%)	3.98

14	I prefer receiving instruction from lecturers than CAL	26 (14.29%)	30 (16.48%)	38 (20.88%)	34 (18.68%)	54 (29.67%)	3.33
15	CAL looks somewhat abstract and difficult	47 (25.82%)	35 (19.23%)	33 (18.13%)	33 (18.13%)	34 (18.68%)	2.85
16	Computer students are at advantage when learning with CAL	11 (6.04%)	15 (8.24%)	27 (14.84%)	39 (21.43%)	90 (49.45%)	4.00
17	New concepts are better taught with CAL	19 (10.44%)	24 (13.19%)	38 (20.88%)	35 (19.23%)	66 (36.26%)	3.58
18	I prefer the former method of instruction than CAL	47 (25.82%)	33 (18.13%)	26 (14.29%)	41 (22.53%)	35 (19.23%)	2.91
19	I am not satisfied with CAL as it goes with scientific innovations	54 (29.67%)	32 (17.58%)	25 (13.74%)	37 (20.33%)	34 (18.68%)	2.81
20	ICT based instruction have positive impact on students learning and understanding of content	24 (13.19%)	11 (6.04%)	34 (18.68%)	53 (29.12%)	60 (32.97%)	3.63
21	CAL as a new method of learning makes learning faster, easier and lively	13 (7.14%)	13 (7.14%)	25 (13.74%)	39 (21.43%)	92 (50.55%)	4.01
22	I can do better in my academics without CAL	48 (26.37%)	21 (11.54%)	28 (15.38%)	42 (23.08%)	43 (23.63%)	3.06
23	If I have my way I would rather study using CAL only	32 (17.58%)	23 (12.64%)	42 (23.08%)	50 (27.47%)	35 (19.23%)	3.18
24	CAL is better used in pure science classes	29 (15.93%)	28 (15.38%)	43 (23.63%)	38 (20.88%)	44 (24.18%)	3.22
25	I prefer traditional learning methods than CAL	50 (27.47%)	23 (12.64%)	36 (19.78%)	42 (23.08%)	31 (17.03%)	2.90
26	I am not satisfied with CAL as it requires knowledge of science	56 (30.77%)	30 (16.48%)	30 (16.48%)	31 (17.03%)	35 (19.23%)	2.77

As for the negative statements (11, 12, 15, 18, 19, 22, 25, & 26), it can also be observed that the proportions of students that disagree is more than those that agree in over 95% of the cases even though none is able to make it up to 50%. Thus, 42% of students disagree that CAL makes learning cumbersome and uninteresting while 30% agree to it. 41% disagree that they could excel in academics without CAL against 43% that agree to it. 44% of students disagree that CAL looks abstract where 37% agree to it. 43% of students prefer traditional method of instruction to CAL. 39% of students indicated dissatisfaction with CAL as it goes with scientific principles while 47% feel satisfied with CAL. 37% disagree to doing better in academics without CAL while 46% agreed.

The foregoing analysis shows clearly that larger proportion of NCE students in this study are of the notion that CAL has positive (assistive) impact on Conceptual Change.

3.2. Test of hypothesis

Hypothesis I: There is no significant difference in the students’ perception of CAL’s impact on Conceptual change based on college difference.

One way ANOVA statistics was used to test this hypothesis. To achieve this the mean, sum of squares, mean squares, F-statistics, and p-value were computed from the collected data. The result of the analysis is shown in table, 3.

Table 3: Analysis of Variance for differences in students’ attitude based on college difference

Source	Degrees of freedom	Sum of Squares	Mean Square	F	P value
Treatments	3	15.26	5.08712	2.48	0.06
Error	4728	9717.01	2.05433		insignificant
TOTAL	4731	9732.27			
				(F _{3,4728,0.05}	= 2.61)

The ANOVA results in table3 indicate that mean values of students’ data from each of the four colleges do not differ significantly. It can be seen that the F value of the data (2.48) is less than the critical F value at 0.05% alpha level (2.61). Also, the p-value (0.06) is greater than alpha (0.05). These results indicate that there is no significant difference in students’ perception on CAL’s impact on conceptual change based on college differences. Consequently, hypothesis I is accepted, thereby providing answer to research question2.

Hypothesis II: There is no significant difference between male and female students’ perception of CAL’s impact on Conceptual change. To test this hypothesis, t-test statistics was used to determine the extent of difference between the mean scores of the two groups. The result of the analysis is shown in table 4.

Table 4: T-test of difference in students’ perception based on gender difference

Variable	No. of samples (n)	Degrees of freedom	Mean (X)	Variance (S ²)	t-value	P-value
Male	1950	4730	3.5236	2.2804	3.189	0.00143
Female	2782		3.3886	1.8939		significant

In table 4, the P-value (0.00143) is smaller than alpha (0.05) - evidence that t is in rejection region. On this basis Hypothesis III is rejected. Thus the difference between the students’ attitude to CAL based on gender difference is significant. Consequently male students have a different perception on CAL’s impact on conceptual change than female students. This provides answer to research question three.

Hypothesis III: There is no significant difference between Business and Computer students’ perception of CAL’s impact on Conceptual change. To test this hypothesis, t-test statistics was used and the result of the analysis is shown in table 5.

Table 5: T-test for difference on students’ perception based on differences in course of study

Variable	No. of samples (n)	Degrees of freedom	Mean (X)	Variance (S ²)	t-value	P-value
CSC	2418	4730	3.3370	2.1160	5.269	0.000001
BED	2314		3.5562	1.9720		significant

In table 5, the extremely small P-value (0.000001) puts t in rejection region. On this basis hypothesis III is rejected. This means that Business students’ perception on CAL’s impact on conceptual change is different from that of Computer students’ perception. This answers the research question four.

4. Discussion

These results generally indicate that the Subjects in this study (Business Education and Computer Science Education students in four colleges of Education in the North-Central zone of Nigeria) have the perception that computer assisted learning has positive impact on Conceptual Change. This outcome is consistent with a number of research findings including that of [1,3] where CAL usage in education is reported to have yielded huge benefits, included among which is that it making studies more enjoyable and fun. Moreover, the results is corroborated by the high ‘motivating’ and ‘cognitive engaging’ power of CAL, which according to [9], are essential factors that drive conceptual change. Results also indicate that students’ perception is similar irrespective of college of study. The real basis for variances in students’ opinion based on gender and course differences is not established in this studies. However, it is reasonable to think that the gender based difference might be due to the differences in the proportion of male to female students’ population in the collages as reflected in our sample population of table1. We can see that the population of female students is more than that of male students (approximate ratio being 55:45). Also, the fact that Business students differ from Computer students in the extent of their interaction with/and usage of computers in their studies could be a strong factor behind the difference in perception of computer students and that of business students.

5. Conclusion

The popular opinion of teacher education students that were surveyed in this research is that CAL has positive impact on conceptual change so it is easy to see that CAL has great potential to promote learning. This observation is partly attributable to the prevalence of usage of computers and other ICT tools in Education and almost all aspects of our daily lives today - trend of reliance on ICT. This observation indicates that NCE students are happy with and ready to use CAL in their studies. By and large the outcome of this research has helped in unveiling the positive impact of CAL and ICT use in education by unveiling the positive effect of CAL usage on conceptual change in the context of Nigerian Teacher students.

5.1. Limitations and suggestion for further studies

This study is limited to students of Computer Science and Business Education Departments of colleges of Education in the North-central zone of Nigeria. The results cannot be generalized to include all students of the colleges of education yet. More studies of similar kind is required to determine if the results would be the same for other students. This study should be expanded to include more categories of teacher education students. Consequently the researchers have a plan to repeat this research work in future with different groups of teacher education students in order to know the generalizability or otherwise of the findings in this research to all teacher education students.

5.2. Recommendations

In line with the findings of this research, which generally indicate that use of CAL and other ICT tools in learning by students do promote understanding and make learning more effective, we put forth the following recommendations.

- I. Authorities of Colleges of Education and sister institutions should, conduct more studies to look in to the impact of CAL and ICT usage in colleges and advice on how to improve it in order to gain the full benefits of its adoption in teaching and learning.
- II. Governments and policy makers should make and enforce Education policies that would emphasize usage of computers and ICT in education delivery system of Nigeria in order to place Nigerian Education at par with that of developed countries.
- III. Educational institutions should be properly funded to enable them introduce and use the CAL technologies in vogue for better education delivery.
- IV. Lecturers, teachers and other education and training facilitators should be trained on how to design and use CAL packages to achieve better learning.

Acknowledgement

The researchers wish to acknowledge and appreciate the ‘Tertiary Education Trust Fund’ of Nigeria (TETFUND) for the complete sponsorship of this research work. We also acknowledge the contribution of the Managements of: Federal College of Education Kontagora; Federal College of Education Okene; College of Education Akwanga; and FCT College of Education Zuba, for their cooperation and permission to use their resources and students in the course of this research.

References

- [1]. Alasoluyi, O. E. “Effect of Computer Assisted Instruction (CAI) On Students’ Performance in Economics in Senior Secondary Schools in Ekiti State, Nigeria”. M. Ed thesis, Ahmadu Bello University, Zaria, Nigeria, 2015.
- [2]. J. O. Ayeduso, R. B. Awoniyi, S. A. Ajinuhi and M. N. Musa. “NCE Students’ Attitude to Computer Aided Learning: A Study of Business and Computer Students in (North-Central) Nigerian Colleges of Education.” *The International Journal of Business & Management*, vol 8, pp.57-66. Jan. 2020.
- [3]. A. I. Gambari, A. Shuaibu, and, A. T. Shittu. “Students’ Perception towards the Use of Computer-

- Assisted Instruction for Learning Mathematics in Minna.” *International Journal of Behavioral Sciences*, vol.4, pp. 35–48, Apr. 2013.
- [4]. O. Y. Mudasiru and O. A. Adedeji.. “Effects of Computer Assisted Instruction (CAI) On Secondary School Students’ Performance in Biology.” *The Turkish Online Journal of Educational Technology*, vol. 9, Jan. 2010.
- [5]. A. Aleksander. “The Impact of ICT on Educational Performance and Its Efficiency in Selected EU and OECD Countries: A Non-Parametric Analysis.” *The Turkish Online Journal of Educational Technology*, vol.11, Jul. 2012.
- [6]. U. R. Fazal, N. Sheeba, and Y. S. Mobashir. “Students’ perception of computer assisted teaching and learning of anatomy in a scenario where cadavers are lacking.” *Biomedical Research*, vol. 23, pp.215–218, Feb. 2012.
- [7]. J. Piaget. “Piaget's theory” in Carmichael's manual of child psychology, 3rd ed., Vol. 1. P. H. Mussen Ed. New York: Wiley, 1970, pp.703-732.
- [8]. S. Vosniadou. “Capturing and modeling the process of conceptual change.” *Learning and Instruction*, vol.4(1), pp.45-69, 1994.
- [9]. L.S. Nadelson, B.C. Heddy, S. Jones, G. Taasoobshirazi, and, M. Johnson. “Conceptual Change in Science Teaching and Learning: Introducing the Dynamic Model of Conceptual Change” *International Journal of Education Psychology*, vol.7(2), pp.151-195, 2018.
- [10]. K. AbdulGafoor and, P. T. Akhilesh. “Strategies for Facilitating Conceptual Change in School Physics.” *Innovation and Researches in Education*, vol.3, pp.34-42, 2010.
- [11]. A. Yazbec, A. Borovsky, M. P. Kaschak. “Examining the impact of text style and epistemic beliefs on conceptual change.” *Interne: <https://doi.org/10.1371/journal>* [Dec. 2019].
- [12]. Computing Dictionary. "Computer-assisted learning." *Internet: <https://www.encyclopedia.com/computing/dictionaries-thesauruses-pictures-and-press-releases/computer-assisted-learning>* [Apr. 2019]
- [13]. J. Olorunosebi. “Introduction to Computer Assisted Learning.” *Internet: <http://resources.intenseschool.com/introduction-to-computer-assisted-learning-cal/>*, Aug. 2016 [Apr. 2019]
- [14]. A. Shafaei. “Computer Assisted Language Learning: A Helpful Approach in Learning English.” *Frontiers of Language and Teaching*, vol.3, pp.108-115, 2012.
- [15]. F. Mahvish, S. K Hadia, and A. M. Mudasir. “CAL: Computer Assisted Learning”, *International Journal of Computer Science and Mobile Computing*, vol.6 , pp.254-258, Jun. 2017.
- [16]. Rishu S. “Computer Assisted Learning – A Study.” *International Journal of Advanced Research in Education & Technology*, vol.4, pp.102-105, Jan. 2017.
- [17]. Essays, UK. “Theory of Conceptual Change.” *Internet: <https://ukdiss.com/examples/conceptual-change.php?vref=1>*, Mar. 2018, [Jul. 2019]
- [18]. J. C. Nunnally. “Psychometric theory” 2nd ed., New York, McGraw-Hill, 1978