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Relationship of Chemistry Teachers' Knowledge, Skills and Affective on Computer-Assisted Learning

Hassan Aliyu[1*], Anas Abdullahi[2], Corrienna Abdul Talib[3], Faruku Aliyu[1], Bilkisu Umar Mani[1]

[1]*Department of Science Education, Sokoto State University, Nigeria*
[2] *Department of Computer Science, Sokoto State University, Nigeria*
[3] *Department of Science, Mathematics and Creative Multimedia, Universiti Teknologi Malaysia, Malaysia*

**Correspondence Author: aliyu.hassan@ssu.edu.ng*

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ABSTRACT
The study investigated the relationship of chemistry teachers' knowledge, skills and affective on computer-assisted learning in Sokoto. A questionnaire was designed and distributed to 81 chemistry teachers in 24 secondary schools in the metropolis. The premises that guide the development of the test items used are strongly based on constructivism theory of learning and related literature. The data obtained from an online survey (Google form) were imported into an excel spreadsheet which was later keyed into SPSS 25 for further analysis. The results indicated that Chemistry teachers of Sokoto are have moderate level of both knowledge, skills and affective of computer-assisted learning. The results reveals that both knowledge, skills and affective serves independent purpose for instruction that utilizes computer-assisted learning. It concluded that the moderate knowledge, skills or affect are not significant for integrating computer-assisted learning in chemistry instruction. Awareness alone cannot guarantee quality integration of instruction in the classroom. Thus, chemistry teachers should seek more professional training on computer-assisted learning through workshop, seminars and conferences.

Keywords: *knowledge, skills, affective, computer-assisted learning*

INTRODUCTION

Chemistry education as occupying core area of Science Education required students to learn the body of knowledge that includes the acquisition of the discipline's concepts and physical skill (Schulman, 2011). These skills include not only remembering the content knowledge but also those that will make learner able to solve problems and contribute to the productive development of the nation. These same skills can enable the individual to recognise and determine the quality and even check or approve the validity of claims made by scientific researchers and thereby making informed decisions about their relevance in solving environmental, medical and social problems in the society. In fact, one of the general goals of science education is to help individuals to learn and use computer-assited method to develop problem-solving and critical thinking skills that will be needed in solving real-life problems in the occupation (Schulman, 2011).

Brewer & Smith (2011), state that students who go on to have successful careers in chemistry must be problem solvers, skilled in quantitative reasoning and modelling, effective at communication and cross-disciplinary collaborative, innovative and creative, and be cognizant of relationships between science and the society (National Research Council, 2012). Students who do not pursue these careers in chemistry need to understand science to serve in their roles as citizens, consumers, and leaders of business and government who need to make wise science-informed decisions in their personal and professional lives. The common features of science education include: learning scientific concepts, developing students' attitudes toward science, delivering instruction in practical skills, or a means of preparing students for their future lively activities in this modern technologically advanced society (Taber, 2008). Even though chemistry shared common features with other areas of science, it has various unique features that made creative thinking clearly a central cognitive process in the subject (Ferk-Savec et al., 2017).

Chemistry teachers in the Sokoto state focus on the knowledge of the content (that is, knowledge of the subject-matter). The content knowledge is a mixture or a synthesis of five different types of knowledge: (1) orientation towards chemistry teaching; (2) knowledge of chemistry curriculum; (3) knowledge of science assessment; (4) knowledge of student understanding; and (5) knowledge of instructional strategies (Drechsler & Van Driel, 2008). To obtain a better scientific understanding of chemistry, more focus should be placed on how to cultivate students' High Order Thinking Skills (HOTS) within the chemistry curriculum (Aksela, 2005). This can be done by the teacher through developing and integrating one's knowledge, particularly content learning; becoming able to apply that knowledge in real-time to make instructional decisions; participate in the discourse of teaching; and becoming acculturated into (and engaging in) of teacher practices that improve participation of students in classroom instructions (Davis & Krajcik, 2005). This will help students to understand the basic principles of chemistry that they also encounter in everyday life, and to make a personal, social, environmental and economic decision about them.

There are four knowledge categories in the revised learning taxonomy in which chemistry teachers as a key factor in the reform of chemistry education, their thinking, beliefs and attitudes, all together, have a strong direct influence in the process of learning the subject (Aksela, 2005). These includes: (1) factual knowledge (knowledge of terminology and details about element); (2) conceptual knowledge (knowledge of classification, principles, models, and structures); (3) procedural knowledge (knowledge of chemistry and scientific skills and algorithms, techniques and methods, as well as knowledge of criteria to employ appropriate procedure); (4) meta-cognitive knowledge (knowledge of strategies, cognitive tasks and self-awareness).

Computer-Assisted Learning (CAL) in Chemistry Education

The Computer-Assisted Learning (CAL), as the name implies, is the use of electronic devices/computers to provide educational instruction and to learn. Similarly, Räsänen et al (2014), defines CAL as using a computer to learn. In a chemistry perspective, Hartley, (2010), defines CAL as a tutoring/learning of chemistry, and the interacting process of learning chemistry facilitated through the use of computers. Ever since the CAL programs were introduced as a modern teaching method, as opposed to the traditional teacher-centred classroom system, a growing number of concerns have been raised about the efficiencies of the CAL teaching of chemistry in the classroom. Nasiru & Bashiru (2012), explain that students are actively engaged in developing deep understanding of the abstract nature of matter when teachers use CAL in the classroom to facilitated learning of chemistry concepts hence, concluded that CAL serves as a means through which teachers can actively engage their students in developing deep understanding of chemistry concepts through visual representation. Thus, the knowledge, skills and teachers affective on CAL must be developed and encourage in the teaching and learning processes of chemistry.

Today, CAL has been one of the significant means of delivering chemistry instructions effectively in the classroom. Teachers that use CAL in their classroom instructions make a significant impact on their students' learning (Aliyu, 2018). Moreover, CAL made the learning of abstract concepts simpler to the students and teachers find it very easy to understand their students' misconceptions thereby correcting them. Many studies (Altun, et al., 2009; Bayrak & Bayram, 2010; Chauhan, 2017; Liao, 2007 & Özmen, 2008) has revealed the effectiveness of CAL in the improvement of achievement of expected goals of teaching and learning of chemistry. The application of CAL in teaching and learning of chemistry heavily depend on the impact intended for the learners, role for which it is expected to play in the classroom instruction and the model through which learning is facilitated. For whatever kind of instructional content, CAL generally improves students' motivation to learn and with that many skills can be easily cultivated (Kimmons, Clark, & Lim, 2017; Smith & Evans, 2010).

Effect of Knowledge, Skills & Affective (KSA) in Chemistry Education

Knowledge, skills and effect are popularly known as domains of learning categorized by Bloom (1956) as cognitive (knowledge), psychomotor (skills), and affective (attitudes). Otherwise known by educators as KSA (Knowledge [cognitive], Skills [psychomotor], and Attitudes [affective]). These represented most of the factors necessary for all secondary school teachers, but yet, lack of any of them could be influential in preventing chemistry teachers in integrating CAL into their classroom instruction. Igwe (2015) reported that there are many factors that made it difficult for secondary school chemistry teachers to integrate recommended instructional strategies into their classroom instructions in which lack of knowledge of CAL is the major. Bloom (1956) presented a taxonomy that describes stages through which knowledge can be developed.

The cognitive domain involves knowledge and the development of intellectual skills (Bloom, 1956). This includes the recall or recognition of facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. There are six major categories of cognitive processes, starting from the simplest to the most complex including Knowledge, comprehension, application, analysis, synthesis, and evaluation. This is called Bloom's taxonomy. This taxonomy of learning behaviours may be thought of as "the goals of the learning process." That is, after a learning episode, the teacher should have acquired a new skill, knowledge, and/or attitude. It provided for classification of educational goals which deal with the recall or recognition of knowledge and the development of intellectual abilities and skills (Hanna, 2007). Briefly, the purposes of the taxonomy as given by its originators are: (1) To help teachers, administrators, professional specialists, and research workers who deal with curricular and evaluation problem to discuss their problems with greater precision; (2) To facilitate the exchange of information about curricular developments and evaluation devices; (3) To suggest the kinds of objectives that can be included in a curriculum; (4) To help teachers and others to gain a perspective on the emphasis given to certain behaviour by a particular set of educational plans; (5) To help curriculum builders to specify objectives so that it becomes easier to plan learning experiences and prepare evaluation device.

Munzenmaier & Rubin (2013), points out that the domains of learning can be used in research or teaching for the development of motor abilities and skills. Teachers and curriculum makers can make use of it in developing materials for classroom use; and test makers can use it to communicate more easily with those they serve. Perhaps the greatest benefit will accrue from rounding out the three domains, and thus providing for a better study of the total field of objectives and the planning of educational programs in response to objectives broadly conceived. However, in chemistry education, for teachers to create thinkers as opposed to students who simply recall information, they must incorporate learning strategy like CAL into their classroom instruction to provide higher levels thinking, which can only happen by moving students up the taxonomy as they progress in their knowledge.

However, Krathwohl (2002), represented revised "Bloom Taxonomy" by changing the six cognitive domains from noun to verb, rearranged them, and come up with processes and levels of knowledge dimension. Table 1 represented a comparison of the original taxonomy with the revised taxonomy in relation to CAL in chemistry education.

Table 1. Original and Revised Bloom's Taxonomy

Original Taxonomy	Revised Taxonomy	Examples, keywords (verbs), and computer for learning (activities)
Knowledge	Remembering	defining, describing, identifying, knowing, labelling, listing, matching, naming, outlying, recalling, recognizing, reproducing, selecting, stating
Comprehension	Understanding	comprehending, converting, defending, distinguishing, estimating, explaining, extending, generalizing, comparing, gives an example, classifying, inferring, interpreting, paraphrasing, predicting, rewriting, summarizing, translating, Internet search
Application	Applying	applying, changing, computing, executing, constructing, demonstrating, discovering, manipulating, modifying, operating, predicting, preparing, producing, relating, showing, solving, using, implementing, blogging
Analysis	Analysing	analysing, breaking down, comparing, contrasting, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers,
Synthesis	Evaluating	appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports
Evaluation	Creating	categorizes, combines, compiles, composes, creates, devises, designs, explains generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes

(Krathwohl, 2002)

This revised taxonomy reflects a more active form of thinking and is perhaps more accurate. The revised Taxonomy not only improved the usability of it by using action words but also added a cognitive and knowledge matrix. The knowledge dimensions comprise of four categories rather than three. These include, factual knowledge (basic element learner must achieve to be acquainted with the chemistry or even solve problems like knowledge of element or terminologies); conceptual knowledge (interrelationship among the basic elements within a large structure that enable them to function together like knowledge of classification/categories, principles/generalization, theories/models /structures), Procedural knowledge (A series of step-by-step actions and decisions that result in the achievement of a task, methods of inquiry, criteria for using skills or method), and metacognitive knowledge (knowledge of cognition, in general, as well as awareness and knowledge of one's own cognition like strategic knowledge, self-knowledge and knowledge about cognitive task).

Krathwohl, (2002), presented a two-dimensional table to describe learning objectives. In this two-dimensional table, the knowledge dimension forms the vertical (y) axis while the cognitive dimension forms the horizontal (x) axis of the table. The objective identified at the point of intersection between knowledge and the cognitive process. However, others have identified the fifth knowledge dimension called "processes and principles" contents or artefacts (Munzenmaier & Rubin, 2013). The processes knowledge is a flow of events or activities that describe how things work rather than how to do things. Whereas the principles of knowledge are a guideline, rules, and parameters that govern. It includes not only what should be done, but also what should not be done. Principles allow one to make a prediction and draw implications. Principles are the basic building blocks of causal models or theories.

Table 2. The Classification of The Four Objectives in A Taxonomy Table

The Knowledge Dimension	Remember	Understand	Apply	Analyse	Evaluate	Create
Facts	list	paraphrase	classify	outline	rank	categorize
Concepts	recall	explains	show	contrast	criticize	modify
Processes	outline	estimate	produce	diagram	defend	design
Procedures	reproduce	investigate	relate	identify	critique	plan
Principles	state	converts	solve	differentiates	conclude	revise
Meta-cognition	proper use	interpret	discover	infer	predict	actualize

Skills include physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution. Thus, psychomotor skills rage from manual tasks, such as the scientific investigation of facts or problem, to more complex tasks, such as conducting an experiment to solve real-life problems. Munzenmaier & Rubin (2013), represented seven major categories which are arranged from simplest behaviour to the most complex including perception (awareness), set, guided response, complex overt response (expert), adaptation and origination.

Providing chemistry instructions in a secondary school classroom is very complex requiring the development of essential skills as well as continuous professional growth (Moore, 2012). Skill areas from the analyses of learning task necessary for the teachers which are grounded based on constructivist learning perspectives are presented by Moore (2012). These include skills of preparation and quality planning of instruction, preparation of the positive classroom environment, integrating proven classroom instructional strategies (IBL and CAL), and possession of professional behaviours.

The affective domain concern with the chemistry teachers' feeling, emotion, and attitude toward teaching and learning. Thus, it could be understood to involve the manner through which chemistry teachers' deal with teaching and learning of chemistry emotionally, which could include feelings, values, appreciation, enthusiasms, motivations, and attitudes. Lashari Alias, Akasah, & Kesot (2012), posit that affective domain is important in facilitating the effective cognitive processes and the internalization of cognitive knowledge. They are also of the opinion that affective domain results in undervaluing the students' potential which leads to the poorer realization of students' achievement. Moreover, Lack of knowledge of Models of teaching and learning has a direct effect on the cognitive domain, which in turn affected the attitude (Bakarman, 2011). It was categorized in the form of the hierarchical structure based on internalization principles arranged from simpler feelings to more complex as receiving, responding, valuing, organization, and characterization.

The process in which the chemistry teachers' affective toward classroom instruction goes from level of general awareness to a point where the best attitude is adopted and consistently controls or guides their behaviour is referred to "internalization". Thus, when chemistry teachers' affect move to the level of more complexity, they tend to become more committed, involved, and internally motivated as described by Sincero (2014), below.

Receiving – This is awareness, willingness to hear, selected attention given to something by an individual (Sincero, 2014). This is the lowest affective that involves passively paying attention and being aware of the existence of CAL, the materials that support their integration, or chemistry phenomena that can be best learned through investigation, questioning and experimenting. The keywords that guide this level are to acknowledge, asks, attentive, courteous, dutiful, follows, gives, listens, understands. Thus, chemistry teachers must pay attention and be willing to ask questions regarding the learning strategies that guide their professional practice in the classroom.

Responding – This is the active participation of an individual. It is simultaneous or consecutive attention and reacting to a particular phenomenon. Learning outcomes may emphasize compliance in responding, willingness to respond, or satisfaction in responding (motivation). This is the level where chemistry teachers not only balanced on awareness of CAL but also actively reacting by utilizing the knowledge in their classroom instruction.

Valuing – This is the worth or value a person attaches to a particular object, phenomenon, or behaviour. This ranges from simple acceptance to the more complex state of commitment. Valuing is based on the internalization of a set of specified values, while clues to these values are expressed in the learner's overt behaviour and are often identifiable. This is a level where chemistry teachers, after integrating what they learned, began to appreciate the value of CAL for their professional practice. In other words, it is the ability of chemistry teachers to see the value or worth of CAL for their classroom instructions and express it.

Organizing – This is the level where an individual organizes values into priorities by contrasting different values, resolving conflicts between them, and creating a unique value system. The emphasis is on comparing, relating, synthesizing values. This is the level where chemistry teachers put together different values, information, and ideas then relating them to already held beliefs to create their own unique value system.

Characterizing – This is where an individual internalizes values. Has a value system that controls their behaviour. The behaviour is a pervasive, consistent, predictable, and most important characteristic of the learner. Instructional objectives are concerned with the student's general patterns of adjustment (personal, social, emotional). Acting consistently in accordance with the values you have internalized.

The classroom instructions can only be effective when chemistry teachers integrate personal and affective need of the students in the teaching and learning process. The lack of consideration of CAL by chemistry teachers is partly due to the difficulty in integrating affect into teaching and learning as well as the lack of pedagogical expertise.

Perhaps the outbreak of the COVID-19 pandemic forces Sokoto State chemistry teachers, like all other educators in the world, to be on the verge of providing CAL when the students are required to sit in a “social distance” complying with lockdown regulations. This happened following the statement issued by the Sokoto State Government on March 20, 2020, which took effect from March 23, 2020.

Formerly (that is, before the outbreak of COVID-19), CAL was partially used by teachers in the mix to create blended learning pedagogy (Ehrlich, McKenney & Elkbuli, 2020). Today, there is no crowded face-to-face interaction; therefore, virtual platforms and CAL must be integrated for instruction as a whole. Govindarajan & Srivastava (2020), reported that not all classroom teachers are comfortable with CAL and that there exists a digital age division between those teachers who have never used even the basic audio-visual equipment, relying on blackboards and flipcharts, and those younger faculty members who are aware of and adept at using newer technology. While most of them may not be emotionally satisfied with CAL because their inability makes them feel unsecured, some school teachers in Nigeria (especially secondary school teachers) have been conveying their classroom instruction via TV and radio stations, while others are using social media like WhatsApp. In addition, like in other developing nations, factors like perceived usefulness, inexperience, culture, perceived ease of use, lack of technical know-how, lack of access to all infrastructure and equipment, poor internet connectivity, large number of students, and limited time for preparation, etc., may prevent some Nigerian teachers from integrating virtual education effectively.

Computer-Assisted Learning (CAL) has changed the lots–of–effort demanding traditional method of instructions to more complex, easy-to-deliver strategies, despite the level of denial it faced by the chemistry teachers of Sokoto for its complexity in integration process (Bugaje, 2013). This strategy provided opportunity for secondary school teachers to engage learners to create their own questions for investigation, thereby developing hypotheses, designing strategies to carry out experiments, and then use technological tools, applications, or resources to perform the experiment through sophisticated learning strategy which in turn generate data that will be analysed by the student (Schulman, 2011). Todays' education can be perceived to have completed a cycle which advanced from the traditional classroom environments to the digital e-learning where students learned online and back to the classroom where learning is facilitated by computers (Saadé et al., 2011).

Even though, generally there are a number of activities that computers can do to replace time and energy-consuming efforts for the teacher, in the future of learning, computers cannot replace teachers, but amplifying their abilities to meet the learning needs of the students, which include: taking attendance in the classroom, administer and grade assessments, deliver basic instructions, streamline lesson planning, and tracking students' progress; but, more importantly, technology cannot replace teachers' roles like, creating classroom environment where academic inquiry is extremely exciting, providing social and emotional support, guiding students to manage their daily task, providing guidance on how to reason, analyse, design, compose, apply and find creative solutions to problems (Arnett, 2017).

In an experimental study conducted to investigate the effectiveness of computer-assisted learning compared to the traditional instructional method has indicated that students who participated in classroom instruction with CAL with the teachers' intervention outperformed the student that participated in the traditional classroom instructions regardless of teachers' personality (Seo & Bryant, 2009). The study intended to investigate the level of chemistry teachers' knowledge, skills and affective of computer-assisted learning.

METHODOLOGY

The study is conducted in the Sokoto metropolis. The Table 3 below represented 81 chemistry teachers distributed in 24 secondary schools in the city. The study is intended to cover all the chemistry teachers in the area thus, are the respondents of the research. Hence, the study is quantitative research which adopted survey design for the purpose of data collection.

Table 3. List of Chemistry Teachers in Science and Technical Education Board (STEB) in the City of Sokoto

S/No.	Science and Technical Education Board Secondary Schools	No. of Teachers
1	Nagarta College Sokoto	6
2	Government Girls' College Sokoto	5
3	Government Technical Farfaru	5
4	Government Technical Runjin-Sambo	4
5	Federal Science College Sokoto	8
6	Sokoto Science College	4
7	Giginya Memorial Secondary School	2
8	Hafsatu Ahmadu Bello Girls' Arabic Secondary School	2
9	Nana Girls Day Secondary School	2
10	Sheikh Abubakar Gummi Secondary School	2
11	Sultan Abubakar College	3
12	Sultan Attahiru Secondary School	3
13	Sultan Atiku Secondary School	3
14	Sultan Bello Secondary School	3

S/No.	Science and Technical Education Board Secondary Schools	No. of Teachers
15	Women Centre for Continuous Education	2
16	Sani Dingyadi Unity Secondary School Farfaru	4
17	Government Day Secondary School Arkilla	2
18	Ahmadu Bello Academy	3
19	Usmanu Dafodiyo University Model Secondary School	4
20	Sultan Maccido Institute for Qur'an and General Studies	4
21	Army Day Secondary Schools	2
22	Shehu Shagari College of Education Staff Secondary School	3
23	Sokoto State Polytechnic Staff Junior Secondary School	2
24	Federal Government College Sokoto	3
	Total number of teachers	**81**

To determine the consistency of the items representing the response of the individual teacher, Cronbach's Alpha coefficient of reliability is used since the items is in Likert scale response anchor (Cresswell, 2012). This will help the researcher to understand whether the scores from the instrument are stable and consistent. The data obtained from an online survey (Google form) were imported into an excel spreadsheet which was later keyed into SPSS 25 for further analysis. To run the Cronbach alpha test, the data was divided into three based on the scales of the instrument. Thus, the following Table 4 describes the reliability coefficient of three scales of the CAL scale.

Table 4. Cronbach's Alpha Reliability Coefficient for the Instrument

No.	Scale	Cronbach's Alpha	N of Items
1	Chemistry Teachers' Knowledge of CAL	0.848	9
2	Chemistry Teachers' Skills of CAL	0.824	6
3	Chemistry Teachers' Affective of CAL	0.751	5
		Total	**20**

Table 4 shows the Cronbach's alpha values for the scales, and the number of items for each scale in the questionnaire. The higher the Cronbach's alpha coefficient of reliability, the more reliable the scale (Santos, 2013). The closer to 1.00 the coefficient value, the higher the reliability, the more items measures the same construct. Cresswell (2012), stressed that if the instrument is significantly reliable, the response should nearly be similar when the researcher administers the survey many times at different times. Meaning, when a teacher responds to an item in a certain way, the individual should consistently answer the closely related questions in the same way. Having reliable data describes the existence of an ideal situation in the study since the items on the instrument are cleared and unambiguous, the standard and similar procedure of test items administration was used (Cresswell, 2012), and the participant understands the items, are not nervous, no guessing and are not overloaded.

Based on the scale "Chemistry Teachers' Knowledge of CAL, Skills of CAL, and Affective of CAL" with a total of 20 test items, their reliability coefficient 0.848, 0.824 & 0.751 respectively indicates that the items are closely related to each other in their scale indicated in Table 4. The internal consistency between the items in the scale is very high, thus the scale is highly reliable.

RESULT AND DISCUSSION

The result presentation starts with the demographic information of the respondents. These provide features of the individuals that participated the study. Table 6 provide gender, age, qualification and the experience of the respondents.

Table 6. Pre-and-Post-Test Results of Experimental Group B

	Frequency *(N)*	Percentage *(%)*
Gender		
Male	63	94.0%
Female	4	6.0%
Total	**67**	**100%**
Age		
19 years and below	0	0.0%
20-25	11	16.4%
26-30	14	20.9%
31-35	24	35.8%
36 years and above	18	26.9%
Total	**67**	**100%**
Qualification		
Diploma	11	16.4%
NCE	5	7.5%
Degree	47	70.1%
Master	4	6.0%
PhD	0	0.0%
Total	**67**	**100%**
Teachers' Experience		
0-5 years	23	34.3%
6-10	36	53.7%
11-15	6	9.0%
16-20	1	1.5%
21-24	1	1.5%
25 years & above	0	0.0%
Total	**67**	**100%**
Frequently used method		
Problem-solving	35	52.2%
Inquiry-based learning	16	23.9%
Blended learning	4	6.0%
Computer-assisted learning	12	17.9%
Traditional method	0	0.0%
Total	**67**	**100%**

It can be observed directly from Table 4 about 94.0% of the respondents are male while 6.0% are female. It should not be surprised to record zero value for the age range between 19 and below while 16.4% of the respondents are between 20-25, 20.9% are between 26-30 years, 35.8% between 31-35 years and the remaining, 26.9% comprises of 36 years and above. It can be observed that there are no single teachers with PhD qualification in Sokoto secondary school while 70.1% of the respondents are bachelor's degree holders and only 6.0% of the chemistry teacher has a master qualification. However, for the teaching experience, 34.3% of the respondents have teaching experience ranging between 0-5 years, whereas 65.7% of them are between 6-24 years in the profession. Moreover, while less than 20% of the respondents are using computer-assisted learning in their classroom, not more than 23% uses IBL, but over 50% thought to be using problem-solving in their chemistry classroom instruction.

Table 6. Frequency and Percentage of Chemistry Teachers' Knowledge of Computer-Assisted Learning Scale

S/N	Items	Frequency *(N)*	Percentage *(%)*
1.	**The CAL is a form of active learning process used in secondary school for teaching chemistry**		
	Not at all aware	1	1.5%
	Slightly aware	17	25.4%
	Aware	26	38.8%

S/N	Items	Frequency *(N)*	Percentage *(%)*
	Extremely Aware	23	34.3%
	Total	**67**	**100%**
2.	**Through CAL, teachers can engage their students in investigating chemistry concepts in the classroom**		
	Not at all aware	19	28.4%
	Slightly aware	13	19.4%
	Aware	22	32.8%
	Extremely Aware	13	19.4%
	Total	**67**	**100%**
3.	**In a CAL, chemistry teachers organized their classroom instruction into systematic (step-by-step) procedures that may lead to the construction of new knowledge.**		
	Not at all aware	14	20.9%
	Slightly aware	18	26.9%
	Aware	30	44.8%
	Extremely Aware	5	7.5%
	Total	**67**	**100%**
4.	**Integration of IBL in the secondary school chemistry classroom can easily be facilitated by using CAL**		
	Not at all aware	13	19.4%
	Slightly aware	25	37.3%
	Aware	22	32.8%
	Extremely Aware	7	10.4%
	Total	**67**	**100%**
5.	**The CAL facilitates collaboration between teacher-students, student-student, and student-expert**		
	Not at all aware	13	19.4%
	Slightly aware	26	38.8%
	Aware	19	28.4%
	Extremely Aware	9	13.4%
	Total	**67**	**100%**
6.	**In CAL instruction, teachers serve as a facilitator during classroom inquiry where knowledge of chemistry concepts is constructed**		
	Not at all aware	22	32.8%
	Slightly aware	16	23.9%
	Aware	21	31.3%
	Extremely Aware	8	11.9%
	Total	**67**	**100%**
7.	**The chemistry teachers can use CAL in teaching a large group of people**		
	Not at all aware	0	0.0%
	Slightly aware	15	22.4%
	Aware	32	47.8%
	Extremely Aware	20	29.9%
	Total	**67**	**100%**
8.	**Chemistry teachers can deliver their classroom instruction through multimedia when using CAL**		
	Not at all aware	0	0.0%
	Slightly aware	18	26.9%
	Aware	30	44.8%
	Extremely Aware	19	28.4%
	Total	**67**	**100%**
9.	**Most of the abstract concepts in chemistry can be learned through CAL**		
	Not at all aware	29	43.3%
	Slightly aware	11	16.4%
	Aware	20	29.9%

S/N	Items	Frequency *(N)*	Percentage *(%)*
	Extremely Aware	7	10.4%
	Total	**67**	**100%**

The Table 6 above indicates that over 70% of the respondents are aware that the CAL is a form of active learning process used in secondary school for teaching and learning of chemistry; over 60% are aware that through CAL, teachers can engage their students in investigating chemistry concepts in the classroom; about 80% are aware that in a CAL, chemistry teachers organized their classroom instruction into systematic (step-by-step) procedures that may lead to the construction of new knowledge; over 80% are aware that integration of IBL in the secondary school chemistry classroom can easily be facilitated by using CAL; over 70% are aware that computer device facilitates collaboration between teacher-students, student-students, and student-expert during chemistry classroom inquiry; over 75% are aware that in CAL instruction, teachers serve as a facilitator during classroom inquiry where knowledge of chemistry concepts is constructed; over 90% are aware that chemistry teachers can use CAL in teaching a large group of people; and over 90% are aware that that instruction can be delivered through multimedia like Microsoft power point.

Table 7. Frequency and Percentage of Chemistry Teachers' Skills of Computer-Assisted Learning Scale

S/N	Items	Frequency *(N)*	Percentage *(%)*
1.	**Computer knowledge and skills are essential to the chemistry teachers**		
	Not at all aware	0	0.0%
	Slightly aware	0	0.0%
	Aware	29	43.3%
	Extremely Aware	38	56.7%
	Total	**67**	**100.0%**
2.	**Chemistry teachers can improve their motivational skills in order to order to be influential to their student's classroom participation**		
	Not at all aware	8	11.9%
	Slightly aware	20	29.9%
	Aware	31	46.3%
	Extremely Aware	8	11.9%
	Total	**67**	**100.0%**
3.	**Chemistry teachers can guide their students in the scientific investigation of chemistry concept in the classroom**		
	Not at all aware	1	1.5%
	Slightly aware	20	29.9%
	Aware	43	64.2%
	Extremely Aware	3	4.5%
	Total	**67**	**100.0%**
4.	**Higher-order thinking skills can be easily improved, developed or even cultivated**		
	Not at all aware	20	29.9%
	Slightly aware	11	16.4%
	Aware	30	44.8%
	Extremely Aware	6	9.0%
	Total	**67**	**100.0%**
5.	**Chemistry teachers can improve their communication skills through classroom discourse and social interaction at the cause of facilitation of inquiry**		
	Not at all aware	16	23.9%
	Slightly aware	12	17.9%
	Aware	25	37.3%
	Extremely Aware	14	20.9%

S/N	Items	Frequency *(N)*	Percentage *(%)*
	Total	**67**	**100.0%**
6.	**Chemistry teachers can improve their questioning skills by asking or posing and conferring meaning to students' ideas and connecting one idea to the other(s)**		
	Not at all aware	0	0.0%
	Slightly aware	15	22.4%
	Aware	25	37.3%
	Extremely Aware	27	40.3%
	Total	**67**	**100.0%**

From Table 7, it can be observed that about 56.7% of respondents are aware that computer knowledge and skills are essential for chemistry teachers; over 85% are aware that chemistry teachers can improve their motivational skills in order to order to be influential to their student's classroom participation; over 95% are aware that chemistry teachers can guide their students in the scientific investigation of chemistry concept in the classroom; about 70% are aware that higher-order thinking skills can easily be improved, developed or even cultivated when chemistry teachers utilized CAL in their classroom instructions; over 70% are aware that chemistry teachers can improve their communication skills through classroom discourse and social interaction at the cause of facilitation of inquiry; and over 75% are aware that chemistry teachers can improve their questioning skills by asking or posing and conferring meaning to students' ideas and connecting one idea to the other(s).

Table 8. Frequency and Percentage of Chemistry Teachers Affective of Computer-Assisted Learning Scale

S/N	Items	Frequency *(N)*	Percentage *(%)*
1.	**In CAL instruction, the Internet provides faster access to learning resource than any other media**		
	Not at all aware	17	25.4%
	Slightly aware	17	25.4%
	Aware	30	44.8%
	Extremely Aware	3	4.5%
	Total	**67**	**100.0%**
2.	**In CAL instruction, chemistry teachers can provide effective classroom instruction through a social network like Facebook**		
	Not at all aware	15	22.4%
	Slightly aware	29	43.3%
	Aware	16	23.9%
	Extremely Aware	7	10.4%
	Total	**67**	**100.0%**
3.	**Utilization of CAL motivates chemistry teachers to improve their skills for better instruction in their classroom practice**		
	Not at all aware	19	28.4%
	Slightly aware	30	44.8%
	Aware	15	22.4%
	Extremely Aware	3	4.5%
	Total	**67**	**100.0%**
4.	**With CAL teachers have the ability to deliver their classroom instructions by using videos to develop a deep understanding of chemistry concepts**		
	Not at all aware	11	16.4%
	Slightly aware	16	23.9%
	Aware	31	46.3%
	Extremely Aware	9	13.4%
	Total	**67**	**100.0%**
5.	**In CAL, chemistry teachers can utilize the computer in assessing their students' learning that gives them the opportunity to understand their learners, thereby**		

S/N	Items	Frequency *(N)*	Percentage *(%)*
	providing emotional assistance to the learners		
	Not at all aware	9	13.4%
	Slightly aware	43	64.2%
	Aware	12	17.9%
	Extremely Aware	3	4.5%
	Total	**67**	**100.0%**

It can be observed from Table 8 that about 70% are extremely aware that the Internet provides faster access to learning resource than any other media during classroom instruction; over 74% are aware that chemistry teachers can provide effective classroom instruction through social media like Facebook; 70% are aware that by utilizing CAL in the classroom instruction, chemistry teachers become motivated to improve their skills for better teaching and learning activities in their classroom; over 80% are aware that deep understanding of the learning concepts can be achieved through watching instructional videos; and over 85% are extremely aware that computer can be utilized in the classroom instruction for assessing students' learning.

Today, assessment becomes complex due to the increasing number of students in the classroom and the advancement of instructional practice from one-way direct instruction to strategies that employ many activities that facilitate learning. Availability of computer devices made learning assessment very easy. Today, computer programmes like Quizzes, Kahoot, PowerPoint, Google form and Excel are used for assessing learning in the classroom.

Table 9. Mean Value for Chemistry Teachers' Knowledge, Skills and Affective of Computer-Assisted Learning

SN	Scale	Mean	Remark
1	Chemistry teachers Knowledge of CAL	2.5522	Moderate level
2	Chemistry teachers skills of CAL	1.8209	Moderate level
3	Chemistry teachers affective of CAL	2.2478	Moderate level

The information contained in Table 9 presents the results of chemistry teachers level of knowledge, skills and affective of CAL. The teachers' knowledge, skills and affective of CAL is viewed as moderate level from the mean value of 2.5522, 1.8209 & 2.2478. However, more than half of the respondents have knowledge of CAL except that there is a lack of some significant features necessary for effective integration into chemistry classroom. These features include knowledge of; step-by-step procedures; teachers and students role in the classroom, collaborative support and useful functions of CAL in the facilitation of chemistry classroom teaching and learning processes. These are among the key features that drive integration CAL into the classroom instruction.

The result of this study reveals that less than half of the respondents have required skills for delivering chemistry instruction in secondary school using CAL. Skills are essential qualities that a classroom teacher must possessed. These skills involve six different types of thinking that include metacognition, critical thinking, creative thinking, cognitive process (problem-solving and decision-making), core thinking skills (representation and summarization), and understanding the role of content knowledge.

The information contained in Table 9 reveals that the mean value, 2.2478 explains that there are moderate of chemistry teachers' affective on CAL. However, attainment of moderate level does not inform excellent affect toward CAL, but some deficiency existed. In other word, the result indicated that there is little deficiency of affective in CAL with respect to self-motivation and utilization of social media in their classroom instruction.

Chemistry Teachers' Knowledge of Computer-Assisted Learning

Based on the analysis, it is indicated that chemistry teachers have moderate knowledge of CAL. It shows that they are slightly aware of constructs in items 4, 5, 6 & 9 which include learning environment, collaboration, teachers' role and relevance of CAL in teaching and learning chemistry. Thus, this level of knowledge is not significant for effective integration of the strategy for chemistry instruction. According to Blessinger & Carfora (2015) CAL is an instructional approach that engage learners in a more meaningful, purposeful, and self-regulated way to learn concepts in chemistry which could also be applicable and relevant across all disciplines and levels within education. It is a strategies in which most of the learning activities in a chemistry classroom are purposely designed to cultivate knowledge and thinking skills through the investigation, experimentation, or exploration of meaningful and authentic questions or problems using computer software.

The availability of CAL made it easier to represent/teach a large group of students' microscopic concepts of chemistry through modelling (Gilbert, 2009). However, multimedia gives students choices about how best to convey a given idea (e.g., through text, video, animation) (Chiu & Wu, 2009). In part, because they have the capability to produce more professional-looking products and the tools to manipulate the way information is presented, students in many CAL classes are reportedly spending more time on learning (Mayer, 2012) chemistry concepts through design and audience presentation practice.

Chemistry Teachers' Skills of Computer-Assisted Learning

The results indicated that the respondents are much aware of the skills of CAL in teaching and learning of chemistry. The main edge/advantage that CAL has over education methods is interaction. Computers can stimulate and arouse the active interest of students during the learning process at multiple levels. Ever since the CAL programs were introduced as a modern teaching method, as opposed to the traditional teacher-centred classroom system, a growing number of concerns have been raised about the efficiencies of the CAL teaching method. Sometimes, teachers do show anxiety about CAL because they fear the computers could take over their jobs. Secondly, most of the technologies used in CAL are new and therefore teachers need the training to become familiar with the new technology. Teachers are required to test run the system before the class begins and to anticipate and fix technical glitches that might occur during the class. If the generation gap is taken into consideration, the teachers who volunteer to use the CAL program have to adjust their orientation and competence to what could seem a completely new teaching system.

One of the major aims of chemistry education to cultivate skills and be able to produce a graduate that could use gained skills to solve societal problems. Provision of classroom instruction in secondary schools requires a large repertoire of skills and ability to put these skills to use in different situations. Good teachers advance: no one approach works equally well all the time and the entire situation. In short, the effectiveness of the chemistry classroom instruction may depend on students, concept and the learning environment. Teachers cannot guide their learners on how to develop skills unless they possess such skills themselves. Being aware, understanding and learning to use such skills will improve one's classroom instruction effectiveness.

Chemistry Teachers' Affective of Computer-Assisted Learning

The process in which the chemistry teachers' affective toward CAL as effective classroom instruction goes from level of general awareness to a point where the best attitude is adopted and consistently controls or guides their behaviour. Thus, when chemistry teachers' affective move to the level of more complexity, they tend to become more committed, involved, and internally motivated.

It is indicated by the results of the analysis that the respondents have slight affective of CAL in chemistry teaching and learning. The responses from items 37, 38 & 39 indicated that the respondents have no awareness of socializing classroom instruction through social media, merriment classroom through instructional videos (like dance chemistry) and motivation. Talib et al (2017), point out that research indicates that, there are five different types of videos that were widely used in learning chemistry in the classroom include demonstration video, instructional video, simulation video, tutorial video, and video games. It is also indicated that many studies suggested that integration of technology that includes video in teaching and learning may increase students' understanding, attention, and interest in exploring scientific ideas during classroom instruction. Due to the flexibility videos in teaching and learning, they are preferably used to specify instructions in secondary school because of their value and cost-effective nature in providing meaningful learning in the chemistry classroom (Talib et al., 2017).

Digital learning through a social network like Facebook is already happening. A recent study indicates that social network learning revolution is in full swing majority of secondary school-aged spent many hours on social media, 57% of students expressed they have more control over their learning when using social network, 3 out of 5 flipped classroom teachers believe social network learning increases student confidence and motivation, and 77 per cent of parents consider the social network learning as effective learning channel that uses technology as vital to their child's future (Greenhow, 2011).

Secondary schools Teachers should be using social media channels like Facebook to connect with other schools and individuals who can help them adapt their teaching practices to make the most of the digital tools. On the other hand, also, students should be using a social network like Facebook to connect with other students, not only in their country but also across the globe, to engage in self-directed learning in areas of personal expertise and interest (Greenhow, 2011).

CONCLUSION

The results indicated that both knowledge, skills and affective serves independent purpose for instructions that utilizes computer-assisted learning. The end results of this research indicated the need for integrating CAL in every chemistry classroom instruction in secondary school, hence represented and emphasize on the recommended learning strategy for chemistry teaching and learning in secondary schools. To make a sound conclusion, the findings of this study have brought about in the development of an integrated CAL framework for effective delivery of chemistry instruction in Sokoto state secondary schools. The CAL is a very important approach to chemistry teachers due to its abilities in providing effective classroom instruction. From the analysis of the obtained data, it can be understood and concluded that chemistry teachers are less knowledgeable on CAL.

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