

# Assessing Chemistry Teachers Knowledge and Skills in Using ICT in Teaching Organic Chemistry at the Senior High School in the Ashanti Region

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## Abstract

The advancement of science and technology vis-à-vis the constant need to improve upon the teaching practice is a course that when successfully put together would efficiently be very advantageous to the students and the teacher. The purpose of the study was to assess the barriers of ICT use, Support system and teachers' knowledge and skills of ICT use in the teaching of Chemistry in senior high schools (SHSs) in the Ashanti Region. The teachers sampled for the study were from the various types of Senior High Schools (SHSs) such as mixed or co-educational SHSs, single sex female and single sex male in the Ashanti Region. The research instrument that was used to collect the data was questionnaire. Descriptive statistics were carried out to analyze the data using Statistical Package for Social Scientist (SPSS) software version 16. The findings of the study identified perceived barriers of ICT integration in teaching in the SHSs as lack of enough or limited access to computers/computer lab, non-availability of computer software, lack of time in school schedule for integrating ICT and lack of adequate technical support. It also included not get any current technical support for provision of technical course for operating and maintaining computer system and having a technician in the classroom. Teachers' knowledge and skill in technology use was not seen as a barrier to ICT integration in teaching. It is recommended that computer laboratories should be setup in SHSs and furnished with computers and software that will enable teachers plan and deliver their lesson effectively using ICT. The time table of the SHSs should be reviewed to cater for ICT integration which teachers' perceived to be time consuming.

**Keywords:** Administrative support, Technical Support, Information and Communication Technology, Senior High School and West African Examination Council

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## Background to the Study

Chemistry is a dynamic and rapidly changing field. It is an extraordinarily interesting subject to study and an intriguing one to teach. The diversity of knowledge of beginning students presents an exclusive challenge to the student and to the teacher (Goldberg, 2004). Chemistry is concerned with the study of matter and its changes. As a result, it is a subject of vital importance for life (MOE, 2010). In Ghana, the teaching and learning of organic chemistry starts from the Senior High School (SHS). It forms part of the chemistry syllabus (that is being offered by elective science students) and also part of integrated science syllabus (which is a core subject offered by all students at the SHS). The organic chemistry as an aspect of the chemistry syllabus was formally taught at the final year, currently it is being taught at the second year (MOE, 2010). After going through stipulated years of secondary education, students are assessed on the topics covered in the syllabus. The West African Examinations Council (WAEC) generally sets about 60 objective test items and some structured questions and essay questions at the WASSCE (Paper 1). Paper 2 could consist of three practical questions (MOE, 2010). In recent years' science is not seen as mere academic discovery of the physical world. Nowadays, science is seen as an indispensable tool that enables technological advancement to flourish (Anamuah-Mensah, 2004). A strong scientific base is therefore, essential for socio-economic advancement of any nation. This assertion is supported by the fact that the most technologically developed nations thrive on science and technology and devote huge sums of money to this end. A case in point is the amount of monies spent on space exploration.

The advancement of science and technology vis-à-vis the constant need to improve upon the teaching practice is a course that when successfully put together would efficiently be very advantageous to the students and the teacher. Majority of students today are more proficient and inclined to computer use than their parents, but the computer is very seldom used to facilitate their studies. Computer programmers have been able to develop softwares that serve to increase students' learning by affecting cognitive processes and increasing motivation (Mondal, 2012). The core of theory-driven chemistry education consists of the constant shift between the different representational domains of chemical thinking: the macroscopic, the sub-microscopic, and the symbolic domains. Because the sub-microscopic domain can neither be seen nor directly visualized, it requires specific forms of visualization—pictures and animations illustrating the model-based level of discrete particles, atoms, or molecular structures (Eilks, Witteck & Pietzner, 2012). The dictates of the information age demand a change of mindsets of teachers of science and technology. The shift from a view of Information Communication Technology (ICT) as a

special activity where teachers have no control over to the one where teachers view ICT as a tool for teaching and learning is gaining currency globally. The focus of integrating ICT in education has increasingly become an important concern in education not only in developed countries but in developing countries as well. Developing countries cannot afford to be left behind in the race for survival in a global environment that is characterized by the application of ICT for nation building and this is reported by a number of researchers (Agyei, 2012, Agyei, & Voogt 2011a,b; Ottevanger, Van den Akker, & de Feiter, 2007; Tilya, 2008) conducted in Sub-Saharan Africa.

More particularly, the report on Developing Science, Mathematics and ICT (SMICT) education in Sub-Saharan Africa suggested changes to the teacher's instructional role from presenter of knowledge and the use of drill-oriented methods to participatory teaching and learning involving ICT skills and pedagogical application of ICT (Ottevanger et al., 2007). Teachers of science and technology therefore, have to heed to these realities of this science and technology driven age (Anamuah-Mensah, 2004). Even though there are advances in using technology in teaching and learning there are a lot of barriers that militate against its use. Researching into the barriers to the use of ICT in teaching and learning may assist educators to overcome these obstacles and become effective technology adopters in the future. According to Bingimlas (2009) there are several other key issues related closely to lack of accessibility to resources as a barrier which themselves be considered barriers to teachers' use of ICT. Even though the resources are present in schools, lack of time does not allow teachers to access these resources. Also, lack of teacher training reduces the integration of technology into teaching and learning. Teachers' lack of pedagogical or skills-related (practical) training in how to use these ICT resources hinder the use of technological materials that may be available in these schools. Providing ICT tools in schools without teachers' technical knowledge can prevent the teacher from interacting with these tools.

A similar study conducted by Osei, Larbi, Osei-Boadu (2014) examined teachers' perceived barriers in high schools in Ghana, and found the following strong barriers to the adoption of ICT in teaching: educational qualification, age, gender of teachers, and teaching experience, influence teachers' adoption of ICT in teaching, lack of time, absence of in-service training on ICT usage, little knowledge about ICT before joining the teaching profession, inaccessibility of computers and management's ignorance about teachers' use of ICT in classroom. A lot of researchers attest to the fact that (Agyei and Voogt 2011; Kopcha 2012; Prestridge 2012; Goktas, Gedik and Baydas 2013; Al-Mulhim 2014) barriers that militate against teachers' experience in the integration of ICT in the classrooms include lack of access to resources, lack of confidence among teachers, lack of time, lack of training opportunities, technical problems, lack of knowledge about ways to integrate ICT in lessons, poor administrative support and poor fit with the curriculum. With the knowledge of these barriers on the teachers' ineffectiveness in using ICT can help strategies in helping to curb these challenges. According to Tarman, Kilinc, and Aydin (2019), barriers to the Effective Use of Technology Integration in Social Studies Education indicated that the most highly identified barriers were mainly external obstacles. These included lack of technology, restricted Internet access, and a lack of administrative and technical support. They also reported there was no statistical difference between female and male teachers' perceived barriers. Rather they found a statistically significant difference between teachers who attended technology-related professional development and those who did not. Carver (2016) in his study indicated that first order barrier, such as technology availability, is still a major concern that impacts both student and teacher use of technology. Availability of equipment, more than any other factor, seemed to have the greatest impact on whether technology was incorporated into classroom instruction or not. Teacher knowledge and skill with the use of technology, although a concern, was not the teachers' first consideration.

Francom, (2019) opines to the fact that barriers to technology integration: a time-series survey study was as a result of time. Time was the most stable and persistent barrier to technology integration among the respondents. Access to technology devices and resources remained a challenge, yet teacher beliefs, and training and technical support declined over time. Time is seen as a major barrier to ICT integration. The rate of technological change and the improved access to new technologies means that individuals will constantly need to reinvent themselves. The need to incorporate ICT into education is now necessary (Goktas, Yildirim & Yildirim, 2009). ICT has had a significant impact in enhancing the quality of education. The importance of integrating ICT education in particular, is to help students to learn and teachers to perform their teaching profession more effectively (Goktas, Yildirim & Yildirim, 2009). In the teaching of chemistry in the Ghanaian context, the most commonly used teaching methods include lectures and laboratory classes which are more teacher-centred. Students receive knowledge passively. These traditional methods do not stimulate students' interest in this subject. Most times, the knowledge students get is only superficial; they are unable to reach a deep level of understanding. The study assessed teachers' use of ICT in their teaching and learning process.

### **Statement of the Problem**

Recent literature suggests that integrating visualization into teaching can have more significant effects on students than traditional teaching. A lot of benefit has been derived from information and communication technologies in attempting to overcome the difficulties encountered by students in the conceptual learning of chemistry (Pekdag, 2010). One of the pre-requisite skills that qualify a junior high school student to study chemistry at the senior high

school is to have basic knowledge in the use of the internet and search engines (MOE, 2010). This presupposes that the teacher should be technologically inclined to take students through the subject (chemistry). But whether this is the situation of the teachers in the real classroom setting or not is the subject of the present study. However, studies on the teaching and learning of organic chemistry at the SHS in Ghana tend to focus more on students' perception of the difficult topics in organic chemistry (Davis, 2010), using laboratory based method in enhancing students' performances in organic chemistry (Offei-Koranteng, 2013) and students' performance in IUPAC nomenclature of organic compounds (Adu-Gyamfi, Ampiah & Appiah, 2013). It appears much study have not been reported on the use of modern technology in teaching chemistry in Ghana. Also the chief examiners report for WAEC (2006-2012) has consistently reported on students' poor performance in answering questions related to organic chemistry. The study was intended to; determine the perceived barriers of ICT use in teaching chemistry in the Senior High Schools (SHSs), Support system and teachers' knowledge and skills of ICT use in the Ashanti region.

## Methods

The purpose of the study was to assess the barriers of ICT use, Support system and teachers' knowledge and skills of ICT use in the teaching of Chemistry in senior high schools (SHSs) in the Ashanti Region. The study is an ongoing research and is built on the framework of design-based research. The needs and context analysis of the actual study took place at the SHSs in the Ashanti Region. The preliminary stage (needs and context analysis) of the study was intended to explore the barriers of ICT use in teaching Chemistry in the SHSs in the; Support system and practicing Chemistry teachers' knowledge and skills of ICT use in the teaching of Chemistry in SHS's in the Ashanti Region and the opportunities of ICT use in the teaching of chemistry in SHS's in the Ashanti Region. The research instrument that was used to collect the data was questionnaire and observational checklist was used by the researcher to have a view of the technological facilities and the conditions in which these facilities were. The items on the instrument that is the questionnaire were adopted and modified by the researcher for this study. Experts in the Department of Science and Mathematics Education at the Faculty of Education, University of Cape Coast, read through the items on the questionnaire and observational checklist to examine the face and content validity in order to ensure that they were devoid of ambiguities vis-à-vis the research questions.

A pilot-study was carried out on the feasibility ratings of the reliability of the data collection instrument. This was to ascertain whether the instrument was measuring what was supposed to measure. Three senior high schools within the Central Region were sampled during the pilot-study. These schools offer the General Science Programme. Three practicing Chemistry teachers of these schools were used for the pilot-study. It was assumed that teachers of these schools have similar characteristics as those at the SHS in the Ashanti Region where the actual study took place. All of the chemistry teachers selected for the pilot study had the minimum qualification in education (Bachelor or Degree) and were all trained at the various public universities in the country. There was direct administration of questionnaire by the researcher to the respondents. The questionnaires were given to the practicing Chemistry teachers, and an ample time was given to them to respond to items on the questionnaire. The questionnaires were collected later when the respondents had finished answering the items. The data collected were analyzed using the Cronbach alpha coefficient to check the reliability of the instrument. The items on the questionnaire were grouped and analyzed with reliability values as follows; barriers of ICT integration, administrative support, 0.71; technical support, 0.87; knowledge and skills of ICT use, 0.99; technology-based teaching of hydrocarbons, 0.91; perceived barriers of ICT, 0.72; perceived support of ICT, 0.86. From the analysis of the data collected from the pilot-study, some of the items with negative reliability were deleted while others with negative wordings were reframed to get the reliabilities.

The target population for the actual study included all science teachers who teach at the 45 SHSs which offer the General Science Programme in the Ashanti Region. The accessible population included only practicing Chemistry teachers teaching Chemistry in the 45 SHSs and the heads of the science department. The sample size comprised all practicing Chemistry teachers teaching at the 45 SHSs and the heads of science department of these schools. The non-probability sampling technique namely purposive sampling was employed to select the schools in the Region. The purposive sampling technique was employed to select all practicing Chemistry teachers and heads of science department teaching at the SHSs which offer the General Science Programme in the Region. These groups of people were purposefully sampled because they were considered the right people to provide useful information.

## Results

The study was intended to; determine the perceived barriers of ICT use in teaching chemistry in the Senior High Schools (SHSs), Support system and teachers' knowledge and skills of ICT use in the Ashanti region were studied. Descriptive statistics were carried out to analyze the data using Statistical Package for Social Scientist (SPSS) software version 16. Tables have been provided to illustrate and support the findings. The results is organized and presented under the following sections:

- Demographics
- Perceived barriers of ICT integration in teaching
- Support system (Administrative support and Technical support)
- Teachers' knowledge and skills of ICT use

### Demographics

A total of 48 teachers participated in the study. Out of this total, 9 females and 39 males, were practicing Chemistry teachers and heads of science departments at the SHSs selected for the study. The ages of the teachers ranged from 27 to 49 years with an average age of approximately 35 years. The teachers had some teaching experiences which ranged between 2 and 21 years with an average teaching experience of approximately 9 years. Some of them had thought other subjects before teaching Chemistry whereas others started their teaching carrier teaching Chemistry. With the teaching experience in Chemistry, the average age was approximately 5 years and it ranged from 1 to 18 years. To teach at the SHSs in Ghana, one is required to have a basic qualification in the first degree relating to the subjects taught at the SHSs. All the teachers (practicing Chemistry teachers and heads of science department) who took part in this study had their first degree. The programme they offered at the universities varied, which included the following; BSc Applied Chemistry (6), BSc Chemistry (10), BSc Agric (7), BEd Science (13), BSc Computer Science Engineering (2), BSc Biochemistry (5), BSc Chemical Engineering (2), and BSc Applied Biology (3). Only one of the teachers had his second degree in MPhil Analytical Chemistry. The teachers were from the various types of SHSs such as mixed or co-educational SHSs, single sex female and single sex male.

### Perceived Barriers of ICT Integration in Teaching

The school barriers that militates the integration of ICT in Chemistry lesson were investigated. The respondents were asked to indicate their views on the school barriers to ICT integration on a three point scale (3– major barrier; 2– minor barrier; 1– not at all). The score were interpreted as follows: one was the lowest score, which represents a no barrier and the three the highest score which represent a major barrier and the score two represented a minor barrier. Table 1 describes the mean values of the barriers to ICT integration. The first two barriers and the last bordered on available resources with mean value of  $2.56 \pm 0.62$ ,  $2.52 \pm 0.74$  and  $2.65 \pm 0.53$  s. d. emerged as major barrier to ICT integration. Another barrier which centred on available time had mean values of  $2.27 \pm 0.73$  and  $2.29 \pm 0.79$  s. d. were seen as a minor barrier against ICT integration. The next barrier centred on technical know-how with mean values of  $1.92 \pm 0.74$ ,  $2.31 \pm 0.78$ ,  $1.98 \pm 0.64$  and  $2.29 \pm 0.58$  s. d. were reported as minor barriers against ICT integration. Finally the school factors were seen as barriers that hinders ICT integration recorded mean values of  $2.50 \pm 0.68$  and  $2.08 \pm 0.79$  s. d.

Table 1

**Distribution of School Barriers in the Integration of ICT in Chemistry Lessons (n = 48)**

Items	Mean	Standard Deviation
Not enough or limited access to computers/computer lab	2.56	0.62
Availability of computer software	2.52	0.74
Lack of time in school schedule for integrating ICT	2.27	0.73
Lack of adequate technical support	2.50	0.68
lack of knowledge about ways to integrate ICT in lesson	1.92	0.74
ICT integration is not a school priority	2.08	0.79
Table 9 continues		
Not enough training opportunities for ICT integration knowledge acquisition	2.31	0.78
Lack of confidence to try new approaches	1.98	0.64
Lack of time necessary to develop and implement activities	2.29	0.79
Lack of knowledge to identify which ICT tool will be useful	2.29	0.58
Lack of digital learning resources in my school	2.65	0.53

Note: 3– major barrier; 2– minor barrier; 1– not at all

### Support system (Administrative support and Technical support)

To ascertain the current situation of ICT support systems provided at the SHSs, the teachers were asked if they were getting both technical and administrative support. Tables 2 and 3 give a summary of their responses. From Table 2 the responses of the teachers indicated that they currently get a little of technical support when using ICT in the teaching with mean values of  $1.52 \pm 0.74$  and  $1.69 \pm 0.85$  s. d. However, they do not get any current technical support for provision of technical course for operating and maintaining computer system and having a technician in the classroom and the mean values of  $1.17 \pm 0.43$  and  $1.02 \pm 0.14$  s.d. were recorded. From Table 3, it shows that the teachers were not given any administrative support when using ICT, the means values obtained were  $1.63 \pm 0.91$ ,  $1.64 \pm 0.91$  and  $1.67 \pm 0.86$  s. d.

Table 2

**Distribution of Technical Support System in the Schools (n = 48)**

Technical Support	Mean	Standard Deviation
Troubleshooting	1.52	0.74
Installation of software	1.69	0.85
Provision of technical course for operating and maintaining computer system	1.17	0.43
Having a technician in the classroom	1.02	0.14

Note: 4 – a lot, 3 – somewhat, 2 – a little and 1 – not at lot.

Table 3

**Distribution of Administrative Support in the Schools (n = 48)**

Administrative support	Mean	Standard Deviation
The administrative work arising from the use of ICT in my teaching (eg. booking computer labs, changing class schedules) is easy to do in my school.	1.63	0.91
The current reward structures adequately recognize those utilizing ICT.	1.64	0.91
When implementing innovations, our school considers teachers' opinion and adjusts its action plan as needed.	1.67	0.86

Note: 4 – a lot, 3 – somewhat, 2 – a little and 1 – not a lot.

**Teachers' knowledge and skills of ICT use**

With regards to knowledge and skills in accomplishing task using ICT, the teachers were asked to indicate the extent to which they were confident with their knowledge and skills in ICT application. They had to indicate one of these responses from a 4-point scale (4 – a lot, 3 – somewhat, 2 – a little and 1 – not a lot). Table 4 reveals the teachers responses to the various items. Generally the teacher responses indicated that they could confidently accomplish tasks with the knowledge and skills they have in ICT. The items included basic application programmes on a computer such as the use of word processor, emails, hyperlinks, PowerPoint etc. with the mean values ranging  $2.52 \pm 1.20$  to  $3.40 \pm 0.96$  s. d.

Table 4

**Distribution of Teachers' Knowledge and Skills of ICT Use in Accomplishing Task (n = 48)**

knowledge and skills of ICT	Mean	Standard Deviation
I am able to use a word processor to develop a written work	3.10	1.04
I know how to edit documents as needed	3.22	0.95
I can spell-check documents as needed	3.17	1.02
I can format documents	3.17	1.12
I am able to use software such as PowerPoint to make presentations.	3.15	1.18
I can add text and graphics, to presentations	2.75	1.14
I can add video and audio presentations	2.92	1.16
Table 12 continues		
I can add hyperlinks to presentations	3.02	1.26
I can use basic functions (e.g., sum or average).	2.94	1.04
I can use a spreadsheet to make a graph, chart, or Table.	3.04	1.13
I am able to use my email account to send and receive email.	3.19	1.14
I can send and receive email attachments (files).	3.25	1.00
I can send emails to multiple addresses and can forward email.	3.21	1.01
I am able to make use of www search engines (e.g., Google) to find online information and resources.	3.35	0.84
I can use advanced searching features (eg. and, or not)	3.08	1.04
I am familiar with specific educational web sites and can bookmark my favorite sites.	2.63	1.00
I can use devices such as digital cameras and scanners to capture images	3.06	1.17
I can save and manipulate images on a		
Table 12 continues		
Computer	3.13	1.16
I can transfer digital images into a variety of software applications (e.g., word processors, presentation software).	2.52	1.20
I can create animations and use them to teach.	2.69	1.24



I am able to connect a computer to the Internet.	3.40	0.96
I can produce a letter using a word processing programme	3.25	1.04
I can produce presentations with simple animation	2.88	1.18
I can prepare lessons that involve the use of ICT for instruction	2.89	1.06
I can find useful curriculum resources in chemistry on the internet for teaching	3.29	0.97
I can install educational software on my computer	3.10	1.15

Note: 4 – a lot, 3 – somewhat, 2 – a little and 1 – not a lot.

The teachers' views on the use of ICT in teaching hydrocarbons at the SHSs were solicited. They were to indicate their response on a 4-point scale, thus; 1 – never, 2 – sometimes, 3 – often and 4 – nearly always. The teachers were asked to indicate whether they gather information on the internet to assist them in planning their lessons. From the responses, teachers sometimes looked for information on hydrocarbons, which shows it is not something they mostly do. Thus, from the results the teachers did gather information on hydrocarbons through the use of ICT but did not plan and present their lessons to the students using ICT. The mean values for gathering information ranged from  $2.38 \pm 1.00$  to  $2.88 \pm 0.64$  s. d. With regards to the planning of lesson the mean values ranged from 1.50 to 2.40 and low mean values  $1.71 \pm 0.97$  to  $2.38 \pm 1.00$  s.d. were recorded for lesson delivery.

### Discussion and Conclusion

This study is associated with assessing the barriers of ICT use, Support system and teachers' knowledge and skills of ICT use in the teaching of Chemistry in senior high schools (SHSs) in the Ashanti Region. Under this section, the results of the study are discussed on the basis of three research questions. The teachers sampled for the study were from the various types of Senior High Schools (SHSs) such as mixed or co-educational SHSs, single sex female and single sex male in the Ashanti Region. The current changes in science and technology require much more effort from each individual to be technologically inclined (Anderson, 2014). Teachers need to be able to accept the changes and adjust to them. The study focused on assessing teachers' perception in ICT use in teaching organic chemistry. The newly accepted didactic terminology called TPACK – Technological Pedagogical Content Knowledge has been advocated by researchers as one of the tool that facilitates teaching and learning (Koehler, Mishra, and Cain, 2013). Technology have been considered as a double edge sword, in which both ends cuts. However, the rate of development of technology is on a fast pace and for nations that wish to advance and develop needs to move along with the growing trend in technology. Science and technology are interwoven. Basically, the products (principles, concepts, laws etc.) of science are mostly tapped and developed through the use of technology. The use of ICT in teaching organic chemistry have been appealed by researchers (Bhowon, Jhaumeer-Laulloo, Wah., and Ramasami, (2009).) as one of the tools that enhances and facilitates the teaching and learning of organic chemistry.

Even though ICT promotes the teaching and learning of organic chemistry, the results of the study show there barriers that hinders it use in various schools. Perceived barriers of ICT integration in teaching in the SHSs as expressed by the teachers included not enough or limited access to computers/computer lab, non-availability of computer software, lack of time in school schedule for integrating ICT and lack of adequate technical support. Notwithstanding the prevalence of technology in education, the provision of computer equipment and establishment of computer laboratories to SHSs are still relevant in senior secondary schools in the Ashanti region and this is reflected in teachers' perceived barriers to ICT integrated in teaching. Aside lack of computers in the SHSs, also lack the needed software that will equip teachers in preparing and designing lessons using ICT is a challenge. Lack of time is on the factors that limits teachers from using ICT in teaching. Teachers are normally poised on finishing the content of their syllabus for pupils to have a fair idea about the content of the topics to be covered within the academic year. Even though the teachers' response to lack of technical support was high, this could be as a result of lack of computers and computer laboratories in the various SHSs. The findings of this study in support with earlier research studies conducted by Tarman, Kilinc, and Aydin 2019; Carver, 2016, Nikolopoulou and Gialamas, 2016 which reported most highly identified barriers were mainly external obstacles such as lack of technology, technical support and lack of hardware. Lack of time in school schedule for integrating ICT was in line with the finding of Francom (2019) who attest that time was the most stable and persistent barrier to technology integration.

Another primary barrier perceived by the teachers was related to the support system (Administrative support and Technical support). The teachers indicated that they currently get a little of technical support when using ICT in the teaching. However, they do not get any current technical support for provision of technical course for operating and maintaining computer system and having a technician in the classroom and this does not allow enough time and smooth integrating of ICT in teaching. The lack of administrative and technical support was also reported as a perceived barrier by Francom (2019) and Tarman, Kilinc, and Aydin (2019), there is therefore a similarity of perceived barriers across time and different cultures. Teachers in this study confidently revealed their knowledge and skills of ICT use. The teachers were of the view that they could accomplish tasks with the knowledge and skills they have in ICT. They could use basic application programmes on a computer such as the

use of word processor, emails, hyperlinks, PowerPoint etc. However, for the use of ICT in teaching hydrocarbons, teachers claim they sometimes search for information or gather information from the internet on hydrocarbons which is not a usual practice. Thus the teachers gather information on hydrocarbons but do not plan and present their lesson delivery to the students using ICT. Teacher knowledge and skill, although a concern, was not seen as a barrier to ICT integration. However findings of this study did not support the findings of Osei, Larbi, Osei-Boadu (2014) who attest that teachers had little knowledge about ICT before joining the teaching profession, and ignorance about teachers' use of ICT in classroom are the strong barriers to the adoption of ICT in teaching.

In conclusion, the integration of ICT in teaching (hydrocarbons) have tremendous potential for enhancing the teaching and learning experience of both teacher and students in education. Nevertheless barriers to ICT integration continue to make it challenging for teachers to use ICT to enhance students' knowledge of concepts being thought which goes a long way to facilitate teaching and learning in the educational sector. Overall, findings from this study show perceived barriers to ICT integration as a result or limited access to computers/computer lab, non-availability of computer software, lack of time in school schedule for integrating ICT, lack of adequate technical support and support system (Administrative support and Technical support). Teachers' knowledge and skills of ICT use was not seen as a barrier to ICT integration. Results from this study lead to possible recommendations to mitigate the effects of these barriers. Computer laboratories should be setup in SHSs and furnished with computers and software that will enable teachers plan and deliver their lesson effectively using ICT. The time table of the SHSs should be reviewed to cater for ICT integration which teachers' perceived to be time consuming. Finally the SHSs should provide teachers with administrative support and technical support in use of ICT in teaching. Discovering teachers' perceptions of barriers to the integration of ICT in teaching is not an end by itself. Future research investigations is needed on how these barriers are to be overcome to support effective integration of ICT in teaching and learning at the senior high schools.

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