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Perceived Factors That Affect the Overall Use of Ibox Among Integrated Science Teachers

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ABSTRACT

The study sought to determine the perceived factors that affect the overall use of iBox among the Integrated Science teachers in the initial Secondary Education Improvement Project (SEIP) supported Senior High Schools in the Upper East Region of Ghana. The study employed a cross-sectional survey research design and used mainly questionnaire as the research instrument. Out of the 162 participants sampled, 155 questionnaires were fully completed and validated. Data analysis procedures included frequencies, crosstab, chi-square and percentages. There was no statistical significance in the differential perceptions of older and younger SHS integrated science teachers' use of the iBox for integrated science lessons, apart from reliable internet service, most of the schools were equipped with iBox servers, display screen (TV), uninterrupted power supply/Solar Systems and Wifi supported computers and the main technical factors that affected the overall use of iBox were poor technical support, inadequate technical training and lack of refresher courses on the iBox. It was recommended among others that the GES and the SEIP to provide regular in-service training in information technology for the integrated science teachers and that they should be provided with the necessary support. It was also recommended that the GES should develop a policy which mandates all SEIP schools to utilise and integrate the available educational technologies installed in their schools. It was suggested that future research be carried out on the overall impact of the iBox on students' academic performance in integrated science from 2015 to date.

Keywords: technology integration, factors, integrated science, perception, iBox

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1. Introduction

All educational levels in Ghana are becoming increasingly pressured to integrate technological tools in lesson delivery and demonstrations. There is no doubt that educational reforms have placed greater emphasis on Information and Communications Technology (ICT) and Science and Technology to the new curriculum (Adu-Gyamfi, Donkoh, & Anim, 2016). This is to equip learners with sufficient knowledge and skills that is required in the twenty-first century (Yidana, 2009). The applications of ICTs were suggested by numerous researchers as imperative for enhancing quality classroom experiences. According to Sarfo et al. (2016), over the past decades, teachers and educational systems in Ghana have agreed that the application of instructional technologies has been an important tool for improving the quality of teaching and learning but it has however seen a low application in classroom management and assessment.

Yidana (2009) also stated that, the use of ICT for educational purposes yields positive outcomes on the part of the students such as increased motivation, active learning, providing efficient resources and better access to information. Yidana further posited that with motivation, it enhanced learners' attention and quest for knowledge and that assessment was more authentic and transparent with ICTs. Technology has great potential to increase learners' motivation, link learners to various information sources, support collaborative learning, and allow teachers more time for facilitation in classrooms (Gebremedhin & Fenta, 2015). Technology and collaborative teaching are important ingredients that help students to develop self-confidence in learning and enhancing their understanding of scientific concepts (Amedeker, Antwi, & Hanson, 2011)

Integrating technology into teaching and learning is not a recent concept. It is most likely to have been in existent several years back and probably as old as technologies such as radios or televisions. In Ghana for instance the tertiary distance education teachers preferred to study through print, audio cassettes, video cassettes, radio and television when they enrol in distance education programmes (Mensah & Owusu-Mensah, 2002) However, considering the brisk improvement in modern information communications technologies such as the internet, technology use has rapidly drawn the attention of a lot of educationists.

The use of diverse technologies in teaching and learning can assist teachers and students to improve and develop the quality of education by providing curricular support in difficult subject areas (Gulbahar & Guven, 2008).To achieve these targets, subject teachers will be required to be fully involved in collaborative projects and development of strategic intervention for a positive change which would encompass teaching and learning with technological tools to improve classroom experiences. Integration can only be deemed to be complete when all salient factors are impeccably combined to create a meaningful instructional environment. The sheer handing out of technological tools such as compact disks, softcopies of presentations and websites does not culminate into technology integration in education.

Sarfo et al. (2016) stated that in the wake of technology pluralism, educational practitioners, particularly teachers, have no other choice than to learn and adopt ICTs in their routine work. They further mentioned that much deployment of ICT could be realised in schools based on the competence of teachers and this should not be over-emphasized. The major barriers observed were low confidence, inadequate competence and unavailability of requisite resources. Since low confidence, competence and accessibility have been found to be the vital components of technology integration in secondary schools. Information technology resources comprising hardware and software, improved professional development, adequate time and technical backstopping for in-service teachers are indispensable for technology integration. A comprehensive amalgamation of all these, are necessary for good teaching. However, the availability of these components increased the tendency for excellent implementation of technologies in the classroom environment. Hence, second cycle school teachers collectively agreed that ICT had the tendency of enhancing students' learning outcomes if it were adequately utilised (Innovation Unit, Aga Khan Education Services and the Aga Khan Foundation, 2018). If information technology tools were implemented within the appropriate context such as using suitable sources, methods of training and easy access to technical support, it could result in meaningful outcomes on teaching and learning. The key factors that affected the learning outcomes of students was not the availability of technological tools but the pedagogical approach to effective implementation of instructional technologies. Instructional technology should en suite the curriculum and not the other way round. Therefore, effective instructional technology integration should focus on pedagogical improvement through its application.

1.1. Statement of the Problem

Senior High Schools in Ghana are grouped into categories (A, B, C and D) based on their infrastructure and academic performance. Schools with good infrastructure and high academic performance are placed in category A and those with highly inadequate infrastructure and poor academic performance are also placed in category D. Besides, all categories of schools are found in all the regions in Ghana. Due to inadequate infrastructure and low academic performance of category C and D schools, Secondary Education Improvement Project (SEIP) was designed to improve the quality of low performing senior high schools in Ghana. The project was designed to help low academic achieving school attain at least six (6) credits of performance at West African Secondary School Certificate Examination (WASSCE). Through SEIP, workshops were organised for science and mathematics teachers on how to integrate ICT in their lessons. Science and Mathematics teachers were trained on how to integrate and use iBox in their lessons in order to improve the academic performance of students. After five years of implementation of the program, the academic performance of students in SEIP schools continue to decline most especially schools in the Upper East Region of Ghana. Through our observation and communication with teachers in SEIP Schools in the Upper East Region, we realized that many integrated science teachers do not use iBox in their lessons which accounted for the abysmal performance of students in integrated science in WASSCE. Yet no study has investigated the effectiveness of the project and also factors that affect integrated science teachers use of iBox in their lessons. It is against this background that the researchers deemed it important to investigate on factors that affect the overall use of iBox among integrated science teachers in the region.

1.2. The Purpose of the Study

The study sought to determine the differential perceptions of older and younger integrated science teachers' use of the iBox. It also seeks to establish the resources available in the various school laboratories that can support the effective use of the iBox and to determine the technical factors militating the effective integration of the iBox in the various SEIP schools in the Upper East Region.

1.3. The Objectives of the Study

The specific objectives of the study were:

1. To determine differential perceptions of older and younger SHS integrated science teachers' use of the iBox for Integrated Science lessons.
2. To determine the available resources in the school ICT laboratory necessary for effective use of the iBox.
3. To establish the technical factors that affects the overall use of iBox among the integrated science teachers.

1.4. Research Questions

The following research questions were addressed in the study:

1. What are the differential perceptions of older and younger SHS integrated science teachers' use of the iBox for integrated science lessons?
2. What are the facilities available in the school ICT laboratory to support iBox use?
3. What technical factors affect the overall use of the iBox among the integrated science teachers?

1.5. Hypothesis

Ho: There is no differential perceptions of older and younger SHS integrated science teacher's use of the iBox for integrated science lessons.

1.6. The Significance of the Study

The result of this paper will add-on to the existing body of knowledge, regarding iBox implementation in the classroom, which was relatively new and had received little attention among secondary school teachers and students. In addition, this study was aimed at identifying some demographic factors which might pre-dispose educators to either a positive or negative perception of use of instructional technologies in integrated science lessons (Ballew, 2017).

1.7. Assumptions

The Teachers' demographics were assumed to be correct since information were provided by each participating teacher. It was assumed that integrated science teachers were using the iBox in a manner reflected by the questionnaire items. For instance, if the questionnaire contained an item which sought to determine whether iBox had an effect on learners' assessment performance, it was assumed that the teacher employed the iBox for teaching and learning integrated science.

2. Review of Related Literature

2.1. The iBox

The iBox device acts as a local file server. It contains a quad core processor and the current versions have 2 terabytes of local storage (Secondary Eduation Improvement Project [SEIP], 2014). The iBox is a Local Area Network (LAN) server that provides educational content for both teachers and students within the environs of selected SEIP schools. However, the i-campus is an online version of the iBox allowing students and teachers to share their classroom experiences across the country. They both host teaching notes, laboratory simulations, test items, mailing service and self-practice modules. The iBox project will run over the period of October 2014 to November 2019 (SEIP, 2014).

The World Bank (as cited by Cullen et al., 2019) stated that iBox contained already prepared video tutorials, content assessment items and student exercises, to be delivered to the participating schools, for use by both students and teachers. The report mentioned that an independent verification indicated that the iBox was being underutilised by both teachers and students in some Senior High Schools (SHS) that had no supporting infrastructure such as a computer laboratory. Under the current educational policy which prohibited the use of mobile phones and Portable Digital Devices further prevented SHS students from accessing the iBox on these devices.

The iBox does not rely on access to the internet to function. It can accommodate up to 100 hard-wired or wi-fi enabled users at a time, though the reach depended to a certain extent on precisely where it is located and the configuration of rooms around it. Its advantages were that a school needed only laptops, desktops, tablets or smartphones to access the content, removing the need for an expensive or unreliable connection to the internet. The iBox as a local server gave complete control over content and it was only the materials created and installed under the direction of CENDLOS which were loaded (Cullen, Mallett, & Murphy, 2019). This mean that adding and updating materials involves physical access to the machine. So far, this is being

carried out on an annual basis. CENDLOS has also developed a web-based access to iBox content via icampus https://icampusgh.com. However, this would entail access to the internet for users. Access to the materials whether located on the iBox or on the icampus website is restricted and necessitates a login credentials (Cullen, Mallett, & Murphy, 2019).

2.2. Secondary Education Improvement Plan (SEIP)

The Secondary Education Improvement Project (SEIP) was funded from the World Bank and aimed at supporting the implementation of the government Community Day Senior High School Project (CSHSP) through two components:

I. Support to Increase Access with Equity and Quality in Senior High Schools; and
II. Management, Research and Monitoring and Evaluation (Secondary Eduation Improvement Project [SEIP], 2014).

As part of this SHS iBox project, each of the 125 SHS were provided with iBox system to interface into the existing Local Area Network of the beneficiary schools. The system informed and guided students as they progressed through the content, taking into consideration their current position inside a lesson and what needs to be done to complete it.

2.3. Factors that Affect Integration of Educational Technology in Classroom

Many factors were found to affect technology integration. These factors included gender, number of years of professional experience, duration of computer use, technical support, individual innovativeness and attitude (Uslu, 2018). Some studies indicated that gender is a variable that affects technology use in education (Nagy, 2018). Generally, most literature stated that technology integration in classroom is low among women compared to men. Besides gender, number of years of professional experience was one of the factors which were reported to affect technology integration in education. Mostly, technology integration decreases with the rise in number of years of professional experience. Some researchers consider number of years of professional experience as a factor that does not affect technology integration.

2.4. Age and Integration of Educational Technology in Integrated Science Classroom

Age was found to affect technology integration in classroom (Nair & Das, 2012). However other literature did not consider age an effective variable in technology integration. Another important factor that affects technology integration in classroom is the duration of computer use. Technology integration increases with the increase in the duration of computer use. Besides duration of computer use, the frequency of use also affects technology integration (Uslu, 2018).Another relevant factor affecting technology integration was teachers' attitudes towards technology as well as its use in education. The possibility of achieving technology integration is higher among teachers with positive attitudes than those without. Individual innovativeness also affects technology integration. There is significant relationship between individual innovativeness and computer use.

2.5. Facilities Available in School ICT Laboratory to Support Educational Technology Integration in Classroom

In Ghana, ICT integration is still far from being achieved as many rural schools still grapple with the lack of electricity and the high cost of ICT equipment. Public schools have complained of the lack of government employed teachers. They are forced to hire teachers thus draining the scarce resources which could have been used for upgrading the ICT facilities. In addition,

parents are not willing to pay any extra fees because of free Senior High School education which was implemented in 2017. They feel it is the responsibility of the government to provide learning facilities (The Commonwealth Secretariat, 2006)

2.6. The technical Factors that Affect the overall Use of Technology among the Integrated Science Teachers

To teach, teachers need to develop an integrated knowledge structure that incorporates knowledge about subject matter, learners, pedagogy, curriculum, and schools; they need develop pedagogical content knowledge for teaching their subjects (Chege, 2014). But for technology to become an integral component or tool for learning the subject, teachers must also develop "an overarching conception of their subject matter with respect to technology and what it means to teach with technology there is the need for teachers to have Technology Pedagogical Content Knowledge (TPACK)" (Niess, 2005). Training needs of teachers can therefore not be oversized. Apart from the one-time training, follow-up refresher courses as well as in-service training must be conducted to meet the technical needs of teachers with regards to integration of educational technology in lessons and classroom experiences.

2.7. The Senior High School Integrated Science Syllabus

The integrated science syllabus was designed to provide and deliver content knowledge in five key thematic areas (Ministry of Education, 2010). The themes covered subjects that included both the pure and applied sciences. The subjects encompassed Biology, Chemistry, Physics, Agriculture, and other natural sciences. The themes cut across Cycles, diversity of matter, energy, and interactions (Ministry of Education, 2018). The syllabus emphasized the imperative need to view these themes wholistically but not as individual units. Students were encouraged to study the themes as a single idea rather than as separate and individual concepts.

The principal aim of the integrated science syllabus was to wholistically equip the Ghanaian student, with the basic scientific concepts and knowledge to be able to thrive in their scientifically enhanced communities. It was also designed to provide learners with the basic scientific knowledge required to be able to build on at the higher level of their education. For instance, the science topics at the basic school level prepared the students to be able to fully participate in an integrated science course at the second-cycle institutions. The integrated science syllabus was designed in a spiral approach to re-enforce what was learned at each stage of the academic ascend (Ministry of Education, 2018). The spiral design of the syllabus provided a platform that added-on to knowledge, improved cognitive development in science, and provided a much deeper concept at the higher level.

The spiral approach to the integrated science course was crucial for providing a building block on which the child gradually developed the required skill, knowledge, and cognitive abilities to better face life's challenges in their society. The basic concepts of science were taught at the pre-school level in Ghana. The build-on was experienced by pupils at both the lower and upper primary schools. The much higher concept formation, skill enhancement, and extra knowledge were much pronounced in students at the Junior High School level than at the lower levels (Ministry of Education, 2018).

3. Methodology

3.1. Design of the Study

The research design adopted in this study was a cross-sectional survey. Survey research investigates associations between respondents' characteristics such as age, education, social class, race, and their current attitudes toward some issue. The participants in a cross-sectional study are selected based on the inclusion and exclusion criteria set for the study (Setia, 2016). Cross-sectional survey method is less expensive.

3.2. Study Area

This research was conducted in the Upper East Region of Ghana.

3.3. Population

There are 125 initial SEIP schools in Ghana who benefited from the iBox project and 9 of these schools are located in Upper East Region. The total number of teachers targeted per each track of the 125 senior high schools is 9 making a total of 18 for both tracks. Therefore, the target population of the study comprised 18 teachers drawn from both track gold and green for each senior high school making a total of approximately 2,250 integrated science teachers for all SEIP schools in the country.

3.4. Sample

Purposive sampling technique was adopted to obtain the sample population for this study. A total of 162 participants were purposively sampled as indicated in Table 1.

Table 1.
Sample Selection for Track Gold and Green

Track	No. of int. sci. teachers	No. of ICT/iBox coordinators	No. of top management	Total	Total sample size
Gold	6	2	1	9	
Green	6	2	1	9	
Total		No. Schools 9		18	162

Table 2 outlines the purposively selected schools for this research. The schools are the SEIP supported schools located in the Upper East Region of Ghana. The additional SIEP schools that were recently added were not included in this study because they had not been furnished with the iBox and its related accessories.

Table 2.
List of the 9 SEIP schools in the UER

SEIP Senior High School	District
1. Zorkor senior high school,	Bongo
2. Gowrie secondary/technical school,	Bongo
3. Bongo senior high school,	Bongo
4. Awe senior secondary/technical,	Kassena-Nankana
5. Our lady of Lourdes secondary/technical,	Kassena-Nankana municipal
6. Kusanaba senior high school,	Bawku West
7. Fumbisi senior secondary Agric school,	Builsa South
8. Sandema senior high school,	Builsa North
9. Sandema sec/tech school,	Builsa north
Total no. of schools	**9**

3.5. Instrumentation

The main instruments used in this study was the questionnaire. Other methods such as personal observations, unstructured interviews and inspection of existing documents were employed for data triangulation's purpose.

3.6. Reliability of the Main Instrument

A total of 100 questionnaires were used to run the Cronbach Alpha reliability test using Statistical Package for Social Sciences (SPSS). A reliability analysis was carried out on teaches' perception of iBox use for integrated science lessons comprising 32 items. Cronbach's alpha showed the questionnaire to reach acceptable reliability, $\alpha = 0.801$. Most items appeared to be worthy of retention, resulting in a decrease in the alpha if the item were deleted.

Table 3.
Reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.801	.731	32

3.7. Data Collection Procedure

An introductory letter was used to seek permission from the headteachers/ headmistresses of the schools that participated in the study. Due to the COVID-19 pandemic, a word-based questionnaire was developed with Text Boxes, Option Buttons and Check Boxes which enabled respondents to complete softcopies of the questionnaire and returned them via WhatsApp, a social media platform. Field notes of schools that were accessible were also taken. Field notes recorded included descriptions of the places, that is both physical layouts and locations of the selected schools' environment (Mulhall, 2003). Notes were taken on participants' designation and positions held in the school.

3.8. Data Analysis Procedure

The acquired data via questionnaire administration was organized into statistically meaningful forms to enable an analysis of the data. The statistical tool that was employed for the analysis of the coded data was Statistical Package for Social Science (SPSS). All data were fed into the system and computations were done using descriptive statistics. The qualitative aspect of the questionnaire was analysed via categorization and frequency counts to make statical meaning out of the data obtained from the field. All data were captured and tabulated for further discussions and inferences.

4. Results and Findings

4.1. Background Characteristics of Respondents

The demographic characteristics of teachers were captured using the questionnaires and all data were analysed and present in the Table 4.

Table 4.
Background Characteristics of Respondents

Variable	Category	Frequency	Percent (%)
Sex of respondents	Male	143	92.3
	Female	12	7.7
	Total	**155**	**100.0**
Age of respondent	Under 30yrs	18	11.6
	31-40yrs	93	60.0
	41-50yrs	35	22.6
	Over 50yrs	9	5.8
	Total	**155**	**100.0**
Educational level	HND	2	1.3
	First degree	142	91.6
	Second degree	8	5.2
	Other	3	1.9
	Total	**155**	**100.0**
Number of years with GES	1-5yrs	35	22.6
	6-10yrs	83	53.5
	Over 10yrs	37	23.9
	Total	**155**	**100.0**
Number of years in current school	1-5yrs	48	31.0
	6-10yrs	87	56.1
	Over 10yrs	20	12.9
	Total	**155**	**100.0**

The analysis of the data obtained via questionnaire administration indicated 92.3% and 7.7% of the teachers of the participating schools were male and female respectively as depicted in Table 4. The low percentage of female teachers among integrated science teachers is a reflection of the low population of female students pursuing pure sciences at various educational levels. Both the pre-tertiary and tertiary levels have recorded low ratios of female to male in the science classes in Ghana which conforms with the findings of some researchers (Mahdi & Al-Dera, 2013). There was no significant difference in using ICT between teachers of varied age ranges and experiences. However, their results indicated that there is a difference between male and female teachers in using ICT to teach. Their findings, as collaborated by the findings in the Table 4 indicated that Female teachers reported less use of iBox in their instruction than male teachers.

Regarding the age of the teachers, the findings indicated that cumulatively most teachers 111 (71.6%) are 40 years and below and a lower proportion of teachers 44 (28.4%) were above 40 years in conformity to the findings of some researchers (Mensah & Owusu-Mensah, 2002). This study showed that all the science teachers in the sampled schools were professionally qualified with a higher number142 (91.6%) of teachers having a first degree and a few 8 (5.2%) were having second degrees. The data showed that the majority of the teachers had a working experience of above six years that is 120(77.4%). Though many of the teachers had been with Ghana Education Service for a period more than 6 years, a substantial number 135(87.1%) of them had been in their current school for a period less than ten years. The number of years of experience in teaching a particular subject is an essential factor in technology integration in teaching (Mahdi & Al-Dera, 2013).

Research question one (1):

1. What are the differential perceptions of older and younger SHS integrated science teachers' use of the iBox for integrated science lessons?

The data was analysed using crosstabulations of age of respondents and teachers' perception of iBox usefulness for lesson delivery in classroom. The results were displayed in Table 5.

Table 5.
*Age of respondent * I perceive ibox to be Useful for lesson delivery*

		I perceive ibox to be Useful for lesson delivery					Total
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Age of respondent	Under 30yrs	0	2	2	6	8	18
	31-40yrs	7	10	8	24	44	93
	41-50yrs	5	1	4	8	17	35
	Over 50yrs	0	1	2	2	4	9
Total		12	14	16	40	73	155

From Table 5, it is very apparent that teachers aged less than 40 years generally held a good view of the usefulness of iBox in science classroom, that is about 71.23%(52). The number of teachers who strongly agreed to the questions "*I perceive ibox to be Useful for lesson delivery*?", was quite high (44 out of 73), ranged between the ages of 31 and 40 years. However, ironically about 7 teachers who aged less than 40 years indicated they strongly disagreed to the question posed in the questionnaire as opposed to only 5 who were above 41 years and strongly disagreed. The available statistics makes it obvious that the youthful teachers tend to embrace and are more opened to using educational technology (iBox) than their older counterparts. Only four (4) teachers aged above 50, for the sampled schools, strongly agreed to the question posed. It was also quite obvious that teachers who were under 30 years were fewer (18) than those who were aged between 31 and 50 years (137).

Table 6.
The Pearson Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.112[a]	12	.776
Likelihood Ratio	10.008	12	.615
Linear-by-Linear Association	.147	1	.702
N of Valid Cases	155		

a. 12 cells (60.0%) have expected count less than 5. The minimum expected count is .70

***Ho*: There is no differential perceptions of older and younger SHS integrated science teacher's use of the iBox for integrated science lessons**

From the chi-square test in Table 6 with α =0.05, there was no statistically significant association between age and teacher perceived usefulness of iBox in lesson delivery, (X^2 (12) = 8.112, p=0.776). Therefore, the null hypothesis was not rejected. The age of teachers (respondents), therefore does not statistically significantly indicate a difference in perception of the usefulness of iBox among in-service integrated teachers of the selected SEIP schools in Upper East Region. Both older and younger teachers therefore agreed to the usefulness of the instructional technology tool, the iBox. There was however a slight tilt towards the more youthful ages (below 40years) thus 82 respondents *agreed to strongly disagreed* to the usefulness of iBox for lesson delivery as depicted in the crosstabulation in Table 5.

4.2. Age of Respondents and Integration of iBox in Integrated Science Classroom

The pictorial diagram in Figure 1 displays the use of iBox by teachers (respondents) at different age groups.

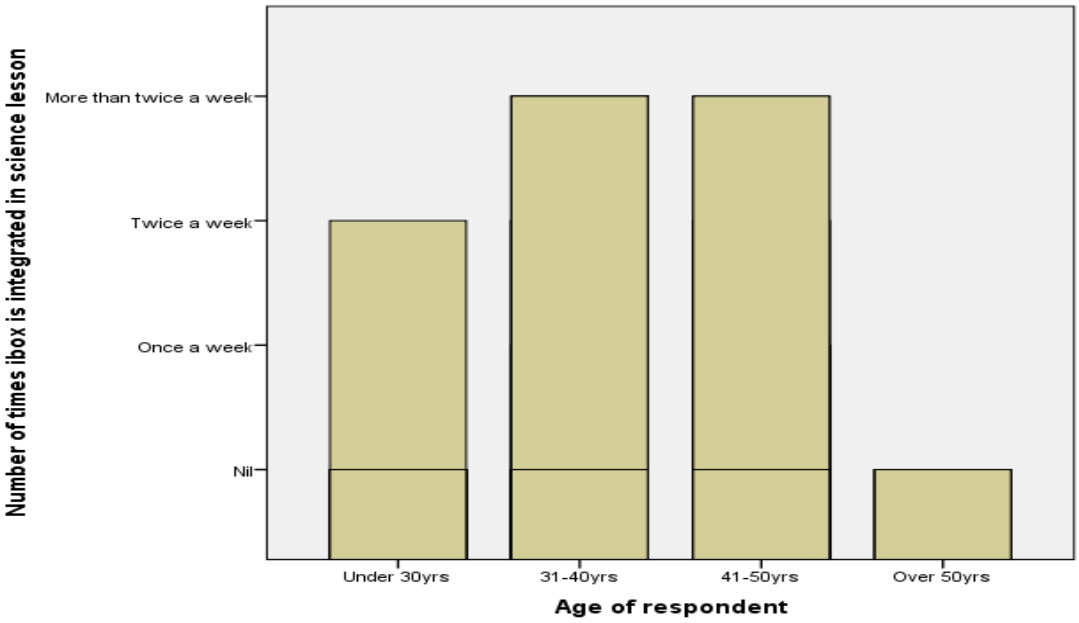

Figure 1. Frequency of use of the iBox against age of respondents

From Figure 1, it is noticeable that teachers who aged between 31 and 50 years integrated the iBox in integrated science lessons more than twice a week. The other categories of teachers were those who aged under 30years and integrated the iBox in integrated science lessons twice a week. The group of respondents who rarely used the iBox were teachers aged over 50years. It is therefore observed that older teachers (Over 50years) tend to use the iBox far less than those who were much younger (Figure1).

Research question two (2):

2. What are the facilities available in the school ICT laboratory to support iBox use?

From Table 7 it is evident that over 90% of integrated science teachers responded in affirmative to the availability of iBox and its related facilities in their schools. A high figure 93.5% on the contrary indicated that they had no internet facilities in their schools. From the statistics it is clear that most of the schools interviewed had iBox servers 98.1%, display screens (TVs) 94.2% and Uninterrupted Power Supply (Solar system)69.7% and Wifi-supported computers 90.3%. Table 7 shows a good trend in terms of resource availability for effective utilisation and integration of iBox in all the SEIP supported senior high schools in the Upper East Region. Apart from internet service with only 6.5% availability, the iBox servers, display screen (TV), uninterrupted power supply/Solar Systems and Wifi supported computers were available in most schools as shown in Table 7.

Table 7.
Facilities Available in Schools' ICT Laboratories

Variable	Category	Frequency	Percent (%)
iBox Server	available	152	98.1
	Unavailable	3	1.9
	Total	**155**	**100.0**
Display Screen (TV)	Available	146	94.2
	Unavailable	9	5.8
	Total	**155**	**100.0**
Uninterrupted power supply (Solar system)	Available	108	69.7
	Unavailable	47	30.3
	Total	**155**	**100.0**
Wifi support computers	Available	140	90.3
	Unavailable	15	9.7
	Total	**155**	**100.0**
Internet Service	Available	10	6.5
	Unavailable	145	93.5
	Total	**155**	**100.0**

Research question three (3):

3. What technical factors affect the overall use of the iBox among the integrated science teachers?

Table 8 contains data on the technical factors affecting the overall integration and utilisation of iBox among the teachers in the selected senior high schools. These factors were obtained from the open questions in the questionnaire.

Table 8.
Technical Factors Affecting iBox Integration

Technical factors	Frequency	Percentage (%)
Inadequate proficiency in computer use	23	14.8
Poor technical support	29	18.7
Inadequate Technical training	32	20.6
Lack of refresher courses on the iBox	28	18.1
Limited number of wifi-supported computers	11	7.1
Difficulty in using the iBox	10	6.5
Contend is not comprehensive	13	8.4
Time constrained	9	5.8
Total	**155**	**100.0**

From the Table 8, most of the respondents cited poor technical support (18.7%), inadequate technical training (20.6%) and lack of refresher course on the iBox (18.1%) as the main factors affecting the use of the iBox in teaching integrated science lessons. The results indicated clearly that the limited number of wifi-supported computers (7.1%), difficulty in using the iBox (6.5%) and time constrained (5.8%) were the least respondents indicated as the factors affecting utilisation and integration of iBox in lessons. The findings were consistent with that of Uslu (2018) who observed that technological pedagogical content knowledge had the greatest direct effect on technology integration.

5. Discussions

The first research question sought to determine the differential perceptions of older and younger SHS integrated science teachers' use of the iBox for integrated science lessons. Regarding the age of the teachers, the findings indicated that cumulatively most teachers who responded to the questionnaire had ages between 31 and 50 years. There was no statistically significant difference between older and younger SHS integrated science teachers regarding their perception of usefulness and integration of iBox in teaching integrated science lessons among the SEIP schools in the Upper East Region. However, teachers who were aged below 50 years were inclined to use the iBox more frequently (More than twice a week) than those who were aged above 50 years. It is clear that younger teachers are more open to the use of ICT than most older teachers but not all older teachers as recorded in this study and by other researchers (Mensah & Owusu-Mensah, 2002).

The second research question was posed to identify the facilities available in the school ICT laboratory to support iBox use among SEIP schools in the Upper East Region of Ghana. The available data indicated that apart from the inadequate availability of internet facilities, most schools were equipped with iBox servers, display screen (TV), uninterrupted power supply/Solar Systems and Wifi supported computers. Averagely, all the schools responded positively to the availability of support facilities for the iBox. This finding was in line with Cullen et al (2019) who indicated that the iBox and its related infrastructure were deployed but however received limited usage as was envisaged.

The third research question was to determine the technical factors that affect the overall use of iBox among the teachers. The main technical factors that affected the overall use of iBox were poor technical support, inadequate technical training and lack of refresher course on the iBox. The data obtained points out to the fact that most schools had the needed facilities except internet services which was limited to a few schools. Though most of these facilities were available in all the nine (9) SEIP schools, there was generally a low integration and utilisation of the iBox among integrated science teachers in their lessons.

5.1. Educational Implication and Practice

This study should lead to an increase in provision of essential technological tools for effective utilisation of iBox and other related instructional technologies in Senior High Schools in Ghana. It will also provide evidence of low uptake and use of the iBox which will sensitize teachers on the need to utilise it as envisaged by the Ghana Education Service.

5.2. Suggestions for Future Research

This study was cramped by time, finances and academic requirements. There is the need to carry out further and more comprehensive studies of the iBox in the following aspects;

1. The overall impact of the iBox on students' academic performance in integrated science from 2015 to date.
2. A nation-wide assessment of the integration and implementation of the iBox among all the initial 125 SEIP schools from 2015 to date.

5.3. Conclusion

The following conclusions were drawn from the study:

1. There was no statistical significance in the differential perceptions of older and younger SHS integrated science teachers' use of the iBox for integrated science lessons

2. Apart from reliable internet service, most of the schools were equipped with iBox servers, display screen (TV), uninterrupted power supply/Solar Systems and Wifi supported computers and
3. The main technical factors that affected the overall use of iBox were poor technical support, inadequate technical training and lack of refresher course on the iBox

5.4. Recommendations

The following are the recommendations;

1. It is recommended that the GES and SEIP should provide regular in-service training for integrated science teachers to enable them use the iBox in the schools.
2. Integrated Science teachers should be provided with the necessary motivation and support
3. The GES should develop a policy which mandates all SEIP schools to utilise and integrate the iBox installed in their schools.

Data Availability

The statistical data presented in this study to support the findings are included in the article text.

Conflict of Interest

The researchers declares that there is no conflict of interest in carrying out of this study.

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Appendix

Research instrument: Questionnaire

BACKGROUND CHARACTERISTICS OF RESPONDENTS

(*Kindly Tick by Right-Mouse clicking*)

1. Sex of Respondent

☐ Male ☐ Female

2. Age of respondent

☐ Under 30 ☐ 31 - 40 ☐ 41-50 ☐ Over 50

3. Educational level of respondent:

☐ HND ☐ First Degree ☐ Second Degree ☐ Other (Specify)

4. Number of years with GES:

☐ 1-5yrs ☐ 6-10yrs ☐ Over 10yrs

5. Number of years in your current school [ ] 1-5yrs [ ]6-10yrs [ ] Over 10 yrs

☐ 1-5yrs ☐ 6-10yrs ☐ Over 10yrs

6. What is/are your position in the school?

☐ ibox/ICT coordinator

☐ Head of Department

☐ Integrated Science Teacher

☐ Senior school management

7. How many periods do you teach in a week (If you are a subject teacher)

☐ 3-9 Periods per week

☐ 10-16 Periods per week

☐ 17-22 Periods per week

8. How many times do you integrated iBox in your lessons in a week

☐ Nil

☐ Once a week

☐ Twice a week

☐ More than thrice a week

TEACHERS' PERCEPTION REGARDING IBOX INTEGRATION AND USE IN CLASSROOM

Kindly tick by right-mouse clicking the appropriate number based on the code below:
Adapted from TAM3

ITEM	*Teachers' perceived* ***Computer Self Efficacy*** *(CSE)*	Very Good	Good	Satisfactory	Poor	Very Poor
9	Ability to effectively use a computer	**1**	**2**	**3**	**4**	**5**
10	Use of new computer software programs with a minimum of effort.	**1**	**2**	**3**	**4**	**5**
11	Confidence with the keyboard and mouse usage in computer applications.	**1**	**2**	**3**	**4**	**5**
12	Ability to type, edit and format lesson plan on Microsoft word application using computer.	**1**	**2**	**3**	**4**	**5**
13	Knowledge in the use of Microsoft Powerpoint, Excel, and office picture manager	**1**	**2**	**3**	**4**	**5**
14	Proficiency in the use of computer and related applications	**1**	**2**	**3**	**4**	**5**
15	Speed in using computer to typeset end of semester questions	**1**	**2**	**3**	**4**	**5**
16	Capability in using computer to play music, watch movies and perform other multimedia functions	**1**	**2**	**3**	**4**	**5**