Adoption of Blended Learning in Ghanaian Senior High Schools: A Case Study in a Less Endowed School

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Abstract: During COVID-19 pandemic, most tertiary institutions in Ghana were compelled to continue delivering of lectures online using internet technologies as was in the case of other countries. Senior high schools in Ghana were, however, not asked to do same, currently, the setting of most literature on blended or online learning in Ghana is focused on tertiary education. This paper situates the blended learning model in a less endowed senior high school to unearth the prospect of its implementation. The research provides an alternative to the traditional face-to-face learning, which is faced with the challenge of inadequate infrastructure, high number of students to class ratio, less compatibility with 21st learning skills and long-life learning in Ghana.

A customed Moodle application as web application tool, hosted students online in both synchronous and asynchronous interactions. Purposive quota sampling size technique was used to select an appreciable sample size to fully go through the traditional face-face model for a term and then study through the blended learning model for another term. Students' examination performances for both were analyzed with a paired t test statistical model. Interviews with participants were conducted to ascertain their evaluation of the blended learning model and questionnaires were also administered to discover the institutional, technological, and human resource readiness for blended learning in senior high schools. The analysis of the data gathered, proved that blended learning in senior high schools has high prospect and is better alternative to face-to-face learning in Ghana.

Index Terms: Adoption, Blended Learning, E-learning, Face-to-Face, Ghana, Senior High Schools.

1. Introduction

Teaching and learning have been carried out through the face-to-face system of delivery since formal education started in Ghana. Face-to-face system of delivery is the kind of educational delivery where teachers and students meet at the same time and place for the purpose of teaching and learning. Successive increase in number of students per teacher coupled with less space and infrastructure has made it needful that another model of teaching and learning delivery should be coupled with the traditional face-to-face system. Every year, some students are left stranded because they were not place in their school of choice during the computer selection placement process. It is obvious that sometimes students are not selected because the school of their choice does not have enough resources to accommodate them. The ministry of education rolled out the double track system as a temporary solution to mitigate these challenges. The double track is an intervention that enables schools to accommodate more pupils in the same space, effectively

encouraged by its ability to relieve overcrowding and save money in the near term compared to building new schools structures [1].

In their research, "Sentiment Analysis with Word Embedding: The Case of Double track Education System" predicted the sentiment divergence of tweets regarding the execution of the double-track education system in Ghana [2]. The analysis is as shown in the pie chart below.
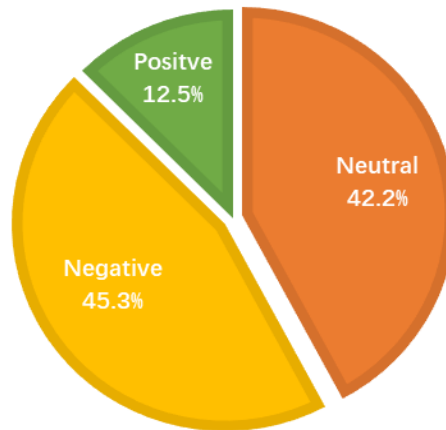

Fig. 1. Double Track Education System in Ghana

The analysis predicted 45.3% (greater portion) of the sentiments received in the tweets were negative. This demands that a wholistic approach should be undertaken to review the whole process. Hence, the need for this research.

Careful research into how traditional face-to-face and electronic learning can be blended will go a long way to reduce if not eliminates the impacts of these challenges on senior high schools. Blended learning is the effective application of a variety of theories, methodologies, and technology to enhance learning in a particular environment [3]. He emphasized that blended learning definition should include context, theory, method, and technology. It is a useful framework that may be used to incorporate a variety of successful methods of instruction and learning to promote the use of present-day technologies to enhance learning.

The goal of this research is to propose the adoption of blended learning model in senior high schools in Ghana to ascertain its prospect. Blended learning increases access and convenience, promotes cost-effectiveness, and increases effectiveness of teaching and learning [4]. Consequently, when the successfulness of blended learning is attested, then the challenge of insufficient infrastructure and less space that impede senior high schools from admitting qualified applicant would have been mediated.

1.1 Electronic Learning:

E-learning is structured learning conducted over an electronic platform. It is an Instruction delivered on a digital device (such as a desktop computer, laptop computer, tablet, or smart phone) that is intended to support learning [5]. Currently, it has become an increasingly popular format for presenting education in colleges and universities. The public and private sectors have all come to rely on electronic learning as a valuable instructional tool especially during the peak of the COVID-19 pandemic. E-learning's successfulness is commonly ascribed to the increased capability to teach more students without compromising the quality of learning compared to face-to-face instruction. Improved tone and uniformity of learning resources also stands as strength to e-learning. It is loosely worn down into two types which are synchronous and asynchronous. Synchronous e-learning comes in real-time mode with participants collaborating with each other from remote areas whiles asynchronous refers to learning situations in which the learning event does not take place in real-time.

E-learning provides self-paced learning which permit pupils to play at their own rate. It develops knowledge of the Internet and computer skills that will help learners throughout their lifetimes and callings. Successfully completing online course builds self-confidence and inspires students to accept responsibility for their learning. Notwithstanding, learners with low motivation or bad work habits may fail to be successful. Without the everyday structures of a traditional class, students may become lazy to meet class activities and deadlines. Again, students may feel separated from the instructor and class fellows. An instructor may not invariably be available when pupils are studying or need help at that very instant. Slow Internet connections and digital devices with low specifications (processor speed, RAM etc.) may weaken the desire of students when accessing course materials. Managing computer files and online learning software can sometimes seem complex for students with novice-level in information technology.

However, with rapid development in IT infrastructure, the environment may be ripe for blending the traditional face-to-face learning and eLearning to help increase access to education, For this reason, it is important to ascertain the readiness of senior high schools to adopt blended learning to expand the access to education for the citizenry of Ghana.

2. Related Literature

2.1 Adoption of Blended Learning in Ghanaian Educational Institutions

The traditional face-to-face delivery method of teaching has dominated in the teaching and learning strategies in Ghanaian education. However, there has been a gradual shift in recent years towards a hybrid of face-to-face and online instruction either consciously or unconsciously, especially in our tertiary institutions. In a review of e-Learning environment at the Kwame Nkrumah university of science and technology Ghana, it was concluded that, blended is replacing face-to-face delivery [6]. Nevertheless, many academic staff members lack the background necessary to teach blended learning since they have only very limited knowledge of or exposure to ICTs [7]. Universities lacked the infrastructure needed to assist blended learning with technology-related artifacts [8]. Inadequate ICT resources include computer labs, projectors, lecture workstations, video conferencing capabilities, and consistent and dependable internet connectivity. There is the probability that colleges will accept and use blended learning techniques if these resources are put in place [9]. Their research focused on the methods the university employed for implementation. It's interesting that their study showed that despite the eLearning program's positive reception from stakeholders, it encountered significant pushback because of lack of well-articulated and communicated execution strategies. The analysis showed that the absence of consistent policy regulations caused the failure of the project. Students' opinions of the process suggested that insufficient awareness had been raised, and faculty members agreed that the project should not have been implemented in its entirety but on pilot bases.

Additionally, it has been noted that student technology proficiency is lacking. The study used a mixed methods approach and discovered that although most students had favorable opinions of blended learning, technical issues related to insufficient technical support, inadequate training, infrastructure gaps, such as a lack of computer labs and inadequate I.T., had a negative impact on students' intentions to adopt blended learning [10].

Two external factors, namely, the institution's desire and the institution's intentions inform management decision to embrace blended learning [11]. Therefore, managers implementing blended learning must approach blended learning implementation with adequate knowledge that addresses the stated intention of the institutions and how they intend to roll out blended learning."

It is obvious from the literature that, all these related works were done in higher school environments, and this has revealed the readiness and challenges existing in the tertiary institutions. Similarly, this work intends to look at the adoption of blended learning in high schools in Ghana. It tends to expound on the recommendation of Anthony Jr et al [12], who said future studies in blended learning should examine readiness, and effectiveness from students, lecturers, and administrators.

2.2 What is blended learning?

Blended learning is engaging a diversity of media and methods, mostly a mixture of electronic and face-to-face learning. This combination is subject to a range of combinations in technologies, pedagogies, and contexts [4,13]. Designing blended learning is about mixing appropriate synchronous and asynchronous learning modalities to reach specific desired learning objectives [14]. Graham [4], establishes that blended learning could be a mix of face-to-face instructor led and self-paced online learning. In unfolding the concept of blended learning, Driscoll [15], categorizes it into four. These are: mixing modes of web-based technology, combining pedagogical approaches, combining any form of instructional technology, and mixing instructional technology.

2.3 Blended Learning Pedagogies:

For a successful blended learning, the pedagogies used must correspond to learning objectives that would provide a framework for designing learning activities. Weller [16], designed eight online pedagogical approaches as follows: Community of practice learning, Peer-to-peer learning, Content-led learning, Instructor-led learning, Resource-based learning, Problem-based learning, Collaborative learning, and Complex learning.

2.4 Types of Blended Learning:

Twigg [17] mentioned the type of blended learning as Replacement, Supplemental, Emporium, and Buffet. The categorization was done based on the relationship between the face-to-face and online components of the course.

The replacement model substitutes face-to-face lectures either partially or fully by web base material and consequently reduces or eliminates the face-to-face contact hours. It is assumed that some tasks can be completed more effectively online, either alone or in small groups, than in a classroom [17]. It gives students the opportunity to participate in discussions or active learning exercises [18]. Instructors may use it also to instruct students to complete other activities prior to the face-to-face lesson.

The supplemental model according to Twigg [17], provides additional course material for the students. The students are required to attend all face-to-face classes and go online to access the supplementary course materials that are provided to aid students understanding of the subject under study. Twigg also classifies initiatives by instructors to add web-based technologies to what they do in the classrooms as instances of the supplemental model.

The emporium model requires students to work exclusively online but within a learning resource centre. The emporium concept substitutes all class meetings with a learning resource center that offers online resources and on-demand individualized assistance [17]. Students only learn online, there are no traditional face-to-face classes, but the learning resource centre is manned by instructors who are always online to provide on-demand help. The centre is open for long hours and the learning resource consists of tutorials (which might be video or animations), readings, and exercises.

The buffet model tailors the learning environment for each student based on learning preference and academic goals. It provides pupils a variety of customized paths to achieve the same learning issues [17]. It rejects the idea of wholesale teaching which group students as having the same abilities and tastes. Twigg [17] put it this way, "Students need to be treated like people, rather than homogenous groups, and should be offered many more learning options within each course."

2.5 Factors That Promote Successful Blended Learning:

Stacey & Gerbic [19], upon review of literature grouped the factors that will aid a successful blended learning into four headings which are Institutional success factors, Teachers/facilitators success factors, Student success factors and Pedagogic success factors.

2.6 The Learning Theory

Teaching and learning processes are structured and designed based on Theories. Theories are very important in the design of any concept. It serves as the guiding principles to achieving a goal. The learning theories behaviourism, cognitivism, and constructivism long before the start of modern learning technologies explicitly explained how learning occurs. 21st century learning requires learners to use technological skills to query information and construct their knowledge out of their own experience which none of the learning theories mentioned above can address. Connectivism is as a result offered as a substitute theory, which is more appropriate for the information technology age.

Transue [20], explained that "connectivism is an emerging learning theory positing that knowledge comprises networked relationships and that learning comprises the ability to successfully navigate through these networks. Successful pedagogical strategies involve the instructor helping students to identify, navigate, and evaluate information from their learning networks." It emphasizes that, connections that enable us to acquire more knowledge are more important than our current state of knowing. Connectivism is situated within the context of constructivism rather than considering it as a new learning theory. It is in this perspective that this research was carried out to apply technology to the learning process in search of solutions in blending face-to-face learning and electronic learning.

2.7 The conceptual framework

Having reviewed and explored the body of literature as above, this paper proposes a conceptual framework made of the graphical presentation of how blended learning can be implemented in the senior high schools without compromising quality. The framework stands to explain the key elements or factors in the study and the apparent relationships that exist among them. This framework is derived from Ussiph [21] conceptual framework expounded within the context of his research and Weller [16] pedagogical approaches to blended learning.
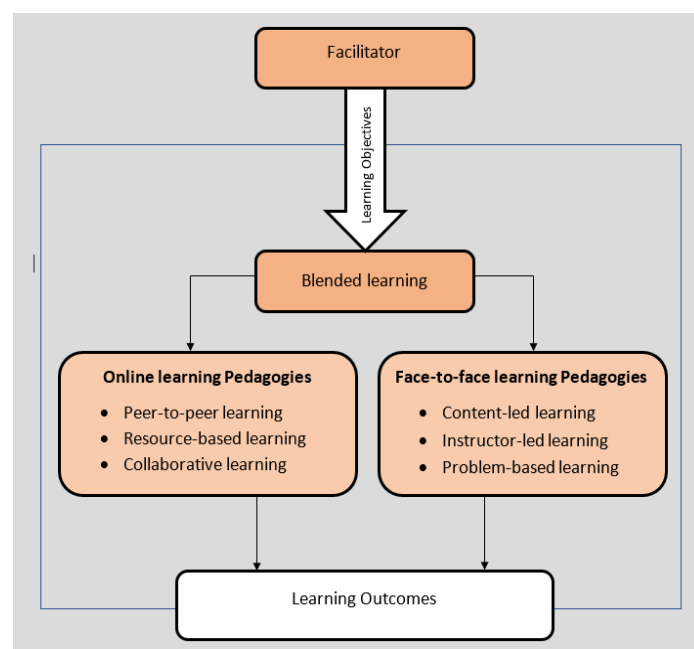

Fig. 2. Conceptual framework

The framework's goal is to describe the main concepts, and variables in the study as well as how they are interrelated In the framework, the facilitator having a good knowledge of the content of what the curriculum prescribes determines which of the content will go online and otherwise. The pedagogies used in the delivery of teaching and learning in traditional face-to-face and in technology-mediated environments are the primary aspects under examination, as shown in the image. The facilitator applies the professional knowledge and competency to carefully select which of the learning content can be treated best in the technology-mediated environment and face-to-face. The resources that are available for both models are factored in the selection process. Weller [16], pedagogies are carefully selected and applied to meet the learning objectives of the content of the curriculum. At the end of the study, students' assessments are evaluated and compared to the learning outcomes to see to what extent has the learning objectives been achieved.

3. Methodology

This study combines case study with action research to gain profound and pragmatic knowledge into blending the traditional face to face with electronic learning and making intervention to effect the positive change. The objective of the hybrid method is to combine some case study methods to gain understanding into institutional setting and action research method to effect the desired change. The case study applied gives a better understanding of the institutional environment to the researcher who's major objective is to look into the prospect of blended learning in senior high schools. This method reveals the strength, challenges and working and non-working existing solutions to the challenges. The action research method guides the researcher to investigate interventions that can be made to mitigate the persisting challenges and future challenges blended learning may face.

Stenmark [22], explains that the resulting hybrid method, 'action case' method has been successfully applied by numerous researchers. Action case is consequently a hybrid of understanding of theory and its change to practice [23] Using this methodology aids the researcher to gain deeper insight to how senior high schools' teaching and learning occurs because of the case understudy, and appropriately select tools and models that will propel the intervention needed to cause the desired change. The interpretivist paradigm was applied to enable the researcher ascertains views of the participants being studied and recognizes the impact and experiences their own background can have on the research process to make findings.

3.1 Profile of study Area

Dunkwa Senior High Technical School formally called Kyerefem Technical School was established in 1990. It has current student population of 1250. Dunkwa Senior High Technical School has two (2) well-furnished computer Laboratories with twenty (20) laptops, five (5) Desktops, a printer and a scanner at each lab with internet connectivity each. The school has a local area network where staff and students can login to access the school's MIS.

3.2 Population and Sample Size

For ethnography, Morse [24] suggests approximately 30 - 50 participants. For grounded theory, Morse [24] has suggested 30 - 50 interviews, while Creswell [25] suggests only 20 - 30. And for phenomenological studies, Creswell [25] recommends five to 25 and Morse [24] suggests at least six. In this research, among the 1,250 students in the school, 30 students were selected for the research and were all in second year. Among the 30 chosen one stopped schooling and the total participants dropped to twenty-nine (29).

Sampling Techniques: The method of sampling was a combination of purposive and proportionate quota sampling.

Research Instruments: The paper [26] outlines four main techniques for data collection which three were adopted in this study. They are mixed questionnaire, interviews, and observation.

Data for the Study: Data used in this study was obtained from two main sources; primary and secondary. The primary sources included field survey, (examination result, questionnaire, and interview) and personal observation. The secondary sources included a review of existing literature on blended learning.

Research Implementation

The research was carried out in five (5) stages and they are

i. Selecting the most appropriate model
ii. Designing a blended learning course
iii. The blended Learning Model
iv. The blending Process
v. Evaluation

3.3 Selecting the most appropriate Model:

Reviewing [17] on the type of blended learning that would address the needs of the students and other stakeholders in general, it is obvious that the Replacement model would be most appropriate. This is because the replacement model substitute's face-to-face lectures partially by web base material and consequently reduces or eliminates the face-to-face contact hours. If the face-to-face contact hours are reduced what it means is that now there is a little pressure on the physical infrastructure of the school and hence the authorities can now enroll more students and reschedule when each would come for the face-to-face contact hours and study the rest at the comfort of his home. The students after each

schedule of face to face would then interact with facilitators online. Six (6) out of the eight (8) pedagogical approaches outline by [16] were considered and effectively integrated in the model. The face-to-face session was characterized with the Content-led, Instructor-led, and Problem-based learning pedagogies. Whiles the online learning was characterized by Peer-to-peer, Resourced-based and collaborative learning pedagogies. This is captured in the conceptual framework.

3.4 The blended Learning Model:

Three (3) subjects were taught for two academic terms. The subjects were English, Mathematics, and Integrated Science. These three subjects were chosen because they have a direct impact and relationship to all the electives subjects each student offers. The blended model was the blending of the traditional face to face with the online learning with each model corresponding to three set of pedagogies that may be appropriate. In other words, there was also a blend of pedagogies. The online learning tutorial involves, Recorded videos, presentation graphics design, text, audio, etc. The tutorials were uploaded onto the Moodle platform. After each face-to-face lesson, students are directed to watch or listen to specific tutorials online for the continuation of the topic that was taught in class. Because of the internet speed the tutorials were also made available on the school's local area network (LAN) for easy access and at a high speed. Tutorials were also downloadable, so students were not restricted to always be online before accessing study materials. Submitting of assignments were strictly by email to ensure student visit the net for the online educational materials. Each facilitator had a specific time to meet students online for synchronous discussions on topics that are taught.

3.5 The Custom Moodle platform

Moodle is used to build Internet-based courses using the constructivism teaching paradigm. In Moodle, modules are used to implement every feature. It offers site management, user management, course management, task modules, chat room modules, selection modules, forum modules, logging modules, test modules, resource modules, and other features that may be combined and used in course design. This educational system was developed by using Apache, MySQL, and PHP. Moodle is open-source software under the terms of the GNU General Public License.

The students enrolled in three courses. During the conduction of these courses, students read the course content, participated in a discussion forum, and completed different assessments. During the course, Moodle records the student interactions as logs file. The academic resources available were made up of Video Tutorials, Text, Presentational graphics with animations, Audio, Simulations and Self-assessment of questions and answers

The custom Moodle also provides to student opportunities to form a discussion board which automatically becomes a virtual class where discussions of all academic purposes transpire. Asynchronous and synchronous communication also occurred between students and facilitators to enhance teaching and learning. Facilitators monitored each student's activities on the platform to ascertain the students' progress of work.
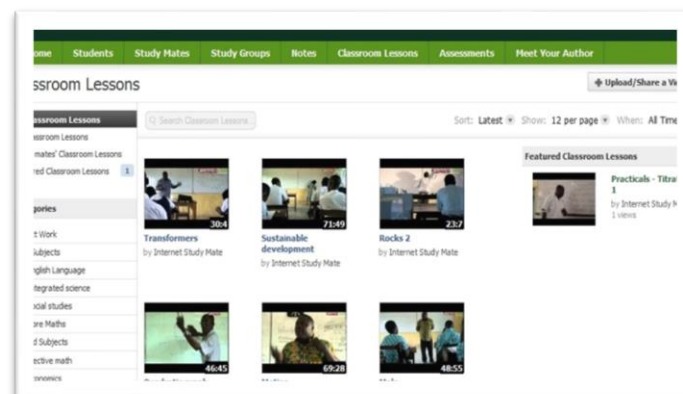

Fig. 3. The Home Page

3.6 The blending Process:

In their article [14] postulated a quadrant of blended learning setting. These settings were used to guide the blending process. The quadrant is as shown figure 4 below.
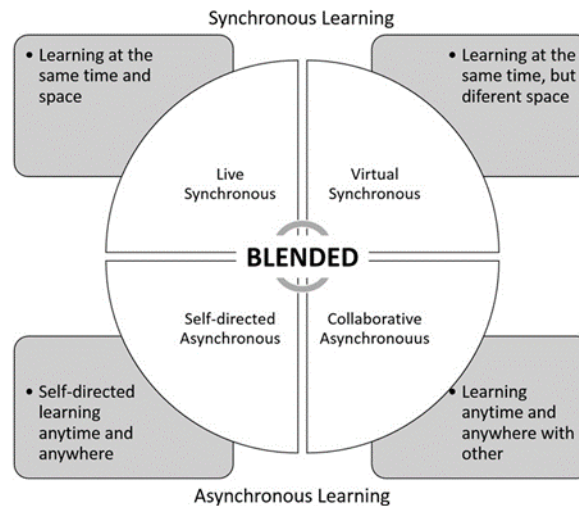
Fig. 4. The Quadrant of blended learning settings

The quadrant guided to strategically allocate appropriate activities to engage students for both face-to-face & online sessions and synchronous & asynchronous sessions

The method of sampling was a combination of purposive and proportionate quota sampling. Proportionate quota sampling was applied to curtail the number of participants to a size that can be handle in the specify duration of the research. In this research, among the 1,250 total students in the school, thirty (30) students were selected for the research and were all in the second year. Thirty (30) students were selected because of limited time and infrastructure. Among the thirty (30) chosen, one (1) drop out of school and the total participants remained twenty-nine (29). Out of the twenty-nine (29) participants, fififteen (15) were business students, Four (4) were Agriculture students, five (5) were Technical, Two (2) were general Arts and three (3) were Home Economics students. The students chosen for this study were of different intellectual abilities. That is some were very good students, some average and some low performing but serious students.

33.33% of the official study time was allocated for the traditional face to face. During the face-to-face sessions, facilitators met students in the classroom and reviewed the last online tutorials with the students. The facilitator enquires, if the last tutorials studied had any difficulty that needs to be addressed. When that is done, the facilitator continues with the day's lesson as it is done in the traditional classroom. After the days lesson he/she continues to direct and guide them to access the continuation of the lesson online. Technical support was provided to help ensure reliability by assisting students in dealing with problems faced when using the online facility. The summary of face-to-face and online session's activities are below

Table 1. Details of face-to-face and online activities

Face-to-Face Activities	Online Activities
Classroom lectures	Individual Learning Activities
Individual/group discussions	Collaborative learning Activities
Laboratory Activities	Web based training & Webcast
Presentation Activities	Online tutorial, Blog & chatrooms
Student-student interactions	Discussion board activities
Student-facilitator interactions	Recorded lectures and video
Student Assessment & Feedbacks	Online assessment and feedbacks

Data

Below is how data was collected for analysis and evaluation.

The students were made to study for two academic terms. The traditional face to face was used for the first term and the blended learning model was also used for the second term. The students' performance on class exercises and assignment were recorded. After each term's work, the students were assessed through examination, and their performance together with the class exercises and assignments were recorded and graded. The examination was conducted through the traditional classroom-based method. The class exercises and assignments for the blended learning were submitted via online. The facilitators collated all the marks and submitted them to the researcher. The researcher vetted the validity and accuracy of the students results by cross checking the marked script with the marking scheme and validating the online exercises that were marked by the customized Moodle platform. Questionnaires were administered to student to know their technological skill level and evaluate their view on using the blended learning

model. Subject facilitators and administrators were also interviewed to discover the human resource, technological and institutional readiness to implement blended learning.

The analysis of the qualitative data obtained from fieldwork was done to uncover and understand the issue being investigated. This was done to describe the phenomenon and what it means. Responses from the structured interview tapes were played several times until the full transcription of each participant was obtained. The results were entered into a computer for it to be coded, counted, and analyzed. Content analysis was done for the categorization of verbal or behavioral data, for purposes of classification, summarization, and tabulation.

The researcher summarized the data that has been collected on the field and presented the results in a way that communicates the most important findings or features. The analysis involved the use of the following:

1. Frequencies and percentages of variables
2. Statistical tests designed to estimate the significance of the results and the probability that they did not occur by chance.

Content analysis involving coding and classifying data, (categorizing and indexing) was effectively done with the aim of making sense of the data collected and to highlight the important messages, features or findings obtained from respondents.

The field notes and interviews were coded and analyzed using Microsoft Excel spread sheet.

These details are relevant and of much interest to the researcher because they constitute the basic determinate of the successfulness of blended learning.

4. Results and Discussions

This session discusses the results that were obtained from the questionnaire, interview, examination scores and observations.

4.1 Use of Computers at the Basic Schools:

For a successful blended learning in senior high schools, the students should have been exposed to the use of computers or smart phones. Consequently, an enquiry was made to ascertain the percentage of students who have such experiences.

From the analysis, 62.07% of the respondents used computer at the basic school with 65.52% of the students possessing smart phone.
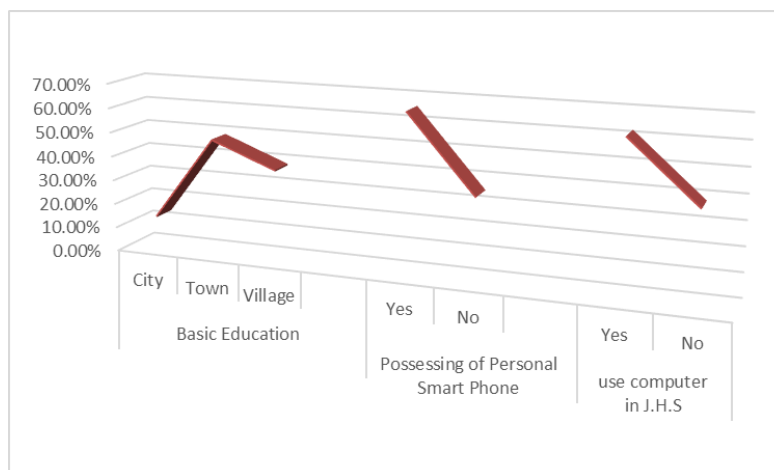
The analysis is shown in figure 5 below:

Fig. 5. Use of Computers at the Basic Schools

These percentages are positive signals for the successful implementation of blended learning. With the 37.93% who did not use computers in their basic schools, they received training and learnt from their colleagues some of the skills that would have hindered them in the blended learning course. The others who did not possess the smart phone from the researcher's observation were not novice at all. This is because, they have been assisting their parents with the use of smart phones.

4.2 Experience of students in using computers and smart phones to access information online

Further enquiry was made in the questionnaire to know how many of the students had experience of using computers and smart phones to access information online.

The study revealed that 31% (n=9) of respondents had never used computer to access information from the web, 34% (n=10) occasionally use computer to access information from the web, 31% (n=9) frequently use a computer to access information from the web and only 3% (n=1) daily use a computer to access information from the web. This simply means that 69% are literate with the use of the internet. This also reveals that most of the respondent have a practical experience with the use of the internet so technical hitches would be reduced during the implementation of the model. The Analysis even revealed that 31% frequently use the web, which is extremely positive for the successful implementation of the model. With the 31% who were illiterate in accessing information online, A little training were organized for them, and it is expected that they would gain more practical training from their colleagues as they move along with the course.

The study also revealed that 34% (n=10) respondents had never experienced asynchronous discussion, 31% (n=9) occasionally experienced asynchronous discussion, 21% (n=6) frequently experienced asynchronous discussion, and 14% (n=4) daily experienced asynchronous discussion. This implies that 66% of the respondent had at least engaged in asynchronous discussion. This is very necessary because student would be using asynchronous discussion to communicate to their facilitators and other colleagues in the same study group during the course.

Again, it was discovered that 21% (n=6) of respondents had never experienced synchronous discussion, 28% (n=8) occasionally experienced synchronous discussion, 38% (n=11) frequently experienced synchronous discussion, and 14% (n=4) daily experienced synchronous discussion. This also reveals that, majority (79%) of the participants have had experience in synchronous discussion and for this reason engaging in synchronous discussion during online course will not be a new thing to the participants. Especially with 38% having synchronous discussion frequently, most technical hitches would be dealt with by the participants themselves.

The study also revealed that 62% (n=18) of the respondents had never experienced uploading of files, 17% (n=5) occasionally upload files, 21% (n=4) frequently uploaded files using the computer, and 7% (n=2) daily uploaded files with computers. It is deduced from here that, most participants would need much training to be able to upload files to their facilitators and colleagues upon demand. With proper training participant will easily be equipped with the skills to upload files. This is shown in the figure 6 below:
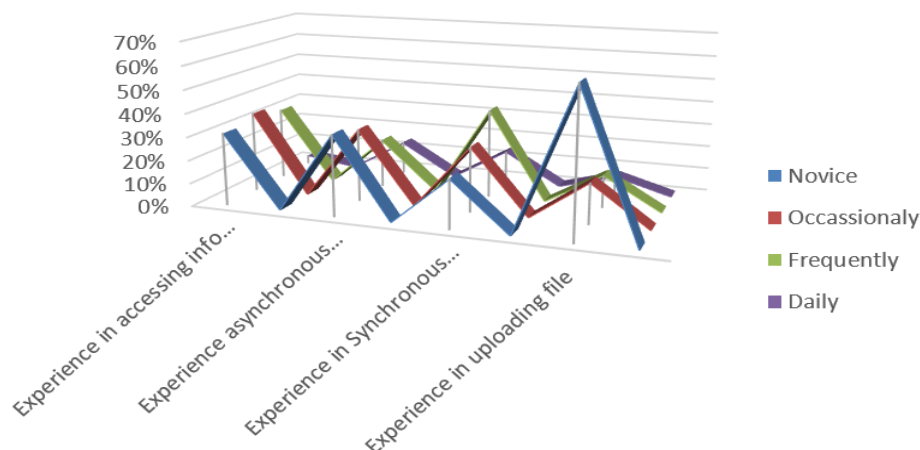

Fig. 6. Experience of students in using computers and smart phones to access information online

4.3 Experiences in following courses that are studied online:

To dive deeper into the students' experiences, the researcher enquired to know the percentage of students who have engaged in an online course.

Students were asked whether they have followed courses involving Asynchronous communication, responses obtained specified that 69% (n=20) had followed courses involving Asynchronous communication, however, 31% (n=9) had not followed courses involving Asynchronous communication. Again, respondents were asked whether they have followed courses involving Synchronous communication and 66% (n=19) responded YES, while followed courses involving Synchronous communication, 34% (n=10) had not followed courses involving Synchronous communication.

Respondents were yet again asked whether they have followed courses in which course material was delivered online. 86% (n=25) responded yes and 14% (n=4) said they have not followed courses in which course material was delivered online. Respondents were also asked if they had followed courses where course assessment was online to have a self-test, 72% (n=21) had followed courses where courses assessment was online to have a self-test, however, 28% (n=8) had not experienced that.

From the responses of the respondents, it appears they have much experience with courses that are offered online but having observed them closely during the blended learning course, it appeared their practical experience does not much their experiences indicated here. The researcher went on to further investigate and it was found out that, almost all

students on campus were registered for an online course but could not complete the course and hence though have had the experience before but lacks the real practical skills. Notwithstanding this, their little experience will go a long way to sail them through the blended learning course. Their responses are analyzed in the figure 7 below:
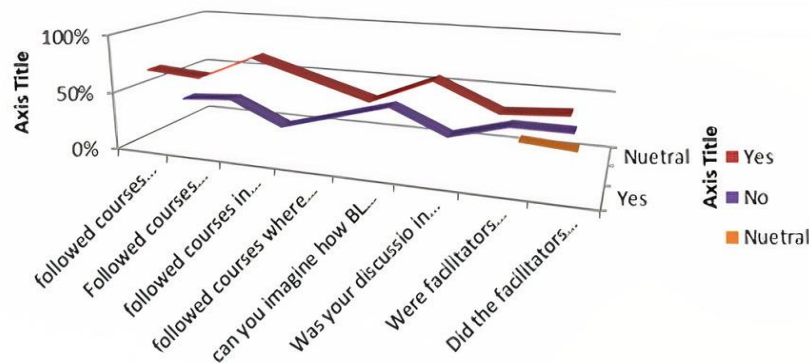

Fig. 7. Experiences in following courses that are studied online

4.4 Performance test result analysis between face-to-face learning and blended learning:

To ascertain the direct impacts of Blended Learning to the traditional face-to-face learning on students' performance, an examination was conducted for both learning methods on three different subjects namely, English Language, Mathematics and Integrated.

A statistical test model called "t test" is employed to compare the means of the two learning methods [27]. T test is an inferential statistic model used to assess if the means of two variables differ significantly. Because the two measurements are made on the same subject (students), paired t-tests is used to analyze the results. A paired t test is a model design to compare the quantum of change of A to that of B for the same subjects [28]. It determines whether the difference between the means of the two sets of scores is statistically significant.

The t-value for a paired t-test is calculated from the formulae.

$$T = \frac{mean1 - mean2}{\frac{s(diff)}{\sqrt{n}}}$$

where: mean1 and mean2=The average values of each of the sample
sets(diff)=The standard deviation of the differences of the paired data values
n=The sample size (the number of paired differences)
n−1=The degrees of freedom

The raw data on student's performance was fed into Ms. Excel statistical tool to analyze the scores using paired t test model to see if the means of the results are statistically significant.

The output indicates the mean for the traditional and blended learning for each subject. The *p* value 1.99E-16, 2.91E-14, 2.44E-15 which are closer to zero (0) describes the probability that you would see a *t* value as large as this by chance. Because the p value is less than the significance level in each subject, the difference between means is statistically significant, that it is unlikely to have happened by chance. That means blended learning has immensely contributed to the result evidenced in the second examination. Table 2,3 & 4 below gives a summary of the analysis.

Table 2. Paired t test analysis for English Language

	F-2-F	*BL*
Mean	55.03448	67.17241
Variance	154.7488	143.9335
Observations	29	29
Pearson Correlation	0.938504	
Hypothesized Mean Difference	0	
df	28	
t Stat	-15.1758	
P(T<=t) one-tail	2.44E-15	
t Critical one-tail	1.701131	
P(T<=t) two-tail	4.88E-15	
t Critical two-tail	2.048407	

Table 3. Paired t test analysis for Mathematics.

	F-2-F	*BL*
Mean	55.48276	69.58621
Variance	215.7586	140.3941
Observations	29	29
Pearson Correlation	0.935272	
Hypothesized Mean Difference	0	
df	28	
t Stat	-13.7307	
P(T<=t) one-tail	2.91E-14	
t Critical one-tail	1.701131	
P(T<=t) two-tail	5.83E-14	
t Critical two-tail	2.048407	

Table 4. Paired t test analysis for integrated Science.

	F-2-F	*BL*
Mean	55.7931	70.2069
Variance	141.17	84.31281
Observations	29	29
Pearson Correlation	0.935016	
Hypothesized Mean Difference	0	
df	28	
t Stat	-16.7535	
P(T<=t) one-tail	1.99E-16	
t Critical one-tail	1.701131	
P(T<=t) two-tail	3.99E-16	
t Critical two-tail	2.048407	

4.5 English Language Exam Comparison

During the face-to-face learning, n=1 of the students had A1 in English, n=1 scored B2, n=2 score B3, n=2 scored C4, n=3 scored C5, n=4 scored C6, n=10 scored D7, n=4 scored E8 and n=2 scored F9. Using the Blended learning to study, 10% had A1 in English, n=7 scored B2, n=6 score B3, n=1 scored C4, n=3 scored C5, n=3 scored C6, n=4 scored D7, n=2 scored E8 and n=0 scored F9. This is shown in the figure 8 below
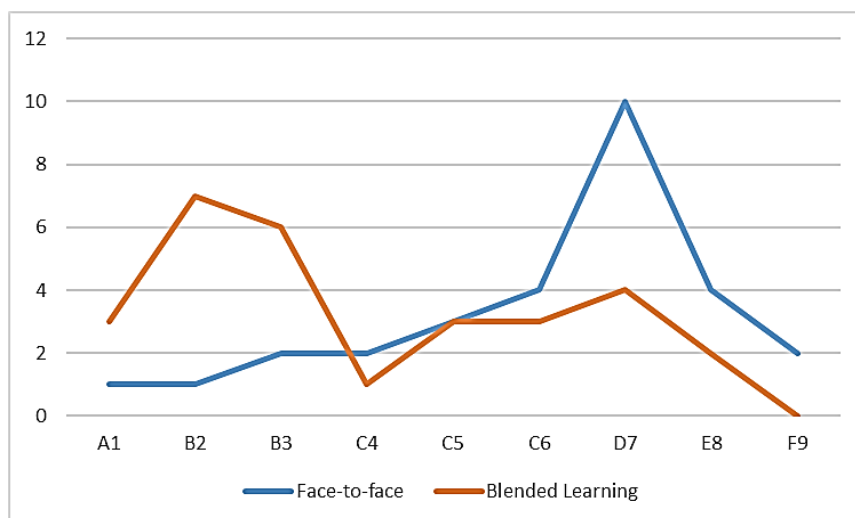

Fig. 8. Comparison of Students' Examinations Performance in English

4.6 Mathematics Exam Scores Comparison

From the data, during the face to face learning, (n=2) of the students had A1 in Mathematics, n=1 scored B2, n=2 score B3, n=1 scored C4, n=4 scored C5, n=2 scored C6, n=8 scored D7, n=6 scored E8 and n=3 scored F9. Using the Blended learning to study, n=4 had A1 in Mathematics, n=8 had B2, n=5 score B3, n=2 scored C4, n=3 scored C5, n=3 scored C6, n=3 scored D7, n=1 scored E8 and n=0 scored F9. This is showed in the figure 9 below:
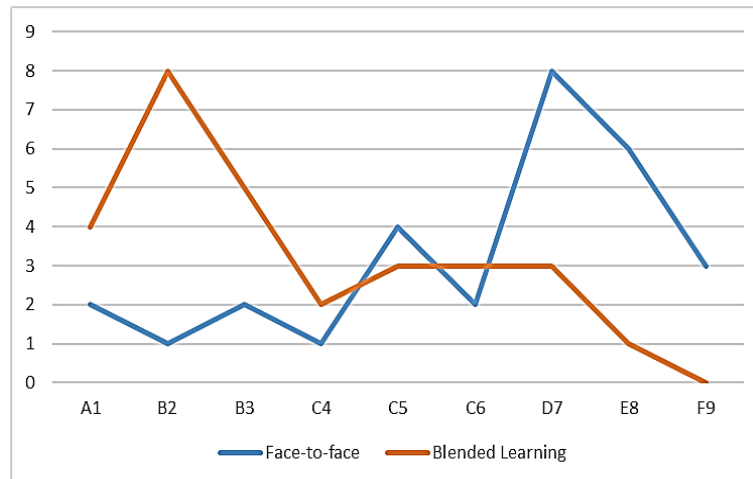
Fig. 9. Comparison of Students' Examinations Performance in Mathematics

4.7 Integrated Science Exam Scores Comparison

From the data, during the face to face learning, none of the students had A1 in Integrated Science, n=1 scored B2, n=1 score B3, n=7 scored C4, n=2 scored C5, n=4 scored C6, n=7 scored D7, n=5 scored E8 and n=2 scored F9. Using the Blended learning to study, n=2 had A1 in Integrated Science, n=8 had B2, n=8 score B3, n=3 scored C4, n=4 scored C5, n=2 scored C6, n=2 scored D7 and none of the students scored E8 and F9. This is showed in the figure 10 below.
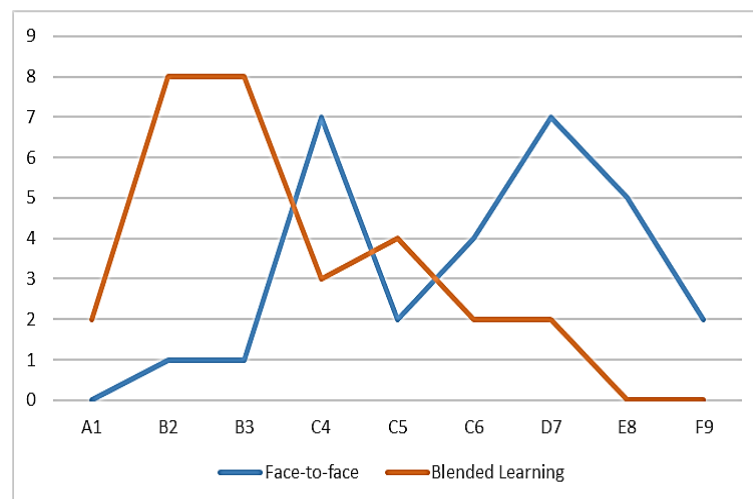

Fig. 10. Comparison of Students' Examinations Performance in Integrated Science

The analysis of all the examination results showed an increase in students' performance which deeply depicts the impact blended learning will have on students learning if given a chance.

4.8 Human Resource, Technological and Institutional Readiness

For effective and efficient implementation of blended learning, the human resource readiness also holds a key. Human resource empowerment in the use of technology, curriculum design, pedagogical issues and the like are essential to be addressed. The human resource readiness to steer up the blended learning initiative was not on the low side. The introduction of ICT/IT as a general course in all programmes of the tertiary institutions in Ghana has resulted in a higher percentage of the teachers becoming IT literate. With this in view, training the teachers to equip them with the technical knowhow in implementing blended learning is less of a work. Currently, there are several workshops and courses that is equipping most teachers with the skills to employ technology in their teaching activities. An example of this is when the regional educational directorate of the Ghana education service in Central region in collaboration with Mfantseman institute of technology organized a 3-day training workshop on "Teaching with Technology" for teachers in the region in May, 2015. Besides there have been several workshops organized by GES and the teacher unions to upgrade teachers' level in ICT proficiency.

As part of Government initiative to improve computer literacy in basic schools, syllabus has been developed to guide all basic schools to run Information and communication technology as a general subject. In addition, government has supplied laptops to aid the study of ICT so that it does not only become theoretical but pragmatic. This reason

accounted for why in the findings most of the respondents were computer literate and just needed a little orientation to push them through blended learning. The ministry of education in collaboration with teacher unions has procured laptops for teachers to aid them integrate ICT in their profession.

Most of the educational institution heads are being trained to experience the new educational revolution. Again, as more human resources are being trained, the cost to engage expertise to employ blended learning reduces. Currently, GES has employed IT assistants for every secondary school. The IT assistant can be tasked to assist teachers in preparing the online materials. As they keep on assisting them, the teachers would be perfecting their skills in multimedia production of online materials.

Communication is an essential component for any successful knowledge acquisition and creation. The overwhelming advantage of electronic learning is that it supports both synchronous and asynchronous communication in multimedia format (text, audio, video etc.) and it can be independent of time, distance, and physical space.

For a successful blended learning institutional building blocks such as organizational readiness, sufficient technical resources, motivated staff, good communication and feedback channels with students, needs to be established for effective blended learning [29]. The paper [30] revealed that institutions who were identified as successful implementers of blended learning had highly contextualized on specific rationales for their adoption of learning.

For this reason, it was important to ascertain if senior high schools are equipped with basic communication infrastructure that will aid the successful implementation of blended learning. In pursuing the government vision of expanding ICT infrastructure some municipal directors have established electronic libraries in their towns and cities where students go to access information. Not only that, but most senior high schools also have well established computer laboratories with laptops that were supplied by the government and other organizations. Besides, the Ministry of Education as part of efforts to promote learning through technology has procured and installed internet connectivity in all the senior high schools in Ghana. [31]

The government of Ghana also has procured a learning resource tool called the internet box (i-box) which contains a lot of learning materials accessed via the school wifi. This learning repository is regularly updated through the internet.

The government of Ghana in collaboration with Televic has established state of the art Computer labs for some selected schools. These computers are powered by solar panels to ensure perpetual power supply.

For this reason, after interviewing administrators, it was found out that senior high schools are technologically on course for blended learning. With this technological advancement it became easier putting few things together to successfully run the blended learning model which resulted in outstanding performance by students.

The major challenge that was discovered is the bandwidth of internet to access multimedia resources. Especially where we have several students in the same area trying to access from one cell site. The network jams up and data is not able to flow.

From the result analysis, blended learning improved the performance of students compared to that of the traditional blended learning. When facilitators were interviewed, 66.66% explained that blended learning provided better understanding of the things that are been taught and students get the opportunity of revisiting the exact thing that was taught for better understanding. That is what makes the different they added.

100% of the facilitators also explained that, students were enthused and motivated to learn and assess materials online and that also contributed to the high performance of students during the blended learning module. Administrators when interviewed added that, the various educational materials that were provided to the students were a major factor. They said students had more than enough study materials to learn. The sharing of knowledge and skills that occurred on their online group discussions also played an important role in their performance the administrators added.

4.9 Implications of the research

The case study and the analysis of the result proved that blended learning promises a great positive impact in Ghanaian senior high schools if proper structures are put in place for its implementation. From the analysis it was found out that 46% of the students qualified to enter the tertiary institution (C6 as minimum grade) during the traditional face to face learning, but during the blended learning, the analysis proved that 86% of students qualified to enter the tertiary (C6 as the minimum grade). Blended learning promises a transparent and self-pace learning for all students but calls for self-discipline on the side of students to be focused in achieving their academic goals especially when they are on the internet.

The students' computer skills from the basic are not very strong to be directly enrolled in the blended learning. Much emphasis can be laid in the ICT course that they do in the basic level with the view of preparing them to enrol them into blended learning courses when they come to the senior high schools.

Students were enthusiastically motivated to learn during the course. For a successful implementation of blended learning, this enthusiasm should be positively reinforced.

Blended learning appears to be a new learning model in senior high schools in Ghana and for this reason; stakeholders must be educated and involved in the planning and implementation process.

Students are likely to have the notion that less face to face might implied less work and hence they must be aware of the dangers if they refuse to manage their time well.

To attain the desired goal, regular evaluation of the teaching and learning process must be designed and implemented.

Ghana Education service is urged to appeal to government to heavily subsidize the cost of smart phones or other digital devices that may be recommended to students for the purposes of blended learning.

Ministry of education and ministry of communication should liaise with the telcos to put up policies that will reduce the cost of internet data on accessing educational materials and improving coverage and bandwidth at cell sites.

5. Conclusion and Recommendation

In this paper, blended learning model is situated in a less endowed senior high school in Ghana. The model was implemented using a customized Moodle application that was deployed as web application tool that hosted students online. Both synchronous and asynchronous interactions were used to engage the students in this virtual classroom. The online session was scheduled to blend with the traditional face-to-face system. A conceptual framework was adopted to guide the study. Human resource, institutional, and technological readiness were assessed using interviews, questionnaires, and observations. Students' performance assessment test was also conducted to ascertain the impact of the model. The analysis of the results indicates that blended learning prospect in senior high schools is very high and feasible. Significant number of participants indicated that low internet bandwidth was the major constraint and rest of the challenges was envisaged to be easily resolved by a dedicated government policy. The research has revealed that senior high schools in Ghana are almost ready for blended learning, and it is a better alternative to the double track system whose main objective is to increase enrolment with the limited resources available. It has unveiled the stage for more research into introducing blended learning in senior high schools.

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