E-LEARNING INTERACTIVITY: PERSPECTIVES OF GHANAIAN TERTIARY STUDENTS

Rahmat Mensah
Department of Health, Physical Education, Recreation and Sports, University of Education, Winneba, Ghana
rahmat.mensah@stu.ucc.edu.gh; https://orcid.org/0000-0002-9119-3367

Farouq Sessah Mensah
Department of Mathematics, Ekumfi T.I. Ahmadiyyya Senior High School, Ghana
farouq.mensah@stu.ucc.edu.gh; https://orcid.org/0000-0002-5437-6199

Daniel Nimo Gyapong
Department of Education, Brekum College of Education, Ghana
danielnimo.dng@gmail.com; https://orcid.org/0000-0001-8704-5153

Isaac Bengre Taley
Department of Mathematics Education, Mampong Technical College of Education, Ghana
bengre.isaac@gmail.com; https://orcid.org/0000-0002-5672-832X

ABSTRACT
The study is in response to abrupt movement from the direct traditionally-centered classroom instruction to E-learning instruction in Ghana owing to the Corona Virus (COVID -19) pandemic. The study aimed at exploring the effect of E-learning interactivity on the effectiveness of E-learning in the Ghanaian context and ways of improving interactivity in E-learning models. The positivist research approach was adopted with cross-sectional survey as the research design. Using a web-based survey, a sample of 2,115 students were randomly selected from 194 different tertiary institutions in Ghana. Correlation and regression analysis was used as the statistical tools to answer the research questions set for the study. The results indicated that all the categories on E-learning interactivity (student-teacher interactivity, student-content interactivity, student–system interactivity, and student-student interactivity) correlated with course effectiveness, students' independent learning skills and student learning behaviour respectively. However, the best predictor for course effectiveness was student–system interactivity, best predictor for students' independent learning skills was student-student interactivity while the best predictor of students' learning behaviour was student-teacher interactivity. The study reiterated that the relationship between different forms of E-learning interactivity have significant impact on course effectiveness, students' independent learning skills and students' learning behaviour. Practical implications and suggestions were made in order to enhance the levels of interactivity within E-learning models.
Keywords: E-Learning Interactivity, Course Effectiveness, Independent Learning Skills, Learning Behaviour

INTRODUCTION
E-learning is now the prevailing curriculum paradigm in the Ghanaian sense owing to the Corona Virus (COVID -19) pandemic. However, concerns have been expressed about the consequences of the abrupt movement from a traditionally-centered classroom instruction to E-learning instruction. Although E-learning is economical, simple to access 24 hours a day, and convenient, its quality and effectiveness are being questioned. Teaching and learning have long been part of human lives and remains an integral part of human society, however, with the advent of e-learning, this field has experienced a substantial degree of change (Jabli & Qahmash, 2013). The E-learning programs involve shifting perceptions and attitudes of students, cost-cutting, enhancing content, and increasing involvement (Jabli & Qahmash, 2013; Alismail, 2015; Anshari, Alas, & Guan, 2016; Shafieiosgouei, Nourdad, Hassantofighi & Shafieioskouei, 2018). In view of the COVID - 19 pandemic that has caused almost all educational establishments to close down across the globe (WHO, 2020), E-learning is crucial to the continuation of the classroom learning cycle. Considering its advantages particularly in the current health environment, its adoption as a model is essential to continue the academic calendar and to enhance educational quality.

Albeit the advantages E-learning offers, there is minimal interactivity and a lack of pedagogical considerations rendering it inferior to traditional classroom based learning (Kuo, Walker, Schroder & Belland, 2014; Croxton, 2014; Salamat, Ahmad, Bakht & Saifi, 2018). As a consequence, the quality of products from an E-learning model has been questioned. In spite of the recent increase in interactivity in E-learning environments, there is still a call for more improvement in E-learning interactivity by several researchers (Kuo, Walker, Schroder & Belland, 2014; Croxton, 2014; Salamat, Ahmad, Bakht, & Saifi, 2018). E-learning platforms remain a little distant from matching

the level of learning in the traditional classroom based according to researchers (Anshari, Alas, & Guan, 2016; Shafieiosgouei, Nourdad, Hassantofighi & Shafieioskouei, 2018), indicating that interactivity elements tend to be absent from E-learning models. To maximize the gains from E-learning models, the missing aspects ought to be identified and integrated within E-learning models. The study is grounded on the assumption that until all facets of E-learning interactivity are resolved, course content and the technology employed will not guarantee that E-learning is successful.

In order to ascertain the competencies, shortcomings and improvement of the E-learning program, researchers (Leungs, 2003; Sawaan, 2005; Reeves & Hedberg, 2007; Alismail, 2015; Anshari, Alas, & Guan, 2016; Shafieiosgouei, Nourdad, Hassantofighi & Shafieioskouei, 2018; Salamat, Ahmad, Bakht, & Saifi, 2018) have advocated for its evaluation. The assessment of the efficacy of E-learning is necessary since it provide key information about its implementation for optimized gains. This study aims to provide concrete guidance on how E-learning systems can be properly structured and implemented. Today's E-learning models essentially provide a centralized learning network with exposure to different learning experiences, however, these structures do not function because the learning environment is made uniform with no attention to varied learning needs and preferences of students (Salamat, Ahmad, Bakht & Saifi, 2018). In designing E-learning programs, the conditions for the application of authentic learning must be considered as Herrington (2006) maintained. Authentic learning elements include credible context and events, collaborations, contemplation, exposure to professional results, various positions and experiences, and accurate articulation and assessment. Authentic learning is the learning experience that can reflect the actual environment of learning. Over the years people have adjusted to the pattern of learning in the traditional classroom based model and therefore the authentic context should be a replica of the traditional classroom based model in which roles and practices are unambiguously described. Learning does not only mean learning the course content but also the ability to construct knowledge, as stated in the theory of constructivism. In view of this, the student's ability to construct knowledge independently is what this study refers to as authentic learning. Consequently, the teacher's role as an instructor will change to that of a facilitator in the knowledge construction process. Therefore teachers may have to adopt other strategies other than the traditional examination-based style to effectively diagnose, reflect, and self-assess the teaching and learning encounters. By implication, the student is expected to be an active participant in the knowledge construction rather than passively receiving knowledge from teachers. Until the pedagogical gap between traditional and E-learning systems is closed, the existing E-learning arrangements will struggle to fulfill students' learning goals. This could be achieved through enhanced interactivity in E-learning systems (Salamat, Ahmad, Bakht, & Saifi, 2018).

Closing in the gap between the traditionally-centered classroom instruction and E-learning models is critical in improving interactivity in E-learning and consequently could be more useful compared to traditionally-centered classroom based model. For its potential to increase access to more students than may be done through a traditional classroom based model and enhanced quality of schooling, E-learning is widely adopted by government and educational organizations across the globe (WHO, 2020). The trend of E-learning started with the internet, which enabled students to navigate a multitude of learning materials, which in traditional classroom based model could never be accomplished. In addition to the wide variety of services accessible to the user, one is always free to select. It was therefore rational to build E-learning programs that allow students to benefit from exposure to a variety of tools worldwide. Nevertheless, constructivist learning as an advantage of E-learning has often been neglected by developers of E-learning models. However, the facilitation of independent learning in E-learning models can help promote constructivist learning.

The impact of e-learning interactivity on its effectiveness in the Ghanaian context and ways of improving such interactivity in E-learning models was the focus of this study. The study's significance is enshrined in the contribution of the current study in the area of E-learning since it focuses on various aspects of interactivity in the context of E-learning. Technology was not the sole variable of interest in this study, as technology is complex and dynamic. Other elements of interaction that influences the effectiveness of E-learning were also considered to help in clearly assessing the requirements in designing E-learning models and consequently models not just economical and convenient but also providing meaningful learning for all students. The research questions addressed in this study are as follows;

1. What is the impact of E-learning interactivity on overall subject effectiveness?
2. What is the impact of E-learning interactivity on student's independent learning skills?
3. What is the impact of E-learning interactivity on the student's learning behaviour?

INTERACTIVITY IN E-LEARNING

E-learning has several definitions (Urdan & Weggen, 2000; Stockley, 2003; Naidu, 2006; Wang, Wang, & Shee, 2007). Naidu (2006) defined E-learning as any individual or group learning engagements taking place both in online and offline schedules. Stockley (2003) defined E-learning as electronically providing a program of learning, training, or education. E-learning could also be defined as using a variety of electronic media as a tool for knowledge acquisition (Urdan and Weggen 2000). E-learning could be described in the narrow sense as any learning activities carried out via the internet (Wang, Wang, & Shee, 2007). For the purpose of this study, E-learning was operationalized as all the medium through which students can learn through the use of a range of technological tools (Desktop Computer, Laptop, Notebook, Mobile Phone, Tablet, etc.) in different platforms (Learning Management Systems, WhatsApp, Facebook, Online Library, Google Scholars, Twitter, Google Classroom, Wikipedia, YouTube, Telegram, Edmodo, Easyclass, E-mail, Zoom etc). Among others, online learning, virtual learning, web-based learning, and technology-mediated learning (Conrad, 2006) have also been cited as E-learning. In generally terms however, E-learning involves the use of online resources to promote a learning process.

E-learning interactivity has been defined as active interaction in online learning activities to include all interactions that occur amongst the student and him/herself, the student and other students, the students and the instructor, the student and the content, and learner interface (Chou, Peng & Chang, 2010). Gradel and Edson (2012) view the learning activities as a blend of modes of interaction between the participants in the teaching and learning activities thus, learner-content, learner-instructor, and learner-learner interactions. Currently, the Learning Management System (LMS) provides vital instruments for interactive course activities such as forums, notifications, online assignments, wiki-format exercises, virtual classrooms, etc. Consequently, teachers are permitted to track and monitor students' learing progression, number of access, activities of logs on the system among others. Several studies (Mandernach, Donnelli & Dailey-Hebert, 2006; Eom, Wen & Ashill, 2006; Evans & Gibbons, 2007; Park & Bonk, 2007; Wood, Solomon & Allan, 2008; Mandernach, 2009; Croxton, 2014; Edumadze, 2019) have shown ways of making interactive activities effective to support students learning process. Self-pacing, self-assessment, and interactive simulation are three interactive tasks as well as the time of using a system are factors affecting students' learning outcomes (Evans & Gibbons, 2007). Their study results indicated that, for better learning outcomes, minimal student-system interaction is required. However, their study did not include other forms of interactions. Likewise, Edumadze (2019) amount of time spent online positively influenced the learning outcomes of students. On the contrary student outcomes did not correlate with other forms of interaction in Eom, Wen and Ashill (2006) study. Some of the key benefits of improving E-learning interactivity as enumerated by Park and Bonk (2007) include; to improve feedback, promote sharing different perspectives, enhance students' dynamic interaction, increase their social presence, encourage emotional communication and provide verbal information. Other researchers (Chou & Chen, 2008; Wood, Solomon & Allan, 2008; Croxton, 2014) recommended that attempts must be made to develop the social, emotional, and interpersonal interactions among learners in order to engage the learners in a way synonymous a traditional classroom based environment. In this study, we explore the impact of student-teacher interaction, student - content interaction, student – system interaction, and student-student interaction as forms of interactivity on learning outcomes.

Student - Teacher Interaction

Teachers play significant roles in the traditional teaching process and student-teacher interaction is also a predominant activity as well (Chessin & Moore, 2004). Student-teacher interactions in different forms are more versatile in E-learning environments as students play a central role. Kang and Im (2013) report that collaborative interactions amongst students and teachers have an impact on students' learning outcomes when carrying out learning interactions like encouragement for learning, social interaction, communication, teacher presence, and support. Liu (2016) proposed that students use video blogging classes in certain special courses for oral instruction as it assists students in achieving good learning outcomes.

Although some scholars (Mazzolini & Madison, 2003; Dennen, Aubteen Darabi & Smith, 2007) have suggested more student-teacher interaction, critics have it that such forms of interaction are not permissible in the E-learning environment. Mazzolini and Madison (2003) for example, found that increased teacher interaction through more messaging would not result in greater student interaction. Owing to the fact that the more the teacher posted messages, the lesser students' responded as response time for voluminous messages increased. Dennen (2005) also

noticed that teachers posted about 50% of the messages themselves in an attempt to get back to every question. Subsequently, Dennen, Aubteen Darabi and Smith (2007) believes teachers' interaction become disruptive to some extent which causes students not to participate. They also maintain that students' failure to participate is as a result of some instructors' communication deficiencies in an online environment which is dynamic, productive, and secure. A strategy to resolve this vulnerability is to build up the course structure in a way which does not call for continual/frequent interaction (Dennen, Aubteen Darabi & Smith, 2007).

Shih, Martinez-Molina, and Muñoz (2008) acknowledged teachers' role in providing students with productive and timely feedback was an essential ingredient for the effectiveness of E-learning. Teachers are entreated to equally encourage learners on how best to utilize the system since technological knowledge and experiences differ from individual to individual. Thus, teachers will raise the students' level of success and reduce the unfortunately high degree of withdrawal in E-learning courses. Furthermore, teachers should encourage the interaction of learners by designing the course appropriately, which benefits students personally and professionally, bearing in mind the importance social interaction play in human performance (Abulibdeh & Hassan, 2011). Volery (2001) found in a study of the hybrid learning system the degree of classroom interaction positively influence the effectiveness of the course. In addition, Volery (2001) concluded that the teacher's role extends beyond an instructor into more of "a learning catalyst and knowledge navigator".

Student - Content Interaction

Content engagement is a vital element of E-learning for students. This is because E-learning has a great deal of knowledge. Moallem (2003) indicated how glaring the designing of an online programs that inspires discovery and reflection for students' needs much more thinking, time, and energy than was expected. Anderson (2003) also claimed that information is the most versatile actor "willing" to pursue any sets and amount of interaction, since it is only the willingness of humans. Additional studies indicate that blogging perspectives influence learning outcomes for students (Sim & Hew, 2010; Lee & Bonk, 2016). The video blog also helps to boost learning performance in the course material (Liu, 2016). A study by Asterhan and Hever (2015) which were also seen in the study of Ramos and Yudko (2008), have shown a positive influence on the contents of learning outcomes. The examination of the correlation between the pages viewed, topic posts, and topic reads by Ramos and Yudko (2008) indicated that, those variables equally affected learning outcomes of students. Similarly, Nandi, Hamilton, Harland and Warburton (2011) equally found increased number of posts once students had to apply assignments or tests, students had enhanced time online for academics during their course.

The emphasis of teachers to provide value-added content is the principal explanation of why student-content interaction in E-learning is of a great deal of importance (Muilenburg & Berge, 2005). Effective interaction in E-learning is quite a challenge for teachers compared to traditional classroom based learning. In an attempt to overcome this challenge, teachers tend to provide very detailed course content. Multiple elements of learner-content interaction exist, including course materials, course structuring, like seminars, technical resources such as lectures, links to websites for students' access to valuable knowledge, etc. The interaction of student content is important in e-learning, mainly because students and teachers emphasize this dimension, leading to a certain level of content-related dependence. Additionally, a greater range of content can be found in E-learning relative to classroom instruction. With the help of the content provided in an E-learning courses, students can construct knowledge independently without any form of training owing to the constructivist social environment it presents. (Benbunan-Fich, 2002).

Student – System Interaction

Three different use of ICT in E-learning has been proposed by Kear, Williams, Seaton and Einon (2004). The first proposal is using ICTs as a resource base. Per this usage, students are provided a variety of learning materials. Secondly ICT allows learners to engage in virtual communication and finally, to support active learning by students. In view of this, ICT proficiency plays a vital role in all facets of e-learning. Yet, rather than having any big impact on the communication process, ICT is more regarded as an enabler for communication and knowledge exchange. Nevertheless, it cannot be ignored that synchronous and asynchronous communication technology contributes to the interaction between participants.

Hara and Kling (2001) conducted a qualitative study of students' E-learning experience and found although the teachers were proficient, students frequently complained that the technical aspects of the course had not been well done. This contributed to a number of issues such as issues with feedback, uncertainty in communication among others, all of which contributed to a feeling of unease and low confidence. It is however arguable, since their work

was conducted approximately 19 years ago and since then technology has advanced considerably. We have high-speed internet, machines with higher processing powers coupled with smooth networking applications instead of low-speed dial-ups in recent times for example. This could have resolved a number of concerns that were raised in that research. However, their work emphasizes that poor performance of the technological systems can affect learner's satisfaction and therefore an appropriate level of technical performance is necessary.

Subsequently, investigations into the relationship between perceived ICT self-efficacy and perceived performance in E-learning courses by a number of researchers (DeTure, 2004; Gaythwaite, 2006; Johnson, Hornik & Salas, 2008). Results of such investigations have revealed a strong correlation between these two variables. This may accounts for the high prevalence of E-learning in technical subjects since such students are more proficient in IT. The researchers have established two different types of IT self-efficacy. The first is to connect the course contents and secondly, the opportunity to access and communicate with other participants (i.e. teachers and other students) using the available technical resources within the context of E-learning (Johnson, Hornik, & Salas, 2008). Gaythwaite (2006) observed a positively direct association between IT self-efficacy and E-learning models. However, DeTure (2004) has a contrary opinion stating that IT self-efficacy does not influence students' success in the E-learning environment.

Student - Student Interaction

Learners are offered better E-learning time and space for interactive discourse. There is a groundswell of the different modes of interaction amongst learners in the course with the supported technology. Dawson, Tan and McWilliam (2011) noted that 80% of the interactions in online learning environments are through discussion forums. They did not however, examine the effects of the forum's activities on students' learning outcomes. Schrire (2006) indicates that when learners engage in discussions with each other, they obtain better academic outcomes than they do with the teacher. An investigation by Song and SW (2011) showed that the number of scores posted did not correlate with the results when they examined the interaction through discussion focusing on the number of postings and log-in with academic learning outcomes. In addition, the authors only worked in the asynchronous collaborative form in this study.

Macfadyen and Dawson's (2010) regression model that indicated a close association between the study results to the number of posts in the forum and the number of assignments completed. An assessment of the number of post and view of 231 students in an online discussion activity by Kent, Laslo, and Rafaeli (2016) revealed similar results. Taking into account the relevance of collaboration, Mitchell, and Honore (2007) pointed out that team work positively affect learning outcomes of students. Another evaluation of the effect of the interaction on learning outcomes of 342 students, focusing on reading blog contents, learner to learner communicating, and engaging in the blog sense by Ekwunife-Orakwue and Teng (2014). The results of their study revealed no significant effect on students' learning outcomes.

RESEARCH METHODOLOGY

Research Design

This study employed a Positivism stance in its investigation. In this study, we employed a cross-sectional survey approach in accessing students' perspectives on the effective and defective components of the current E-learning models. Lavrakas (2008) claims that cross-sectional data is typically obtained in a fairly short period of time from respondents taking the survey. Time is presumed to have a random influence in a cross-sectional study that only produces inconsistency, not unfairness. Creswell (2012) argued that the value of the cross-sectional survey design is that it tests existing behaviors or attitudes. A cross-sectional survey was preferably used in this study as a research design owing to the fact that many questions were asked in this study. The survey was also used so as to reach many learners within a short period of time (Fowler Jr & Cosenza, 2009).

Sample and Data Collection

Tertiary students were chosen for this study because tertiary students in Ghana have unparalleled access to ICT tools and as well use them for E-learning related activities owing to the Corona Virus (COVID -19) pandemic in Ghana. These tertiary students were presently accessing their E-learning from their homes as a result of COVID -19. Through a web-based survey, these students shared their perception about the interactivity they receive in the E-learning environment and how this impacted on their learning outcomes. A total of 2,115 tertiary students from 194 different tertiary institutions in Ghana participated in the study.

Instrument

Data was collected with the help of questionnaire. The questionnaire was deemed appropriate as its administration took less time and the anonymity of the respondents was also guaranteed (Fraenkel & Wallen, 2000). The questionnaire had sections on accessibility, learning utilization, learning outcomes, learner-teacher interaction, learner - content interaction, learner – system interaction, as well as learner- learner interaction.

Data Analyses

Student - content interaction, student – system interaction and student-student interaction served as the predictor variables for the three linear regression models were developed while the outcome variables were subject effectiveness, student's independent learning skills, and student's learning behavior. The b constants, standard deviation, and betas were calculated for each model. The measures of significance were calculated through inferential statistics (f-score) and coefficient of determination (R) at a significance level of 0.05 ($p < 0.5$). The SPSS software was used to analyze the data.

RESULTS AND DISCUSSIONS

Background Information of Students

The results of the analysis revealed that majority of the respondent were females representing 53.4% ($n = 1129$) while their male counterparts were in the minority representing 46.6% ($n = 986$) of the sample. The results seem to suggest that more females are enrolled on tertiary educational programs in Ghana. The age distribution of the students indicated that, cumulatively, majority of the student representing 96.2% ($n = 2035$) were aged 30 years and below with 3.8% ($n = 80$) of the sample aged between $31 - 40$ years. More than half ($55.0\%, n = 1162$) of the students sampled were studying for Bachelor's Degree. Students studying for the award of Diploma and Higher National Diploma (HND) were 25.8% ($n = 545$) and 14.8% ($n = 314$) respectively. However, only a few of the participants were postgraduate students with 3.6% ($n = 77$) studying to obtain their Master's Degree in different fields of study and0.8% ($n = 17$) being Doctorate students. The results of the study seem to suggest students studying for Bachelor's Degree dominated the E-learning platforms. This also highlights the fact that a higher percentage of the sample 98.2% ($n = 2077$) was currently using E-learning models to continue with their respective educational programs owing to the Corona Virus (COVID -19) pandemic in the Ghanaian context. This finding from the study is not surprising as E-learning is crucial to for the continuation of the classroom learning cycle as a result of the Corona Virus (COVID -19) pandemic that has caused all educational establishments to close down in the Ghanaian context. As users of E-learning models, it was expected that, the students sampled could reflect on their interactivities and learning outcomes from these E-learning models. The study results showed a fairly distribution of the nature of course enrolled on with 44.5% ($n = 942$) being completely theory course, 30.8% ($n = 652$) being completely practical course and 24.6% ($n = 521$) being a combination of theory and practical courses. Table 1 presents the results of the demographic background of the students.

Table 1 – Demographic Information of Students

Variable	Category	Frequency	%
Gender	Male	986	46.6
	Female	1129	53.4
	Total	**2115**	**100.0**
Age (in years)	16 – 20	191	9.0
	21 – 25	1536	72.6
	26 – 30	308	14.6
	31 – 35	63	3.0
	36 – 40	17	0.8
	Total	**2115**	**100.0**
Residential Status	Diploma	545	25.8
	HND	314	14.8
	Bachelor's Degree	1162	55.0
	Masters	77	3.6
	PhD	17	0.8

	Total	**2115**	**100.0**
Last Time Using E-Learning	Current Week	937	44.3
	Last Week	683	32.3
	Last Month	457	21.6
	Last Year	38	1.8
	Total	**2115**	**100.0**
Nature of Subject	Complete Theory	942	44.5
	Complete Practical	652	30.8
	Combination of Theory and Practical	521	24.6
	Total	**2115**	**100.0**

Descriptive of Measures

The measures for the study were from relevant extant literature. Course effectiveness, independent learning skills, learning behaviour, student-teacher interactivity, student-content interactivity, student-system interactivity and student-student interactivity were adapted from previous studies by Alzahrani, (2015) and Nguyen (2017). Internal consistency of the measures was ascertained by calculating the Cronbach's alpha coefficient. The measures used in the study were deemed internally consistent as evident in the results presented in table 2 with the reliability coefficients ranging from $0.659 - 0.903$. The mean values of the measures ranged from $2.27 - 4.10$ indicating a relatively moderate positive response from the students sampled. In addition, the standard deviation was close to 1 for all measures indicating how spread out the data set was. The extent of variability of data in a sample in relation to the mean of the measures as indicated by the coefficient of variation also ranged from $23.50\% - 39.12\%$.

Table 2 – Descriptive Statistics

Measures	Cronbach's Alpha	Mean	Std. Deviation	Coefficient of Variation (%)
Course Effectiveness	0.880	2.55	0.815	31.96
Independent Learning Skills	0.790	2.86	0.833	29.13
Learning Behaviour	0.765	3.72	0.877	23.58
Student-Teacher Interactivity	0.903	4.10	0.835	20.71
Student-Content Interactivity	0.676	2.40	0.833	34.71
Student-System Interactivity	0.812	2.27	0.888	39.12
Student-Student Interactivity	0.659	2.69	0.701	26.06

Impact of E-learning Interactivity on Overall Course Effectiveness

The first research question aimed at finding out the impact of E-learning interactivity on overall course effectiveness. The purpose was to establish which of the interactivity: Student-teacher interactivity, student-content interactivity, student-system interactivity or student-student interactivity best predict the overall course effectiveness in E-learning models. Course effectiveness in this study refers to the perceived course effectiveness while the four categories of E-learning interactivity are also perceived values of interactivity. Research question one: What is the impact of E-learning interactivity on overall course effectiveness? To answer this question, Correlation and regression analysis were used. Correlation analysis was first conducted between the overall course effectiveness and the four categories of E-learning interactivity. The results of the correlation analysis shows that, course effectiveness correlated significantly with all the four categories of interactivity in E-learning models with the strongest ($r = 0.603, p < 0.01, n = 2115$) being reported in the student-system interactivity. The next reported was with student-content interactivity ($r = 0.469, p < 0.01, n = 2115$), followed by student-student interactivity ($r = 0.458, p < 0.01, n = 2115$), and with student-teacher interactivity ($r = 0.355, p < 0.01, n = 2115$), a relatively weaker correlation was reported. Table 3 shows the summary of results of the correlation between course effectiveness and E-learning interactivity.

Table 3 – Correlation between Course Effectiveness and E-learning Interactivity (N = 2115)

		Student-Teacher Interactivity	Student-Content Interactivity	Student-System Interactivity	Student-Student Interactivity
Course Effectiveness	Pearson Correlation	0.355**	0.469**	0.603**	0.458**
	Sig.(2 tailed)	0.000	0.000	0.000	0.000

** Correlation is significant at the 0.01 level (2-tailed).

A regression analysis was performed to explore the best predictor of course effectiveness. The results of the study shows that, approximately 43.8% of the variation in a change in course effectiveness is explained by the variation in student-student interactivity, student-teacher interactivity , student-content interactivity and student-system interactivity. This result is accepted on the grounds that course effectiveness could be affected by other compounding variables such as availability of internet, access to computers, computer use competencies, etc. Notwithstanding, the regression model explains the impact of E-learning interactivity on course effectiveness. The $F[(4,2110) = 411.509, p < 0.01]$ associated with the independent variables was statistically significant indicating that student-student interactivity, student-teacher interactivity, student-content interactivity and student-system interactivity predict course effectiveness. According to the standardized coefficients, the regression model is given as:

$$Course\ effectiveness = 0.196\ Student - Teacher\ Interactivity - 0.020\ Student - Content\ Interactivity + 0.496\ Student - System\ Interactivity + 0.172\ Student - Student\ Interactivity$$

The result indicates that student-system interactivity seems to be the strongest predictor of course effectiveness compared to student-student interactivity, student-teacher interactivity, and student-content interactivity. This is an indication that student-system interactivity is very significant in overall course effectiveness. Out of the four categories of E-learning interactivity, three (student-student interactivity, student-teacher interactivity, and student-system interactivity) showed a positive regression coefficient indicating a positive impact on course effectiveness. The significance level these three categories of E-learning interactivity were less than 0.05 indicating a statistically significant causal relationship with course effectiveness. Thus, an improvement is course effectiveness could be achieved by improving the three categories of E-learning interactivity. However, student-content interactivity showed a negative regression coefficient indicating a negative effect on course effectiveness. The p – value for student-content interactivity was greater than 0.05 indicating no statistically significant causal relationship with course effectiveness. This implies that, to improve course effectiveness in E-learning models, the student-content interactivity should be reduced. Table 4 is the representation of the summary of the regression analysis of E-learning interactivity and course effectiveness.

Table 4 - Regression Analysis of E-learning Interactivity and Course Effectiveness

	Coefficients		F-Test		
	Unstandardized Coefficients	Standardized	Sig	F	Sig
Intercept	0.241		0.001	411.509	0.000
Student-Teacher Interactivity	0.191	0.196	0.000		
Student-Content Interactivity	-0.020	-0.020	0.408		
Student-System Interactivity	0.455	0.496	0.000		
Student-Student Interactivity	0.200	0.172	0.000		

$R = 0.662, R^2 = 0.438, Adjusted\ R^2 = 0.437$, *Significant at* $P < 0.05$

Impact of E-learning Interactivity on Students' Independent Learning Skills

Research question two sought to explore the impact of E-learning interactivity on student's independent learning skills. Student's independent learning skill in this context refers to the students' ability to use E-learning models to construct knowledge without being engaged in any form of traditional classroom based learning. Research question two "What is the impact of E-learning interactivity on student's independent learning skills?" was answered using correlation and regression analysis. Correlation analysis shows a positive and statistically significant correlation between student's independent learning skills and E-learning interactivity. The summary of results of the correlation between student's independent learning skills and E-learning interactivity is shown in table 5.

Table 5 – Correlation between Student's Independent Learning Skills and E-learning Interactivity (N = 2115)

		Student-Teacher Interactivity	Student-Content Interactivity	Student-System Interactivity	Student-Student Interactivity
Independent Learning	Pearson Correlation	0.386**	0.297**	0.289**	0.653**
	Sig.(2 tailed)	0.000	0.000	0.000	0.000

** Correlation is significant at the 0.01 level (2-tailed).

The regression analysis showed that, 46.0% of the variation in a change in student's independent learning skills is explained by the variation in student-student interactivity, student-teacher interactivity, student-content interactivity and student-system interactivity. This seems to suggest that, there are other variables with potential influence on the development of students' independent learning skills which were not explored in this study. The $F[(4,2110) = 449.379, p < 0.01]$ associated with the independent variables was statistically significant indicating that student-student interactivity, student-teacher interactivity, student-content interactivity and student-system interactivity predict student's independent learning skills. The regression model is given as:

$$\begin{aligned} &Students' \ independent \ learning \ skills \\ &= 0.192 \ Student - Teacher \ Interactivity + 0.020 \ Student - Content \ Interactivity \\ &- 0.046 \ Student - System \ Interactivity + 0.602 \ Student - Student \ Interactivity \end{aligned}$$

The result suggest that student-student interactivity seems to be the strongest predictor of student's independent learning skills compared to student-system interactivity, student-teacher interactivity, and student-content interactivity. This implies that student-student interactivity predicts students' independent learning skills the most. Three out of the four (student-student interactivity, student-teacher interactivity, and student-content interactivity) categories of E-learning interactivity showed a positive regression coefficient indicating a positive impact on student's independent learning skills. The significance level of two out of the three (student-student interactivity and student-teacher interactivity) categories of E-learning interactivity were less than 0.05 indicating a statistically significant causal relationship with student's independent learning skills. Thus, an improvement in student's independent learning skills could be achieved by improving these two categories of E-learning interactivity. Student-content interactivity although positive was not statistically significant ($p = 0.400,\ p > 0.05$). However, student-system interactivity showed a negative regression coefficient indicating a negative impact on student's independent learning skills. The p–value for student-system interactivity was greater than 0.05 indicating no statistically significant causal relationship with students' independent learning skills. This implies that, to improve students' independent learning skills in E-learning models, the student-system interactivity should be reduce. Table 6 shows the summary of the regression analysis of E-learning interactivity and student's independent learning skills.

Table 6 - Regression Analysis of E-learning Interactivity and Student's Independent Learning Skills

	Coefficients			F-Test	
	Unstandardized Coefficients	Standardized	Sig	F	Sig
Intercept	0.206		0.006	449.379	0.000
Student-Teacher Interactivity	0.191	0.192	0.000		
Student-Content Interactivity	0.020	0.020	0.400		
Student-System Interactivity	-0.043	-0.046	0.058		
Student-Student Interactivity	0.715	0.602	0.000		

$R = 0.678, R^2 = 0.460, Adjusted\ R^2 = 0.459$, *Significant at* $P < 0.05$

The Impact of E-learning Interactivity on the Student's Learning Behaviour

The last research question sought to examine the impact of E-learning interactivity on students' learning behaviour. The purpose was to establish which of the interactivity: student-teacher interactivity, student-content interactivity, student-system interactivity or student-student interactivity best predict student's learning behaviour in E-learning models. Student's learning behaviour was operationally defined as the intentions of student to continue learning using E-learning platforms after finishing formal education in the E-learning models. Research question three: What is the impact of E-learning interactivity on the student's learning behaviour? Correlation and regression analysis aided the answering of this question. Correlation analysis was first conducted between student's learning behaviour and the four categories of E-learning interactivity. The correlation analysis shows that, students' learning behaviour correlated significantly with all the four categories of interactivity in E-learning models with the strongest ($r = 0.608, p < 0.01, n = 2115$) being reported in the student-teacher interactivity and with

student-system interactivity ($r = 0.170, p < 0.01, n = 2115$) having a relatively weaker correlation. Table 7 shows the summary of results of the correlation between students' learning behaviour and E-learning interactivity.

Table 7 – Correlation between Students' Learning Behaviour and E-learning Interactivity (N = 2115)

		Student-Teacher Interactivity	**Student-Content Interactivity**	**Student-System Interactivity**	**Student-Student Interactivity**
Course Effectiveness	Pearson Correlation	0.608**	0.204**	0.170**	0.429**
	Sig.(2 tailed)	0.000	0.000	0.000	0.000

** Correlation is significant at the 0.01 level (2-tailed).

A further regression analysis was performed to explore the best predictor of students' learning behaviour. From the analysis, it was evident that approximately 43.3% of the variation in a change in course effectiveness is explained by the variation in student-student interactivity, student-teacher interactivity, student-content interactivity and student-system interactivity. This results is accepted on the ground that, there could be other variables which could affect students' learning behaviour. The $F[(4,2110) = 402.502, p < 0.01]$ associated with the independent variables was statistically significant indicating that student-student interactivity, student-teacher interactivity, student-content interactivity and student-system interactivity predict students' learning behaviour. According to the standardized coefficients, the regression model is given as:

$$\begin{aligned} &Students' \ learning \ behaviour \\ &= 0.529 \ Student - Teacher \ Interactivity + 0.004 \ Student - Content \ Ineractivity \\ &- 0.082 \ Student - System \ Interactivity + 0.290 \ Student - Student \ Interactivity \end{aligned}$$

The result indicates that student-teacher interactivity seems to be the most prominent predictor of students' learning behaviour compared to student-student interactivity, student-system interactivity, and student-content interactivity. This is an indication that student-teacher interactivity played a very significant role in students' learning behaviour. Three out of the four (student-student interactivity, student-content interactivity, and student-system interactivity) categories of E-learning interactivity showed a positive regression coefficient indicating a positive impact on course effectiveness. The significance level of two (student-student interactivity, and student-teacher interactivity) of the three categories of E-learning interactivity were less than 0.05 indicating a statistically significant causal relationship with students' learning behaviour. Thus, an improvement is students' learning behaviour be achieved by improving student-student interactivity, and student-teacher interactivity categories of E-learning interactivity. Student-content interactivity although positive was not statistically significant. On the other hand, student-system interactivity showed a negative regression coefficient indicating a negative impact on students' learning behaviour. The p – value for student-system interactivity was less than 0.05 indicating a statistically significant causal relationship with students' learning behaviour. This implies that, to improve students' learning behaviour in E-learning models, the student-system interactivity should be minimized. Table 8 shows the summary of the regression analysis of E-learning interactivity and students' learning behaviour.

Table 8 - Regression Analysis of E-learning Interactivity and Students' Learning Behaviour

	Coefficients			**F-Test**	
	Unstandardized Coefficients	Standardized	Sig	F	Sig
Intercept	0.642		0.000	402.502	0.000
Student-Teacher Interactivity	0.555	0.529	0.000		
Student-Content Interactivity	0.005	0.004	0.855		
Student-System Interactivity	-0.081	-0.082	0.001		
Student-Student Interactivity	0.362	0.290	0.000		

$R = 0.658, R^2 = 0.433, Adjusted \ R^2 = 0.432, Significant \ at \ P < 0.05$

Discussions of Results

The findings of the study are discussed in line with the research questions, which are the impact of E-learning interactivity on overall course effectiveness, student's independent learning skills and student's learning behaviour. The findings of the study is in line with previous studies that that agreed that E-learning interactivity was vital in achieving effective pedagogical outcomes (Rochester & Pradel, 2008; Kuo, Walker, Schroder & Belland, 2014; Croxton, 2014; Salamat, Ahmad, Bakht & Saifi, 2018).

With regard to research question one which sought to explore the impact E-learning interactivity on course effectiveness, the findings of the study demonstrated student-student interactivity, student-teacher interactivity, and student-system interactivity categories of E-learning interactivity have positive and statistically significant

impact on course effectiveness. However, the best predictor of course effectiveness was student-system interactivity. This supports the argument that poor performance of the technological systems could affect students' satisfaction and consequently affect the effectiveness of a course in an E-learning model. The result confirms previous studies that a substantial course effectiveness in E-learning models is as a result of student-system interaction (Gaythwaite, 2006; Hara & Kling, 2001). However, DeTure (2004) shares a contrary view on the predictive power of student-system interactivity on the success of students in e-learning environment. The findings of the study contradicts those of Benigno and Trentin (2000); Silong, Ibrahim and Samah (2002); Peng and Samah (2006); Ekwunife-Orakwue and Teng (2014) who found student-content interactivity as a best predictor of course effectiveness.

The impact E-learning interactivity on students' independent learning skills as assessed in research question two. The result reveals that student-student interactivity was the best predictor of student's independent learning skills compared to student-system interactivity, student-teacher interactivity, and student-content interactivity. This finding of the study affirms that of Abulibdeh and Hassan (2011) that student-student interactivity is vital in E-learning models as students' construction of knowledge cannot occur in isolation with an environment of which other students are dominant. Social interaction is a vital component of our cognitive learning process and one of the most important elements in our learning process is student-student interaction. Student-student interactivity helps students through intellectual stimulation and consequently in the development of independent learning skills. This argument is supported by that of Smith and MacGregor (1992) that an "intellectual synergy" of ideas is created when students interact with each other in constructing knowledge. Schrire (2006) indicates that when students engage in discussions with each other, they obtain better academic outcomes than when they do with the teacher which confirms the result of the present study. The results of the study also confirm the assertion of Croxton (2014) that student-student interactivity enables active engagement between students which is crucial for both their content knowledge and independent learning skills development.

Finally, the last research question examined the effect of E-learning interactivity on students' learning behaviour. The result indicated that student-teacher interactivity was the strongest predictor of students' learning behaviour compared to student-student interactivity, student-system interactivity, and student-content interactivity. The findings of the study supports those of Abulibdeh and Hassan (2011) that student-teacher interactivity could better other forms of interactivity in E-learning and consequently improving on students learning behaviour. The task of teachers in E-learning is to make content more comprehensible and to educate students to understand to make sense of online learning. In view of this, teachers need to interact continuously with the students to help build a positive students learning behaviour. The finding also supports those of Kang and Im (2013) who report that collaborative interactions amongst students and teachers have an impact on students' learning behaviour.

Conclusion

The study empirically established how the links between different forms of E-learning interactivity affects course effectiveness, students' independent learning skills and students' learning behaviour. E-learning in Ghana is a relatively new learning platform for tertiary students. The novelty of E-learning models in the Ghanaian context is posing a challenge to its effectiveness as students without prior E-learning experience from their high school education is struggling to cope with it.

This is one of the reasons why the knowledge about the role of E-learning interactivity becomes quite critical in E-learning models. Student-system interactivity is a prerequisite for E-learning and significantly affects the effectiveness of a course in an E-learning model and hence, thorough induction program should be considered to enhance the student-system level of interactivity. Student-student interactivity has been found as a factor with significant impact on students' independent learning skills and continue to support students once they are out of formal learning environment. Student-student interaction helps students build the same social atmosphere as in traditional classrooms based learning. In addition, it promotes teamwork and peer-based learning, which is important for lifelong and active students, which are two key objectives of the constructivist approach to learning. Student-teacher interactivity is critical in improving students' learning behaviour while they are still undergoing formal learning. The role of teachers in E-learning models is crucial, in that teachers do not only deliver the content but also ensure that students develop their independent learning and knowledge construction skills at the same time.

Practical Implications

A number of implications could be inferred from this study. Increasing student-system interactivity will reduce students' reliance on the technologies and rather strengthen students focus on learning. Students should be introduced to E-learning systems from early stages of education to equip them with necessary skills to interact with the systems in E-learning models. Teachers should focus on improving independent learning skills and choose instructional strategies that encourages it. Through encouraging students to define areas of interest individually,

locate information, evaluate them and present them, and by so doing may encourage the student to learn themselves and develop effective independent learning skills. Developers of E-learning models should develop designs that would promote independent learning. Teachers should provide constructive and prompt feedback to the students. This requires the development of feedback-oriented course design which allows students to obtain regular feedbacks. Student-teacher interaction should be driven by students to promote constructivist learning.

Limitations and Further Research

The study like any other studies had some limitations. The use of self-reporting scales to measure variables for analysis in the study could have influenced the outcome of the study may have either underestimated or overestimated their reactions. E-learning interactivity was assessed from students' perspectives ignoring the teacher perspective which could have brought another interesting dimension to the study. The study did not consider the perspective of the developers as this would have brought to light how to bridge the gap between E-learning and traditional classroom based learning. Further research could be explored with a wider scope to include the perspectives of teachers and developers of E-learning models to investigate the effectiveness of E-learning interactivity.

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