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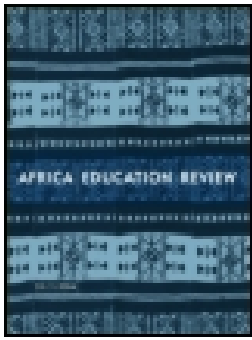
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CONSTRUCTIVIST TENETS APPLIED IN ICT-MEDIATED TEACHING AND LEARNING: HIGHER EDUCATION PERSPECTIVES

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ABSTRACT

This study describes how a professor-instructor of a Master of Arts (MA) programme in Contemporary Issues in an Adult Education classroom applied constructivist tenets to address an ICT-mediated teaching and learning class. The study provides an analysis of the professor's constructivist pedagogical approach in designing curriculum, engaging in learner-centred teaching delivery, developing an assessment method and using educational technologies including the Sakai Learning Management System for the teaching and learning. The University of Ghana was the study area. A qualitative, descriptive case study design was used. The data collection methods were document review, observation and interviews. All the 14 MA students were sampled to be interviewees but 11 applicants were available for the interviews. Convenient sampling method was used. The findings included the unique success associated with using constructivist tenets in teaching and learning. From an international readership perspective, this paper calls for higher educational institutions everywhere to emulate the experience of the University of Ghana.

Keywords: curriculum design; education; higher education; learners; pedagogy; constructivism



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INTRODUCTION

The emergence and advancement of information and communication technology has become a major challenge for tertiary educational institutions in Ghana and other parts of the world. Instructors are persuaded to integrate educational technology in the classroom, but often these technologies are employed as productivity tools to deliver information rather than as cognitive means to support learning. Questions on how educational technology devices such as learning management platforms impact teaching and learning and how best to integrate them into the classroom teaching processes, present pedagogical concerns to instructors. The use of multimedia technologies, the web, Learning Management Systems (LMSs) and Microsoft Office has created new possibilities for the development of instructional materials to deliver course content; and such a move has equally changed how students learn.

Educational context and constructivist theory

Today, the educational environment stresses the need for learner-centred education where the learner is the pivot of the social process and the focus is on learning rather than teaching (Ali, Hodson-Carlton and Ryan 2004; Young and Maxwell 2007). Juniu (2006) argues that creating a learning environment that mimics real-life conditions and settings is fundamental in assisting learners to integrate, analyse and apply concepts of a discipline. Constructivist thinking is applied to classroom practice within a synthesis of cognitive and social perspectives; and this serves as an intellectual anchor (Windschitl 2002, 137). Oliver (2001) states that the use of learning theories can contribute to quality e-learning courses by providing a framework that guides the development and implementation of appropriate teaching-learning activities.

Piaget's (1971) ideas form a basis for cognitive constructivism which maintains that knowledge construction is located in a person's brain. When interacting with their environment, learners absorb or assimilate those ideas that agree with their current cognitive structures and change or accommodate those ideas that do not agree with what they already know. This view was extended by Vygotsky's (1978) social constructivism, traced to the work of Dewey (1933) which emphasises that knowledge building is produced culturally through collaboration with other people within a social context (Rogoff 1990).

The Contemporary Issues in Adult Education course

Empirical studies on Master of Arts (MA) students regarding Contemporary Issues in Adult Education at the University of Ghana were conducted to examine how the dominant constructivist theory played out in classroom teaching and learning by taking into account the main tenet that knowledge is constructed individually and socially. The course was divided into three parts: (1) The Nature and Dynamics of Social Change;

(2) Participation in the Open Online Educational System; and (3) Strategies for Reading and Writing Arguments. The course was intended to run for 14 weeks, once in every week, a four hour lecture was given. The professor structured the class into four groups and various topics were given to them to research into; their findings were presented in class for peer evaluation.

Course objectives and goals

To explore the dynamics and impact of social change on higher educational access for the contemporary adult learner and to apply the concepts and methods of critical thinking to analyse, criticise and evaluate the arguments of scholars and many others involved in philosophical discussions on the impact and value of Open and Distance Learning for adult learners around the globe. Learning outcomes include the need for students to understand the dynamics of social change and the impact on higher educational access for the contemporary adult learner and to exhibit critical thinking, effective writing and presentation skills to evaluate arguments in the philosophical discussions on the impact and value of Open and Distance Learning for adult learners around the globe.

Teaching and learning context

Teachers and students had to battle with poor power supply, lack of generators for backup, slow downloading of materials, poor internet connectivity and the use of old personal computers (PCs).

The research question is: How can an instructor successfully apply the constructivist tenets in a technologically mediated teaching and learning environment? The purpose of the study is to demonstrate how instructors could apply constructivist tenets to inform a successful learner-centred pedagogy in an ICT-mediated teaching and learning environment for easy replication by higher educational institutions that engage in technologically enhanced teaching and learning in sub-Saharan Africa.

LITERATURE REVIEW

Constructivism lays emphasis on the facilitation of knowledge construction through connecting new concepts with prior belief (Overbay et al. 2010). For teachers following constructivist theory, technology should be utilised in such a way that it engages students and persuades them to make deeper connections with the material under study and to generate meaning, rather than regurgitate isolated bits of information. Technology serves as a set of tools for knowledge construction through such means as simulations, hypermedia and “problem-based learning environments” (Mayer 2003). The use of constructivist theory for this paper is to unveil the formal theoretical orientations derived from the work of Piaget and Vygotsky, and the extent to which they have determined pedagogy and how teachers and contexts mediate the theory and practice relationship

(Wood and Bennett 1998). The use of other learning theories could not have been substituted for this one.

Thumlert, de Castell and Jenson (2015) posit that the use of mobile applications, interactive game-controllers, art-making interfaces, distance-learning platforms and course-building software suites are some methods/modes that bring technology and education together. An example is using interactive white boards and course-building software to facilitate students' engagement. Internet resources and digital media are conceived and incorporated as resources that augment established methods, support content-delivery, or make educational experiences more palatable or globally connected.

The Technology Acceptance Model (TAM) is one of the models used to ascertain teachers' readiness to accept technology for teaching and learning. Results from empirical research have shown that subjective norms and computer self-efficacy serve as the two major perception constructs in TAM. Previous studies revealed that perceived ease of use was the sole determinant to the prediction of intention to use, while perceived usefulness was non-significant to the prediction of intention to use. Teachers' readiness to use technology for teaching and learning depends on how they perceive the usefulness, the ease of use, subjective norms, their computer flair, age and gender and institutional motivational policies. At the moment in Africa we still have laggards, those whose attitude to adopt ICT for teaching and learning is very reluctant.

Inana and Lowther (2010) also carried out research that sought to explore the variables influencing instructors' integration of technology into classroom instruction. It tested a research-based path approach based on data gathered from 379 K-12 school teachers to find out direct and indirect contributions of relevant institutional factors such as the overall support for school technology, technical support, professional development, teacher preparedness and teacher belief concerning the use of technology. The key underlying factor of the study was that the hypothesised path model was powerful enough to explain a substantial amount of variance in teacher readiness (43%), beliefs (51%) and laptop integration (55%). The findings revealed that teachers' readiness and belief and professional development strongly predict laptop (technology) integration and that the overall support for school technology and professional development has strong effects on teacher beliefs and readiness, respectively. All school-level variables also had a significant indirect impact on laptop integration, which is mediated by teacher readiness and beliefs.

Kreijns et al. (2013) sought to answer the question: "What stimulates teachers to integrate Information and Communication Technologies (ICTs) in their pedagogical practices?" in the context of teachers' use of digital learning materials (DLMs) and the use of Fishbein's Integrative Model of Behavior Prediction (IMBP). The internal linkages between distal and proximal variables and intention were investigated. The results showed that proximal variables such as attitude, subjective norm and self-efficacy towards DLMs were significant predictors of teachers' intention to use DLMs although the contribution of subjective norm was modest. Effects of distal variables

on intention were mediated by the proximal variables. Attitude, subjective norm and self-efficacy mediated the impact of three distal variables on intention: prior experience with the use of DLMS, perceived knowledge and skills to use DLMS, and colleagues' usage of DLMS. It was suggested that persuasive communication and training be used to enhance positive attitude towards DLMS and improve self-efficacy in using DLMS.

METHODOLOGY OF THE STUDY

A qualitative, descriptive case study design was used to explore answers to the research question. Qualitative research is a context-specific study that describes the real-world settings of people in an attempt to better understand social realities, processes and meaning patterns and structural features (Flick, Von Kardorff and Steinke 2004; Golafshani 2003). The approach is naturalistic and interpretative as it attempts to discover the view of the world from the perspective of those being studied.

Sampling method

All the 14 MA students were selected as the sample for the study (a census approach). However, 11 of the students responded to the invitation to interview. Selective purposive sampling which is a non-random sampling method was employed.

Data collection strategies

Observation

One of the researchers assumed a participant observer role in the class during the entire semester, observing the physical classroom and online dialogue between learners and between the learners and the professor. A field notebook was used to take notes and collect unstructured data to produce an account, to provide a "thick description" of the situation being studied (the instructor and his MA class). Participant observation has the merits of allowing data to be collected on events occurring in real-time situations. A major difficulty with observational research is the tendency to collect a great deal of rather unstructured data which take a longer time to transcribe. Some of the things observed were: the instructor's role in curriculum design and its placement on the Sakai platform; the instructor's engagement with learner-centred pedagogy; the instructor's assessment method; the instructor's constructivist role in the use of the Sakai LMS and other technologies for teaching and learning; and the role of the technology in the constructivist perspective on teaching and learning.

Document sources (mostly electronic) included gleaning information from the course syllabus, lecture notes and e-resources on the Sakai platform, e-library, video and audio links, prescribed textbooks, articles and others. Semi-structured interviews were also carried out. The choice of the semi-structured interview was due to its flexibility, to

enhance deep investigation of the social and personal worlds of the respondents. Such an environment provides the enquirer with the opportunity to immerse himself in the field, create a relationship with the respondent and engage in meaningful dialogue. In the process, initial questions, for example, could be readjusted in reference to the responses from the respondents, permitting more probes of important issues that may arise (Smith and Osborn 2003). In such an environment, a co-creation of meaning between respondents and the enquirer on events and experiences in their lives becomes possible (DiCicco-Bloom and Crabtree 2006). Interview questions centred on respondents' perspectives on teaching innovation and how the learning process allowed interaction with content. Each interview took 30 minutes based on the respondent's approval.

Data analysis

Observation data

Observational data are by their features, naturalistic, unstructured and difficult to analyse. Only parts of the data-set were transcribed based on strict criteria relating to the research focus using a process known as progressive focusing (Agar 1980), sometimes described as funnelling (e.g. Cousin 2009). The "grounded theory" approach was used to analyse the data, a model developed by Glaser and Strauss (1967). This approach involved the selection of categories, using the "constant comparative method" whereby each new piece of data is compared to others already coded in order to identify similarities and differences. Further analysis attempted to clarify the meaning of categories, identify sub-categories and describe potential links between them.

Documentary data

Online textual materials were analysed using a process of category development. Category development is defined as the grouping of items of textual data into similar categories that "fit" the data. Categorisation is the "most important part of content analysis because it reflects the purposes of the research and the theories underlying it. All the online application tools were opened to examine their contents and how they connect to effective learning based on the constructivist principles. Various audio/video material links were clicked to listen to the contents. The forum platform was also viewed to examine students' perspectives of students' debates. Issues were categorised into curriculum, online teaching delivery method, Sakai LMS and assessment methods.

Interview data

Thematic analysis was used to analyse the interview data. The thematic analysis method is used to identify, analyse and report patterns within data as well as interpret various aspects of the research topic (Braun and Clarke 2006). The analysis started by looking

for patterns of meaning and issues of potential interest in the data. The patterns were then organised into meaningful coding schemes and themes. Themes were finally refined and defined and logical connections were established between them and interpretations made. The analysis was at the latent and interpretative levels more than the semantic level. At the interpretative level, the researchers sought to examine the socio-cultural contexts that undergird the views of participants. Such a line of analysis comes from a constructionist paradigm and is flexible in applying it across a range of theoretical and epistemological approaches (Braun and Clarke 2006).

Rigour (validity and reliability)

The present study adopted member checking (interview transcripts, document reviews, and observations were brought back to respondents to see if the interpretations and the results were in order). Also, the comments of peers in the subject area were included and thick descriptions were used to ensure that trustworthiness had been met. Multiple data sources (interview, document review and observations) were used to empower the accuracy of the findings.

Ethical Considerations

Qualitative studies are a reflexive enterprise as they allow some scepticism on the ways in which the researcher and the research process have shaped the data including the role of prior assumptions and experience (Macbeth 2001). In this section, the researchers have shown how ethical responsibilities were demonstrated. Respondents were made aware about arrangements for the interviews and the time involved. They were also told they could opt out of the study if they felt uncomfortable. Respondents' data were kept confidential.

FINDINGS AND DISCUSSION

Documentary review and observation data

The instructor's role in curriculum design and its placement on the Sakai Platform

A 19-page syllabus on Contemporary Issues in Adult Education was given to the students to enable them to engage in independent learning. The instructor adopted student-centred pedagogy and that determined his pedagogical design. There was a move towards classrooms in which students are actively involved in their learning practice as they asked questions, made decisions and analysed their performance. The curriculum was designed such that students were able to immediately see the connection between the course material and their lives. The course content became relevant to their professional

needs. The topics for discussions were selected on the basis of their relevance to current events, their relationship to the main concept, and the extent to which students' current knowledge could inform them.

Through the use of the e-resource tool on the Sakai LMS, the instructor provided learning resources – a syllabus, educational material links, websites and lecture notes – to the students. The instructor uploaded the course outline, course materials, notes and slides, a website for e-books, e-libraries, articles and links for YouTube online within the resource tools. The announcement tool, emails and the chatroom tools on the Sakai platform were used to provide relevant information to students and to alert them to visit the resource tools to download relevant information and material. On the Sakai platform, the instructor used the audio, video file and pdf file, to facilitate students' learning based on the topic. As part of the course objectives, students enrolled with Massive Open Online Course (MOOC)-Coursera and submitted reports through email attachments embedded on the Sakai platform to the instructor. Students completed other assignments, and put them in the Dropbox or submitted them through the email attachments to the instructor which were subjected to turn-it-in checks on the originality of work. Students' awareness of the turnitin alerted them to acknowledge all borrowed information and this created in them academic integrity. The forum platform made room for students to post their report/research on a topic for a debate by peers. The grade book allowed them to access their various scores on assignments and final examinations.

The use of videos embedded in the instructional strategies enhanced deep understanding in the students. By reading the online course materials and watching video clips, the students were able to refresh their understanding of certain topics and clarified their wrong perceptions at their own convenient time and space. The students were really exposed to online learning which has enhanced their boldness and skills in using the computer in the office. The use of the ICT and deployment of appropriate instructional strategy have facilitated and augmented teaching and learning in higher education and this will continue to be the practice.

The instructor's engagement with learner-centred pedagogy

The instructor facilitated learning activity by interacting with the students, providing them with suggestions on appropriate ways to use search engines and offering ideas on the issues of investigation. Guidance that would enable a smooth transition from individualism to interdependence and collaboration was also provided. The instructor provided active learning opportunities and a social interaction platform (forum) to facilitate students' knowledge building.

The instructor, seen as a facilitator who focused on the learner, posed questions and problems, then guided students/learners to find their own answers. Students were helped to learn how to articulate their ideas clearly as well as to collaborate on tasks effectively by sharing in group discussions. This experience provided them with creative

and critical thinking skills, information-sharing skills, communication and relationship skills and problem-solving skills they need in order to be successful in the real world.

Besides, an appropriate support system such as experts' advice on the use of the Sakai LMS, accessing e-library materials, etc. were also made available to them. This environment facilitated students' learning of problem-solving skills to use in the real world of adult educational practice.

The instructor created situations for students to actively solve problems, develop their own ideas about topics that build on their prior knowledge and focus on broad concepts rather than specific isolated skills. The instructor utilised many instructional techniques to ensure that students openly express their ideas. Students could then engage in class discussions in which they related what they had learnt from literature and life experience. The instructor could clarify any errors that emerged in the students' discussions or written work. He supported deep learning by encouraging students to monitor their own learning, and experiment with multiple ideas as they solve adult education problems. This indicates that the instructor played the role of a facilitator, while the learner's role was one of constructing reality through interactions with the environment.

Students acquired new knowledge most effectively when the instructor promoted their learning by helping them investigate, engage in discovery learning, and interact to "evoke ideas and views, scaffolding problem-solving, monitoring and modeling reasoning processes, re-voicing questions and interpretations and promoting collective responsibility" (Kovalainen and Kumpulainen 2007, 142). The students started their group-project activity by brainstorming and deciding the questions and problems on which they would like to focus their investigations. The constructivist theory aided students to represent their ideas, articulate what they knew and explore, manipulate and process information, while actively collaborating with each other (Jonassen, Peck and Wilson 1999).

The instructor's assessment method

This was in the form of assignments which were life situation-centred (rather than only task- or problem-centred); it also took a form of individual assignment that sought originality of thought, initiative and creativity from students. A group research project assignment was also given for several reasons. First, it yielded a specific outcome that is difficult to produce. Second, it required students to develop expertise about a very complex subject. For these reasons, dividing this very large assignment into smaller tasks that were more manageable was easier to do as a team. Third, it reinforced group cohesiveness and required student-to-student dialogue. Fourth, it provided an opportunity to practise skills for effective collaboration (Foyle 1995).

The various assessments by the lecturer/instructor engaged the students in critical thinking and problem-solving activities. Table 1 outlines the assignments, end-of-semester examination and the associated marks.

Table 1: Grading structure

Course component	Percentage of marks
Forum (10 marks each) *3 =	30
Course information (Coursera or edX)	10
Course report (Coursera or edX)	10
PowerPoint presentation (CIPPT)	10
Written report	10
Final exams	30
Total	100

The grading structure in Table 1 is unique due to its spread pattern, depicting various assignments with their corresponding scores. This could really test the quality of students far better than the traditional classroom-based teaching and learning grading system where we normally have 20% allocated to quizzes or assignments, 20% score for mid-semester exams and 60% score for end-of-semester examinations; or where we have 30% for continuous assessment and 70% for end-of-semester examinations. In this technologically based teaching design, one can pass even if one does not take the main examinations. This means assessing a student's capability only by final examination was reduced drastically. Again, the collaborative learning through the group project presentation and forum debate allowed for critical thinking and problem-solving skills.

Interview data

Teaching innovation

Students were asked to express their views on whether the instructor used an ICT-mediated teaching mechanism and whether they found the approach to be learner-centred. In both cases, the students were able to participate easily in the class activities.

See the participants' narrative:

Although learning activities were mostly carried out online, we participated and interacted effectively through fora debates and chat room conversations. (interviewee 1)

Yes, we engaged in active, team-based collaborative and problem-solving learning. The lessons were student-centred as opposed to teacher-centred. We formulated our own questions, discussed, explained, debated and brainstormed during class under conditions that assured us both positive interdependence and individual accountability. (interviewee 2)

Yes, the instructor used varied methods to capture our attention and sustained our interest for active participation both online and face-to-face classroom teaching and learning. (interviewee 3)

Instructors often struggle with new educational technologies and the need to reconceptualise and reorganise pedagogical strategies (Georgina and Olson 2008). However, the instructor in this study was well-versed in the technological, pedagogical and content knowledge and that enhanced successful teaching and learning:

Feedback from the lecturer was swift and highly motivating. Teaching and learning through Sakai was a pathway to participatory learning since the inherent tools were carefully selected to enable students engage in interpersonal communication and also to interact with the instructor. The Sakai technology provided solution to students' needs ranging from students' request response, adequate online resources, peer review, discussion to provide students' progress report/grading through emails, chat room, forum, resources and grade book tools. (interviewee 4)

The traditional face-to-face teaching and learning cannot replace this approach.

As stated by Ali et al. (2004), the learner is the pivot of the social process and the focus is on learning rather than teaching. This is clearly what has been seen in the preceding statement which coincides with the constructivist philosophy. Hattie (2009) posits that the effectiveness of engaging ICT depends on the teaching modes, variety in classroom activities, student-centred learning, enhanced peer-learning opportunities, teacher in-service training and teacher knowledge in ICT, teacher attitudes and institutional factors. What this means is that a problem emanating from any of these variables can cause a barrier to ICT-mediated teaching and learning transactions.

A respondent also commented:

There was willingness on the part of students for increased interaction and participatory learning online; however, some students were challenged by poor internet access at their various locations as well as unstable electricity supply during the semester. (interviewee 4)

ICT can have a significant impact on enhancing the quality of learning because it gives teachers tools to vary teaching strategies which can have a positive impact on student learning. A lecture that includes internet capabilities allows the faculty to involve students in active learning where a student explores, uncovers, finds and explains concepts to be learned.

Interaction with content

Students were questioned to show their perspectives on how the use of digital content impacted on the ability of socio-economically disadvantaged students to go through the course. Respondents commented:

The ability to access lecture notes and course materials online eased the burden on some of us who would have had the challenge of printing and photocopying materials at all times. Assignments and most interactions were online hence saving cost of printing and photocopying of materials though it was very challenging to most students who lacked computer skills. (interviewee 5)

E-books and other media files were easily transferred or shared among students at no extra cost. Students were able to access most of these resources on their mobile devices. This was

more convenient in the sense that it extended the classroom boundary beyond the walls of the university. (interviewee 6)

Basically, online education brings flexibility, convenience and a reduction in costs (Haghshenas, Chatroudi and Njeje 2012). Computer-supported and constructivist-inclined collaborative learning has shown positive effects on students' performance in solving problem-based tasks (Uribe, Klein and Sullivan 2003). Educational technology embraces problem-based learning, contextual learning, collaborative learning, cooperative learning and situated learning (Shih, Feng and Tsai 2008). This does not come without constructivist pedagogical initiative and curriculum layout on technology. The culturally determined joint activity between student and social context results in an internal state of interest, cognitive and affective engagement and motivated behaviours (Sivan 1986). "Finding students' strengths and focusing them on learning is the key role of the teacher" (as cited in Crossley and Corbyn 2010, 95).

Some studies (Palak and Walls 2009) have shown that instructors' use of technology to support student-centred instruction is rare, even in technology-rich environments. However, the professor-instructor in question was able to marry and apply constructivist practice (both Piaget's and Vykotsky's tenets) in an ICT-driven educational environment as explained by the following:

1. The instructor used the Sakai LMS to engage students and persuaded them to make deeper connections with the material under study and to generate meanings rather than regurgitate isolated bits of information.
2. The lessons were student-centred, participatory and allowed students to interact with the instructor, contents and peers.
3. Students were engaged in active team-based collaborative and problem-based learning.
4. The culturally determined joint activity between students and social context resulted in an internal state of interest, cognitive engagement and motivated behaviour.
5. The instructor used the Sakai LMS as a set of tools for knowledge construction through such means as simulations, multimedia and "problem-solving approaches" (Jonassen et al. 2003).
6. Technological tools such as multimedia programs were used to assist students in creating a product out of what they learned. Educational technology facilitated alternative pedagogical models of guided and reflective inquiry through extended projects that generated complex products and resulted in the assimilation of information.
7. The use of the computer for *PowerPoint* presentation was a good visualisation tool that incorporated media such as audio, video, pictures and animation. It set the learners to explore, think, construct and reflect on the topic.

8. The pedagogical approach provided a conducive learning environment, varied learning activities, and opportunities for students to learn at their own pace, encouraging collaborative work, focusing on problem-solving, and involving students in the assessment of their own learning.

The pedagogical design of an interactive learning environment made the content meaningful, authentic and relevant to learners and allowed learners to add further resources to share in addition to those suggested by the instructor (Crossley and Corbyn 2010, 95; Kirschner et al. 2004).

Implications for policy

Implications for policy, limitations and recommendation

O'Bannon and Judge (2004/2005) maintain that the path of developing teachers to use technology is a project to be managed by the entire institution. This embraces various support systems including staff professional development to increase teachers' confidence and skills in choosing software and integrating ICT across the curriculum; and ICT support staff assisting with technical and curricular needs. The need for teachers' professional development is clear but enabling teachers to adapt their pedagogical reasoning and practices in response to learning opportunities provided by ICT is likely to be a very difficult and complex process.

To help students succeed with continuous knowledge and skills refinement, attention to teacher preparation is necessary. On one level, professional development opportunities are needed to provide teachers with the pedagogical grounding that will allow them to bring a constructivist stance to their daily interactions with students. As their careers unfold, lecturers must be offered continued instruction in the art of teaching and the inducement of learning in others.

The managers and the instructors of the course should take note of the following shortcomings and obstacles within the learning context: power outages, poor downloading, poor internet connectivity, inadequate computers, lack of ICT policy, irregular training of lecturers and students for ICT proficiency, inadequate technical support, wifi and wireless challenges in order to improve the learning environment.

Limitations of the study and future studies

Only one instructor and one site case study were considered. While constructivism is widely recognised as a framework for successful instruction, much less is known about the relationship between constructivist practices and beliefs and technology use. Does instructional technology have a causal relationship with constructivist teaching practices? Future studies could tackle these issues by taking into account larger sample size and several study areas at the same time for transferability of findings. However, as

the findings look now, it is still very rich for emulation in similar learning environments worldwide. This is our joy.

Recommendations

A focus on curriculum integration is a necessary contextual element for the effective use of technology to support constructivist teaching. Instructors and ICT experts must be encouraged to collaborate effectively in order to foster a twenty-first-century learning environment in which students' learning is the focus. University authorities should provide an enabling environment that allows effective use of ICT tools for teaching and students' learning.

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