Research Article

PROCESSES ASSOCIATED WITH THE ADOPTION OF MOBILE-BLENDED WITH INQUIRY-BASED LEARNING TO DEVELOP CRITICAL THINKING SKILLS IN NIGERIAN BUSINESS EDUCATION UNDERGRADUATE STUDENTS

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Abstract

The standard of the Nigerian educational system has continued to witness a decline over the years at all levels, contributing to the high rate of unemployment among graduates in the country. Jobs in the 21st century require, among others, employees' abilities to analyse, evaluate, and synthesize knowledge to creatively solve problems, and these abilities are increasingly necessary for survival in the modern world. Despite the emphasis on the need to teach tertiary institution students critical thinking skills, which will better equip them for their future roles, most classrooms in Nigeria are still fraught with the traditional approaches. These methods only focus on equipping students with knowledge of concepts that do not adequately avail them with the required abilities to solve real-life problems in modern society. Jobs in the 21st century demand skills that are focused on what individuals can accomplish with their acquired knowledge through analysis, evaluation, and reconceptualization of information to solve problems. To achieve this, learners need to be engaged in active learning that encourages the use of their cognitive process, to sufficiently prepare them for the future. Cognitive development requires that learning should not just consist of repetitive accumulation of facts and knowledge, but must also encompass effective deep conceptual change to support life-long learning. The main objective of this study was to investigate the processes associated with the effective adoption of mobile-blended inquiry-based learning for critical thinking enhancement. A cross-sectional study that used survey and documentary research was conducted among 120 business educators from three states of the thirty-six states of Nigeria, A validated self-administered questionnaire was used to collect data, which were analysed using mean, standard deviation, and percentage. The study revealed both the online and face-to-face activities of teachers and students that are significantly associated with effective adoption.

Keywords: Blended Learning, Mobile Learning, Inquiry-Based Learning, Critical Thinking

Introduction

The standards of education in Nigeria have continued to decline over several years. The decline in standards is blamed on, among other factors, the persisted use of traditional approaches to teaching and learning, absence or low technology integration and poor educational resource (Longe, 2017; Moyo & Hadebe, 2018; Barnes et al., 2019). The need to adapt to business job requirements in the 21st century has become paramount as business educators continue to struggle to get the attention of today's children into a learning mode that will better equip them. This is because the focus on 21st-century skills is on what individuals can accomplish with their abilities to analyse, evaluate, and synthesize information to solve problems

The jobs whose tasks involve analysis, creativity and problem-solving skills, increasingly require employees with critical thinking abilities (Ananiadou & Claro, 2009; Rimini & Spiezia, 2016). Today's children unlike former generations, grow up with rapidly changing technologies that make them less receptive to traditional modes of learning (Roehl et al., 2013). Lectures encourage memorizing and the recalling of information, which are lower levels of Bloom's taxonomy of learning (Bloom et al., 1956), while engaging in real-time problem-solving during class, enables students to synthesize and apply knowledge through reflection and reconceptualization of ideas (Graham, 2004; Amador et al., 2006). The Adoption of active learning processes is essential to better prepare learners for the future. The capacity to engage in critical thinking, enables an individual to proffer solutions to challenges in real-world contexts, rather than just equipping them with only specific knowledge of a set of concepts (Doerfert, 2011; Brierton et al., 2016). Critical thinking skills demands deep conceptual change and the reconceptualization of information, to promote life-long learning. Cognitive development requires that learning should not just consist of repetitive accumulation of facts and knowledge but must also encompass effective deep conceptual change in order to support life-long learning. Mobile-blended learning allows sufficient time during its face-to-face components to effectively engage learners with inquiry-based activities (problem-solving tasks) that encourage their cognitive development, rather than exposing them to learning experiences that are fraught with a repetitive accumulation of facts and knowledge only.

Blended Learning

A close observation revealed that educational settings that once only supported face-to-face learning, are evolving rapidly into environments that now accommodate technology mediated learning. This emphasizes the importance of facilitating interaction and collaborative efforts to achieve higher results in human endeavours (Graham, 2004; Cocquyt et al., 2018). In the past, distance learning was designed as a one-way communication between an expert (teacher) and a passive-receptor (learner) based on cognitive-behaviourist theory. As technology develops, distance learning is being used to facilitate interactive and constructivist (collaborative) learning by taking advantage of online communications, which allows students to study anywhere in the world.

Blended learning is a combination of two instructional models that incorporates both the traditional face-to-face classroom system, and an online learning platform (Liu et al., 2016; Han & Ellis, 2019) that employs a mix of asynchronous and synchronous interactions (Wu, Tennyson & Hsia, 2010). Online experiences offer valuable tools that supplement or replace aspects of face-to-face traditional lectures, and textbook-based approaches to teaching and

learning. Research has revealed that a course-design embedded with in-class problem-solving, improves learners' performance and reduces the achievement gap between the students (Stockwell et al., 2015).

The availability and utilization of digital learning facilities have led to increased deployment of ICT-mediated instructional elements into the conventional learning environment. This practice affords educators the opportunity to help their students acquire the information and terms associated with the course before class starts, which provides them time to carry out collaborative problem-solving tasks that engage their cognitive processes (Couch, 2014; Clark, 2015; Lee & Lai, 2017). In any e-learning scenario such as mobile-blended learning, students are expected to exercise self-efficacy and regulative skills, while the teachers who are experts in their fields, should be responsive to the interactions of the learners on the platform to achieve the desired objectives. This type of learning does not imply a mere combination of the two models but involves their integration to achieve specific learning objectives by taking advantage of the two environments.

This method affords teachers adequate class time for collaborative problem-solving activities, demonstrations, question and answer sessions, and other engaging tasks that lead the students to a greater depth of understanding (Saitta et al., 2016). It is a pedagogical approach that provides teachers with the opportunity to invert the classroom and homework activities (Du et al., 2014; Obari & Lambacher, 2015), which allows them more time to tutor their students (Wallace, 2014; Alsowat, 2016).

Studies have shown that students can watch, pause and repeat the online learning materials on their mobile devices, which allows them to gain a clearer understanding of the content before class (Herreid & Schiller 2013; Lee & Lai, 2017). This affords the teachers sufficient time to engage them in collaborative inquiry tasks that promote their critical thinking abilities. Nederveld and Berge (2015) stated that in blended learning, teachers are able to concentrate on the application of knowledge of higher-order learning, instead of lower-level thinking activities, which offers the opportunity to identify mistakes and reinforce critical and creative thinking as well as effective communication.

When students are sent learning materials to study via mobile devices, it ensures a more collaborative and engaging environment in the classroom, enabling them to evaluate and reconceptualize the content for problem solving in real life situations. In higher learning institutions, students appreciate the opportunities of flexibility and improved access to learning materials offered by this technology, which results in greater academic achievements due to improved interaction and collaboration with both their peers and lecturers (Talley & Scherer, 2013; Vaughan, 2014; Alsowat, 2016).

Mobile Learning

As Information and Communication Technology (ICT) evolves, the devices become smaller and more mobile with stunning features, from desktop computers to laptops and other mobile devices such as Personal Digital Assistants PDAs, iPads, and smartphones. The mobility of technology in the last two decades has resulted in the emergence of mobile learning that has given rise to a new dynamic of studying in different settings. Mobile learning is the type of studying that takes place using portable devices like Personal Digital Assistants (PDAs) computer tablets and smartphones (Wishart, 2018; Mittal et al., 2020). It is the deployment of pervasive handheld electronic devices to enhance, support, and expand access to teaching/learning activities. It is technology-mediated learning that is powered by mobile technology to make learning occur anywhere and anytime.

Owing to the portability of mobile devices, they permit users to access various services and platforms, including educational materials anywhere and anytime (Lepp et al., 2014; Li, 2020). They have the potential of assisting students to access online educational materials, review and share them, collaborate with other learners, and develop rich media content that can be helpful to both teachers and learners. Mobile learning presents learners with the experiences that may not be obtainable in their immediate environment and at the same time equip them with the necessary ICT consciousness and skills that are essential to actively participate in the modern world.

With the aid of mobile devices, the compulsory requirement for students to be physically present in a particular location at a specific time for learning is eliminated as they can access instructional materials, interact with teachers or other students as well as anyone else to meet their quest for knowledge anywhere and anytime (Ferreira, 2015). According to them, the use of this technology in education leads to a more intimate relationship between the teacher and their students, enhancing their interaction which results in a more participatory learning experience. Their portability and functionality offer learners the option to use their free time for learning rather than deferring their desire to learn pending when they get to a library or have access to a computer. In a mobile learning scenario, students are expected to exercise self-efficacy and regulative skills, while the teachers who are experts in their various fields, should be responsive to their interactions on the platform.

Enhancement of Critical Thinking

Learning experiences that emphasize analysis, evaluation, and synthesis of information help to develop skills for problem-solving through interpretation, creativity, and generalization. These learning experiences promote reproductive thinking rather than productive reasoning. Critical thinking ability is a level that is beyond the memorization of information or quoting facts back to an individual in the same manner as they were previously expressed (Thomas & Thorne, 2009). It is the use of critical and creative thought that enables an individual to solve complex problems through analysis, evaluation, and synthesis of knowledge (Lee & Lai, 2017). Critical thinking is observed when an individual receives and stores new knowledge while interrelating and applying such information to address unfamiliar situations. Individuals can resolve a complex through logical thinking process that allows them to interpret, evaluate, and manipulate previous experiences to confront present life challenges.

The constructivist theory emphasized that students are required to be exposed to learning experiences that inspire and empower them to construct their knowledge and promote their thinking skills. As educators struggle to shift from traditional approaches to more effective teaching/learning processes, most educational stakeholders believe that learners are not just holders but also builders of knowledge, and Piaget believed that reflection leads to higher-order knowledge by permitting the resolution of elements of lower-level knowledge (Mattar, 2018). In an environment where education is student-centred, learning is considered as knowledge constructing activities where learners collaboratively obtain, reorganize, and use the information acquired for analysing and solving the problem. Interaction and collaboration are important in the process of developing students' critical thinking. They need interaction and reflection on what they were previously exposed to, and what they are currently experiencing. Engaging in social interaction with peers in real-world contexts has the potential of facilitating learners' ability to reflect on previous exposure and views. Such social

interactions promote the development of students' critical thinking abilities that enables them to effectively transfer their knowledge across courses and apply it to unfamiliar situations.

Collaboration enables students to interact among themselves by exchanging views and ideas to effectively discover new knowledge to accomplish their objectives. It allows them the opportunity to work as a team with interdependence, and assist others to accomplish specific targets (Fu & Hwang, 2018). Interactive and collaborative environments empower learners to exercise their minds to find solutions to problems and develop higher-order tendencies, as they respond to their peer's questions and remarks.

Collaborative Inquiry-Based Learning

In an environment where education is student centred, learning is considered as knowledge constructing activities where learners collaboratively obtain, reorganize and use the information acquired for analysing and problem solving. Collaborative learning refers to the instructional method that offers the opportunity to learn as a team with positive interdependence, group accountability and interactions which culminates in assisting others to accomplish specific targets (Slavin, 2014; Fu & Hwang, 2018). Collaborative inquiry-based learning is an approach that involves asking questions, gleaning information and new ideas in order to solve problems as a group. This type of learning helps students to exercise their analytical skills (identify similarities or differences in content) to define the cause of change in a variable and its effect (Duran & Dokme, 2016). Mobile-blended learning integrates and exposes students to real-world contexts that trigger their critical thinking processes, while teachers play the role of a guide/facilitator in scaffolding learning through timely questioning (Livingstone, 2012; Zoha & Cohen, 2016).

This approach focuses on active learning, encouraging students to ask questions, formulate hypotheses, and test them using problem solving techniques (Laru et al., 2012). Such learning takes place when students glean both content and reasoning skills including practices within a discipline, via collaborative investigation suitable for real-world situations. In interactive inquiry-based learning, students exercise reflection and approach situations critically. This involves the students' ability to investigate and search for information, which allows them to formulate their own ideas through critical thinking (Seranica et al., 2018). Authentic learning results from a social constructivist's view, which emphasizes that learners are active researchers, and knowledge is generated by investigating and actively experiencing reality.

To encourage productive interaction that promotes critical thinking, sufficient scaffolding is necessary because according to Vygotsky (1978), it makes learning more manageable for students by presenting complex tasks in a manner that makes them accessible, feasible and within the learners' grasp. The factors of inquiry-based learning include both structure and the types of activities that are required by learners to enhance their thinking skills, which will allow them to address problems (Prince & Felder, 2006; Levy & Petrulis, 2012). The focus of inquiry is the comprehension of existing knowledge to resolve situations and develop new abilities; the structure involves inquiring questions framed by teachers or students; and tasks that include problem solving and investigations of practical situations, which results in the generation of greater understanding.

Engaging in social interaction with peers in real world contexts has the potential of facilitating learners' ability to reflect on previous exposure, and collaborative inquiry learning environments, is critical in developing their social

experiences (Hwang et al., 2011; Fu & Hwang, 2018). Such social interactions should be focused on the promotion of critical thinking abilities, which will enable the students to effectively transfer knowledge across courses and apply it to unfamiliar situations. Interactive and collaborative environments empower them to exercise their minds enabling them to formulate solutions to problems and develop higher-order tendencies, as they respond to their peers' questions in more complex and confident ways. Modern mobile technologies can assist students in gaining greater knowledge, due to their portability and support for collaboration that leads to the exploration and discovery of new information.

Links between mobile-blended with collaborative inquiry-based learning approach and critical thinking enhancement

When mobile-blended learning is effectively implemented, teachers acquire a greater amount of class time to engage students in collaborative inquiry-based learning (Fu & Hwang, 2018; Jantakoon & Piriyasurawong, 2018). As students work collectively and share ideas on their inquiry activities, such a collaborative and interactive context facilitates the development of their creative thinking which better equips them for effective participation in their later life engagements.

The aim of education in this digital era is to expose students to more active learning, which facilitates their collaborative problem-solving abilities, culminating in equipping them with the realities of the world of work. When students are engaged in real-time inquiry tasks during class, it encourages them to analyse, evaluate, synthesize, and apply knowledge through reflection and reconceptualization of ideas. The constructivist theory emphasized that learners are required to be exposed to learning experiences that inspire and empower them to construct their knowledge, leading to the facilitation of their thinking abilities. In an environment where education is student-centred, learning is known as knowledge constructing activities where learners collaboratively obtain and improve on the information acquired to solve problems. Interaction and collaboration are important in the process of developing students' critical thinking (Slavin, 2014). They need to reflect on what they were previously exposed to, and what they are currently experiencing.

Engaging in social interaction with peers in real-world contexts has the potential of facilitating learners' ability to reflect on previous exposure and views. These social relationships promote the development of their cognitive processes that enables them to effectively transfer their knowledge across courses and apply it to unfamiliar situations. Collaboration enables students to interact among themselves by exchanging views and ideas to effectively discover new knowledge to accomplish their objectives. It allows them the opportunity to benefit from the inspiration of working as a team, while assisting each other to achieve specific objectives (Fu & Hwang, 2018). Interactive and collaborative learning environments empower students to exercise their minds to find solutions to problems and develop higher-order tendencies, as they respond to their peer's questions and remarks.

Methodology

A documentary research design was fused with a cross-sectional survey. The former was employed to analyse and synthesize literature relevant to the objective of the study. The latter, on the other hand, was used to capture the responses of the lead users as they relate to the processes that could influence the adoption of mobile-blended and collaborative inquiry-based learning to enhance the critical thinking skills of business education undergraduate students in Nigeria. Demographic variables were analysed using frequencies, while Mean, Standard Deviation, and Percentage were used to analyse the processes associated with the promotion of critical thinking in students using mobile-blended with collaborative inquiry-based learning. As the study is focused on business education undergraduate students, a sample of 120 business education teachers was drawn from both universities and colleges in three states in the country. A questionnaire was employed to collect data, and its validity and reliability was ascertained by experts in both educational technology and business education fields. The instrument was a 5-point Likert scale, for the participants to indicate their degree of agreement or disagreement with the processes that are associated with the effective adoption of mobile-blended with collaborative inquiry-based learning, to develop critical thinking abilities in Nigerian business education undergraduate students.

Results

Table 1: Socio-demographic characteristics of the respondents

Variables	N	Percentages
Gender		
Male	67	55.8
Female	53	44.2
Total	**120**	**100%**
Highest Qualification		
Bachelor	19	15.8
Masters	58	48.3
PhD	43	35.8
Total	**120**	**99.9***
Teaching experience		
<10 years	34	28.3
10-19 years	38	31.7
20-30 years	29	24.2
>30 years	19	15.8
Total	**120**	**100**

*One of the respondents did not indicate his present highest qualification in the questionnaire.

Out of the 120 respondents that duly completed and returned the copies of the questionnaire, 67 (55.8%) were male while 53 (44.2%) were female. 19 (15.8%) of them at the time of this study had bachelor degrees as their

highest qualification, while 58 (48.3%) had masters degrees and 43 (35.8%) had doctoral degrees. In relation to the duration of their teaching career, 34 of them (28.3%) had spent less than 10 years in the profession, 38 (31.7%) have spent between 10 – 19 years, while 29 (24.2%) and 19 (15.8%) have spent between 20 -30 years and above 30 years, respectively.

Table 2: Participants Mean Score of Processes for the model utilization. (n = 120)

Variables	Mean	Standard Deviation
Mobile-blended learning community	4.38	0.61
Teachers' support	4.31	0.52
Students' support	4.29	0.54
Mobile-blended learning innovation fund	4.34	0.52
Teachers' online activities	4.37	0.51
Teachers' classroom activities	4.30	0.43
Students' online activities	4.38	0.61
Students' classroom activities	4.35	0.50

As indicated in Table 2 above, the mean score of the mobile-blended learning community was 4.38 SD 0.61. The participants agreed that the mobile-blended learning community facilitates the effectiveness of this approach. They indicated that it fosters collaborative learning among the members, sustains their commitment while helping them not to feel isolated with online learning, as well as ensures they move progressively through the phases of critical inquiry. The mean score of teachers' support unit was 4.31 SD 0.52 (Table 2). The respondents indicated that the support department for the teachers would assist them in the following areas: online course design and development, media creation of course materials, exposure to blended learning prototypes that have been successful and boost their confidence, as well as afford experienced faculty members to serve as mentors to the beginners.

As shown in Table 2, students' support mean score was 4.29 SD 0.54. The majority of the research participants agreed that students' support unit helps them to achieve more in mobile-blended and inquiry-based learning. They admitted that the provision of such support will facilitate students' access to mobile-blended learning facilities and equip them with the knowledge and skills necessary to succeed, as well as helping them with issues relating to the functionality of their devices.

The mobile-blended learning innovation fund mean score was 4.34 SD 0.52 (Table 2), indicating that the majority of the respondents agreed that the creation of the fund as part of the implementation strategies, fosters the provision of the required facilities and incentives for the teachers, as well as ensure the sustenance and transformation of the project.

Teachers' online activities mean score was 4.37 SD 0.51, as shown in Table 2. The participants agreed that the activities such as the design of mobile instructional content to meet learners' needs, delivery of such mobile instructional materials in appropriate formats before class, provision of online clarification of confusing concepts, and

sending online personalized quizzes to students to ascertain their understanding of the content, will adequately prepare them for the interactive face-to-face component of mobile-blended learning.

From Table 2 above, the mean score of teachers' classroom activities was 4.30 SD 0.43, showing a higher level of agreement that classroom activities such as, recapping of the mobile content to refresh the students' memory, question and answer sessions to consolidate their understanding/application of the content, generate real-life problems, divide them into smaller groups that will ensure discussion and scaffold their knowledge by asking logical questions that probe their minds to ignite critical thinking. The participants agreed that these activities enhance the development of critical skills with mobile-blended learning.

Students' online activities mean score, as shown in Table 2, was 4.38 SD 0.61. The majority of the participants agreed that the online activities, such as studying mobile instructional content at various locations, communicating with their teachers anytime anywhere for clarification on confusing concepts, exchanging ideas among their peers regarding the content via mobile interaction, searching for and studying related information online and attempting quizzes from their teachers, are part of the learning processes. They agreed that these activities help the students to sufficiently prepare for the interactive classroom that is dedicated to the development of their critical thinking.

As shown in Table 2, the mean score of students' classroom activities while using mobile-blended with collaborative inquiry-based learning to enhance critical thinking skills was 4.35 SD 0.50. The majority of the respondents acknowledged that part of the students' activities such as, asking questions regarding concepts of the content they do not understand, and studying collaboratively to analyze, evaluate and reconceptualize their knowledge to solve problems, while enhancing their critical thinking skills.

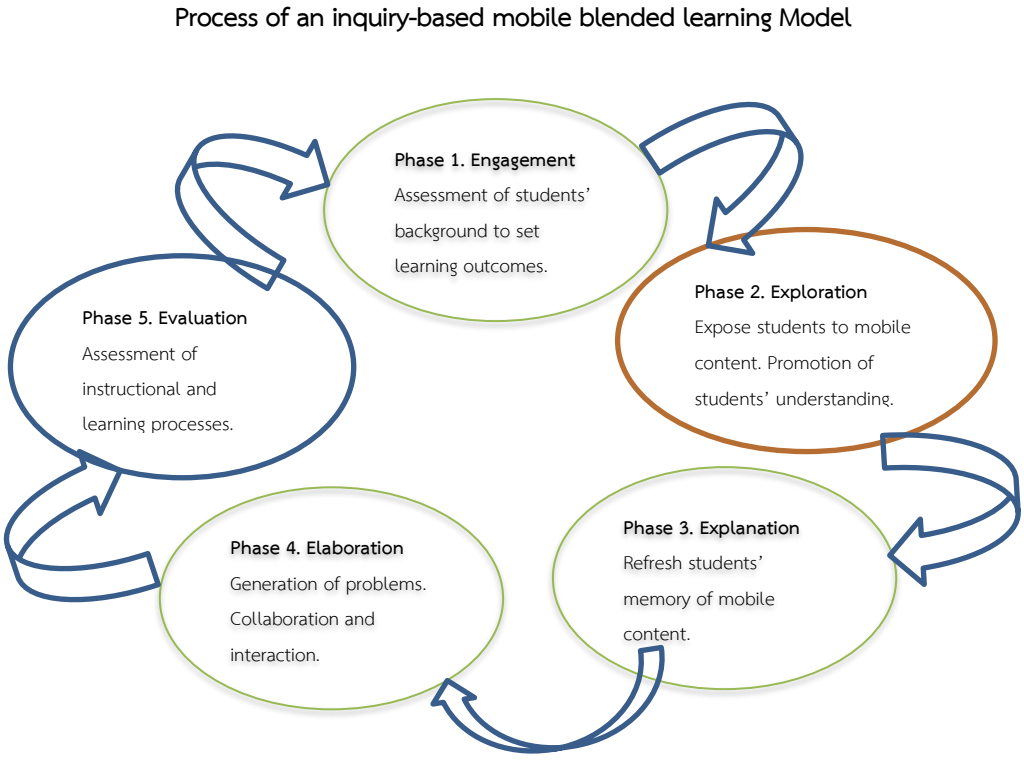

Figure 1: Steps in inquiry-based approach in mobile-blended with inquiry-based learning

Phase I: Engagement

The focus of teachers at this phase is on the students' existing knowledge. What is their background knowledge? It is not intended for teaching or to provide explanation to students, but to find out what they already know, which will form the basis of what they need to learn (Duran & Duran, 2004; Sam, 2019). This is achieved through formative assessments, which leads to the establishment of learning objectives.

Phase 2: Exploration

At this stage, teachers deliver mobile content in an appropriate format (video, text, image or a combination of them) and with a user-friendly platform to students to study (Shrain, 2012; Bergmann & Sams, 2014; Alsowat, 2016). The content should complement face-to-face sessions, and be available to students synchronously and asynchronously (Keskin & Yurdugül, 2019). This enables collaboration when it is synchronous, while it can enable students to consolidate learning when asynchronous. The online presence of teachers needs to be regular and interactive to enable the students to internalize the content. As students study the mobile instructional material, the teachers ask questions via mobile devices to ascertain their understanding while scaffolding their knowledge (Bishop & Verleger, 2013; Hew et al., 2016; Lo & Hew, 2017). This promotes the application of insight gained from the content and consolidates learning, to ensure sufficient preparation for interactive classroom participation.

Phase 3: Explanation

Moving the lecture part of the class activities to an online platform, at the exploration phase, is to allow adequate time for face-to-face encounters which engages the learners in interactive inquiry tasks that promote the development of their critical thinking skills (Bergmann & Sam, 2014; Grypp & Luebeck, 2015; Jantakoon & Piriyasurawong, 2018).

This stage is to enhance students' understanding of the mobile content, at the beginning of classroom sessions of mobile-blended learning. A succinct review of the online instructional material is necessary to resolve any misunderstanding of the content by the learners, and to explain more complex concepts (Grypp & Luebeck. 2015; Chao et al., 2015; Lai & Hwang, 2016; Lo & Hew, 2017). This is to facilitate their ability to reorganize their knowledge of the content and apply it to unfamiliar situations. Teachers ask students questions to determine their understanding of the mobile content.

Phase 4: Elaboration

At this stage students are engaged in collaborative inquiry tasks by giving them ill-structured work-related problems. The problems should be linked with the mobile content, while they are to analyse, evaluate and synthesize their knowledge of the mobile material in solving the problems. The exposure of learners to ill-structured problems triggers their reasoning ability, that enhances their critical thinking, while the teacher plays the role of facilitator (Smy et al., 2016; Jantakoon & Piriyasurawong, 2018; De León, 2018). As they engage in their inquiry activities, teachers scaffold their knowledge by asking logical questions that probe their minds to ignite critical thinking.

To ensure students' interactions and collaborative activities, they should be divided into heterogenous inquiry groups. The ability of a group to solve problems collaboratively, depends on the diversity of the membership in relation to their domains of knowledge and backgrounds (Edmondson & Harvey, 2017; Avdiji et al., 2018). This diversity, to a large extent, determines their level of perspective sharing and their ability to proffer alternative solutions to

problems. Engaging in social interaction with peers in real world contexts has the potential of facilitating learners' ability to reflect on previous exposure, and collaborative inquiry learning environments are critical for developing social experiences (Hwang et al., 2011; Fu, & Hwang, 2018). As the students engage in collaborative problem solving, the teacher has to ensure elaborate interaction. Social interaction is very important in the development of critical thinking, because as the learners share perspectives, their reasoning horizon is broadened to accommodate and further their thinking with the views of others.

Phase 5: Evaluation

Both teachers and students are involved in the assessment. The teachers evaluate the level of the students' critical thinking with an assessment checklist. During the evaluation, the teachers' focus is on the extent to which the students have been able to reorganize their knowledge of the mobile content in their inquiry activities. The students are given an anonymous and structured questionnaire to elicit responses from them on their satisfaction, motivation, teamwork, learning gains, etc., about the innovation, as well as the instructor's attributes, the design, amount of work, etc using five-point Likert-scale (Woltering et al., 2009; Bernard et al., 2016).

Both the teachers' and students' assessments are to determine whether or not the innovation is effective in achieving its goal and to identify the areas that can be improved upon for practicability and effectiveness.

Table 3: Teachers' and students' activities in mobile-blended with inquiry-based learning to enhance critical thinking skills

Inquiry steps	Context	Teachers' activities	Students' activities	Output
Steps 1: Engagement				
1.1 Analysis of students' backgrounds	Face-to-face	1.2 Conducts a formative assessment to analyse students' background knowledge.	1.3 Students participate in formative assessment.	1.4 Teacher establishes learning outcome
1.5 Design of mobile content	Online	1.6 Reviews curriculum outline		1.7 Produces a sketch of learning activities that the students need to undergo to accomplish the set learning objectives.
1.8 Develop mobile content	Online	1.9 Reviews curriculum content to produce mobile learning content		1.10 Produces mobile learning content in suitable mobile media formats.

Inquiry steps	Context	Teachers' activities	Students' activities	Output
Step 2: Exploration				
2.1 Delivery of mobile learning content	Online	2.2 Sends mobile learning content to students via mobile device	2.3 Study mobile learning content in their various location via their mobile devises	2.4 Students develop preliminary knowledge of mobile content.
2.5 Assessment of students' understanding of mobile content	Online	2.6 Sends personalized quizzes on the mobile content to students	2.7 Students answer quizzes from teacher	2.8 Teacher identifies areas in the mobile content students need clarification
2.9 Reinforcement of students' understanding and ability to apply mobile content knowledge	Online	2.10 Clarifies confusing/complex concepts of mobile content 2.13 Asks students to search for and study online content that relates to the mobile content earlier sent to them. 2.16 Encourage students to interact with their peers on the mobile content	2.11 Ask questions on confusing/complex concepts of the mobile content 2.14 Search for and study online content that relates to the mobile content sent to them by the teacher 2.17 Interact with their peers to share ideas on the mobile content	2.12 Student acquire improved understanding of mobile content 2.15 Students generates new knowledge 2.18 students help their peers to gain better understanding
Step 3: Explanation				
3.1 Refresh students' memory of mobile content	Face-to-face	3.2 Summarizes mobile content	3.3 Listen as teacher summarizes the mobile content	3.4 Teacher prepares students for class activities
3.5 Consolidation of students' understanding of mobile content	Face-to-face	3.6 Asks students questions with the view to resolves their misconceptions of concepts of mobile content	3.7 Answer questions on mobile content	3.8 Teacher facilitates students' understanding of mobile content

Inquiry steps	Context	Teachers' activities	Students' activities	Output
Step 4: Elaboration				
4.1 Generation of work-related problems	Face-to-face	4.2 Generates work-related problems with the students in line with the mobile content	4.3 Generate work-related problems with the teacher in line with the mobile content	4.4 Teacher and students establish real-life problem
4.5 Division of students into inquiry groups	Face-to-face	4.6 Divides students into heterogenous groups to reflect their knowledge backgrounds	4.7 Students identify their various inquiry groups	4.8 Students are divided into inquiry groups to promote collaboration
4.9 Presentation of work-related problems to the students	Face-to-face	4.10 Present work-related problems to each of the inquiry groups	4.11 Students interact and collaborate with their group members to analyse the problem and the mobile content	4.12 students are presented with inquiry learning tasks
4.13 Facilitation of elaborate interaction	Face-to-face	4.14 Encourages the students to analyse the problems by asking them questions 4.17 Facilitates students' knowledge of the mobile content by asking them questions	4.15 Use questions from teacher to guide their analysis of the problem 4.18 Use teacher's questioning to analyse and evaluate their knowledge of the mobile content	4.16 Students interactions are enhanced 4.19 Students' knowledge is scaffolded
4.20 Application of knowledge to a new situation	Face-to-face		4.21 Reorganize their knowledge of mobile content to resolve the problem	4.22 Apply synthesized knowledge to resolve problem

Inquiry steps	Context	Teachers' activities	Students' activities	Output
Step 5: Evaluation				
5.1 Evaluation of critical thinking skills with rubrics	Face-to-face	5.2 Assesses the students' abilities in the analysis, evaluation and synthesis of the mobile learning content in their inquiry tasks		5.3 Teacher determines the effectiveness of the instructional process
5.4 Evaluation of the inquiry learning process	Face-to-face		5.5 Assess how the inquiry learning process has enhanced their critical thinking skills.	5.6 Students determine the effectiveness of the learning process.

Criteria for assessing critical thinking skills in an inquiry-based mobile blended learning

1. Ability to separate fact-based information from inferences in the mobile content
2. Ability to analyse the mobile content and separate relevant from irrelevant information
3. Ability to relate fact-based information in the mobile content to new situations
4. Ability to identify new information that support the solutions in their inquiry activities
5. Ability to identify alternative interpretations of the content
6. Ability to reorganize relevant information to solve problem
7. Ability to reason logically in the application of content in a new situation
8. Ability to communicate ideas clearly and effectively.

The mobile context

To ensure maximum benefits from the mobile context, the following are necessary:

1. Both teachers and students must possess ICT hardware such as mobile devices
2. Teachers and students must be proficient in the manipulation of their mobile devices as teaching and learning tools respectively
3. The mobile devices must be internet enabled
4. There must be application software installed in the devices that will assist the teachers and students to deliver and access mobile instructional content respectively, example of such software can be WhatsApp, Line, Facebook messenger or any other preferred learning management system.
5. There should be a learning community of the student where students can interact and collaborate while studying the mobile instructional content.

Discussions

Below is the discussion of the findings of this study, in relation to the processes associated with the adoption of mobile-blended learning with collaborative inquiry-based learning, to enhance the critical thinking skills of undergraduates.

The online learning community was found to be one of the processes for implementing mobile-blended learning to enhance students' critical thinking skills. This is because it fosters collaborative inquiry learning among its members, leading to reconceptualization of knowledge. Antwi et al. (2019) emphasized the need to ensure collaboration in online teaching and learning, rather than studying individually. Social interaction is very important in the development of critical thinking, because as the learners share perspectives, their reasoning horizon is broadened to accommodate and further their thinking with the views of others. Studies have shown that the lack of interaction leads to failure and ultimately their withdrawal from the online platform (Astleitner, 2000; Willging & Johnson, 2009; Kintu, Zhu & Kagambe, 2017). Similarly, teachers are able to collaborate with their colleagues on issues relating to their practices that ensures effective implementation of the innovation.

The support for Teachers was found to be crucial in the implementation of blended learning. This can be in the forms of teaching assistants, technical support and exposure to successful blended learning prototypes, as well as orientation. Such forms of support could be accessed through collaboration, experienced teachers serving as mentors to beginners and the establishment of a technical support unit, to ensure smooth functionality of the devices across the entire innovation (Heaney & Walker, 2012; Gedik et al., 2013; Ma'arop & Embi, 2016). This will boost their confidence and allay any anxiety they may have in embracing the innovation. Teachers require regular training to enhance their competence on how to redesign online instruction and manipulate the learning management system proficiently (Arney, 2015; Pulham & Graham, 2018). Such training initiatives are directed towards achieving a proper blend of both components. In the work of Han, Wang & Jiang (2019) technical and teaching support were found to be among the drivers of successful blended learning in schools.

Adequate support for students is a mandatory requirement, as they are the focus of the activities with regards to the innovation. Rovai (2002) stated that when learners get support, their sense of belonging and social ties are enhanced, which in turn strengthen their participation in online learning. Support from teachers and peer are essential to encourage and sustain learners in online learning (Lee et al., 2011; Fryer & Boyee, 2018). Concluded in their various studies, that teachers' online support is necessary for the promotion of higher order thinking in students, because it is a reflection of the constructivist' approach to teaching and learning, and also guarantees their sustainability while learning (Johnson, 2017; Fryer & Boyee, 2018). Furthermore et al. (2016) observed that online peer support is very helpful for undergraduates to guarantee effective online learning. In addition, Han et al. (2019) emphasized that when challenges are detected while blended learning is being implemented, timely support is essential to sustain its effectiveness. Studies have shown that technical support is crucial to promote effective interaction with technology mediated instructional materials, because it helps to eliminate any anxiety associated with it, and closes the digital gap among students (Graham, 2004; Johnson, 2017; Cocquyt et al., 2019). Prior to implementation, the need to put in place a robust mobile-blended learning lifeline for the students cannot be overemphasized, because it helps to dispel their uneasiness and promote their confidence to leverage on the benefits provided by technology, as learning tools.

The responses of the majority of the respondents of this study indicated the need to create a mobile-blended learning innovation fund, which will serve as a source of incentives to the teachers charged with the implementation. A greater number of them agreed that incentives such as financial compensation, sponsorship for seminars and provision of mobile devices would motivate them to embrace mobile-blended learning, to enhance critical thinking abilities of their students. The provision of incentives like transport fares during face-to-face sessions and grants to participate in conferences, workshops, loans and bonuses by managements, has helped various schools, globally, to encourage the implementers of blended learning to be dedicated (Raphael & Mtebe, 2016). In addition, Porter et al. (2014) stated that many educational institutions have successfully introduced and sustained blended learning with the provision of stipends and devices to the teachers. Hall (2017) also reported other incentives associated with the use of technological tools for teaching to include additional time, technical support, sponsorship for training and other forms of compensation. The creation of mobile-blended learning innovation fund will help to facilitate the provision of these incentives to encourage the teachers towards the adoption, as well as the overall transformation of the innovation in tertiary institutions.

Teachers' online activities to enhance critical thinking, should offer students adequate preparations for classroom interactive learning, by designing mobile instructional content to meet their needs. Delivering such materials in an appropriate format for students to study in their various locations, providing online clarification regarding confusing concepts, and sending personalized quizzes to students to ascertain their understanding of the content. The out-of-class blended learning sessions should enable the learners sufficient information for problem solving in face-to-face environments. As the students study the material in text or video format, the teacher asks questions to ascertain their understanding while scaffolding their knowledge (Bishop & Verleger, 2013; Hew et al., 2016; Lo & Hew, 2017). This promotes the application of insight gained from the content and consolidates learning, to ensure sufficient preparation for interactive classroom participation.

Classroom activities such as recapping the online material to refresh the students' memories, generating real-life problems, dividing them into small groups, ensuring elaborate discussion and scaffolding their knowledge by asking logical questions were found to be associated with the enhancement of critical thinking. A succinct review of the online instructional material is necessary to resolve any misunderstanding of the content by the learners, and to explain more complex concepts (Grypp & Luebeck, 2015; Chao et al., 2015; Lai & Hwang, 2016; Lo & Hew, 2017). The exposure of learners to ill-structured problems triggers their reasoning ability, that enhances their critical thinking, while the teacher plays the role of facilitator (Smy et al., 2016; Jantakoon & Piriyasurawong, 2018; De León, 2018). Grouping students into small heterogenous teams to participate in real-life inquiry-based exercises, has been found to be among the most effective processes in developing their critical thinking abilities. The ability of a group to solve problems collaboratively, depends on the diversity of the membership in relation to their domains of knowledge and backgrounds (Edmondson & Harvey, 2017; Avdiji et al., 2018). This diversity, to a large extent, determines their level of perspective sharing and their ability to generate alternative solutions to problems. As the students are engaged in collaborative problem solving, the teacher has to ensure elaborate interaction. Engaging in social interaction with peers in real world contexts has the potential of facilitating learners' ability to reflect on previous exposure, and collaborative inquiry learning environments are critical for developing social experiences (Hwang et al., 2011; Fu & Hwang, 2018). Such social

interactions promote the development of students' critical thinking abilities that enables them to effectively transfer their knowledge across courses and apply it to unfamiliar situations. As they collaborate, effective implementation of inquiry instruction, requires teachers to appropriately scaffold tasks that will enable their students to understand how to exercise their minds, acquire step-by-step knowledge on how to resolve situations, how to collaborate with peers and how to deeply reflect on their learning (Harris & Rooks, 2010; Gillies & Nichols, 2015).

This study found that the following online activities of the students were important to prepare them sufficiently for their interactive face-to-face sessions: studying mobile instructional content from their teachers, communicating with them anytime anywhere for clarification on confusing concepts, and exchanging ideas among themselves. Searching for and studying related information and attempting online quizzes on the content from their teachers, to consolidate their learning. Moving the lecturing part of the class activities to an online platform, is to allow adequate time for face-to-face encounters which engages the learners in interactive inquiry tasks that promote the development of their critical thinking skills (Bergmann & Sam, 2014; Grypp & Luebeck, 2015; Jantakoon & Piriyasurawong, 2018). By using mobile devices, the gap between teachers and learners is eliminated as they enable teachers to offer guidance to their students that are engaging in online learning activities (Song & Siu, 2017; Wishart, 2018). Mobile learning tools motivate students to participate actively in learning, because as they collaborate with their peers, they are encouraged to share perspectives on issues relating to their learning content (Boyce et al., 2014; Ciampa, 2014; Davie, 2017). During online encounters, learners can access various online platforms that offer educational materials to consolidate their learning (Ozdamli & Cavus, 2011; Lepp et al., 2014; Mwapwele & Roodt, 2016). When teachers' follow-ups are incorporated in online learning, it enhances their students' abilities to apply what they have learnt (Szpunar et al., 2014; Jantakoon & Piriyasurawong, 2018). These activities when carried out effectively, provide an adequate background for learners to effectively participate in the face-to-face interactive sessions of blended learning.

The study revealed that students' classroom activities, such as asking questions regarding confusing concepts in the mobile content, and interacting extensively to reconceptualize new knowledge, while promoting their problem-solving abilities. Questions and answers should be an integral part of reviewing the online content at the beginning of face-to-face meetings, which enables the teacher to assess and reinforce their understanding of it (Grypp & Luebeck, 2015; Jantakoon & Piriyasurawong, 2018). When students engage in collaborative inquiry learning with peers in real world contexts, their critical thinking skills are activated to resolve unfamiliar problems (Hwang et al., 2011; Fu & Hwang, 2018). Such collaboration should be centered on adequate interactions and tasks, that will guarantee their ability to analyze, evaluate and synthesize their knowledge to solve problems.

References

Aghaee, N., & Keller, C. (2016). ICT-supported peer interaction among learners in Bachelor's and Master's thesis courses. *Computers & Education*, 94, 276–297.

Alsowat, H. (2016). An EFL flipped classroom teaching model: effects on English Language higher-order thinking skills, student engagement and satisfaction. *Journal of Education and Practice,* 7(9), 108-121.

Amador, J. A., Miles, L., & Peters, C. B. (2006). *The practice of problem-based learning: A guide to implementing PBL in the college classroom.* Bolton, MA: Anker.

Ananiadou, K., & Claro, M. (2009). *21st century skills and competences for new millennium learners in OECD countries* (OECD Education Working Papers, No. 41). OECD Publishing.

Arney, L. (2015). *Go blended! A handbook for blending technology in schools*. San Francisco, CA: Jossey-Bass.

Astleitner, H. (2000). Dropout and distance education. *A review of motivational and emotional strategies to reduce dropout in web-based distance education.* In Neuwe Medien in Unterricht, Aus-und Weiterbildung Waxmann Munster, New York.

Avdiji, H., Elikan, D., Missonier, S., & Pigneur, Y. (2018). Designing tools for collectively solving ill-structured problems. *Proceedings of the 51st Hawaii International Conference on System Sciences.* Retrieved March2, 2020, from https://scholarspace.manoa.hawaii.edu/bitstream/10125/49940/paper0053.pdf

Barnes, A. E., Boyle, H., Zuilkowski, S. S., & Bello, Z. N. (2019). Reforming teacher education in Nigeria: Laying a foundation for the future. *Teaching and Teacher Education*, 79, pp. 153-163.

Bergmann, J., & Sams, A. (2014). *Flipped learning: Gateway to student engagement*. Washington DC: International Society for Technology in Education.

Bernard, H. R., Wutich, A., & Ryan, G. W. (2016). *Analyzing qualitative data: Systematic approaches*. SAGE Publications.

Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. In *ASEE National Conference Proceedings*, Atlanta, GA.

Bloom, B., Englehart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals.* Handbook I: Cognitive domain. New York, NY: David McKay.

Boyce, C., Mishra, C., Halverson, K., & Thomas, A. (2014). Getting students outside: Using technology as a way to stimulate engagement. *Journal of Science Education and Technology,* 23(6), 815-826.

Brierton, S., Wilson, E., Kistler, M., Flowers, J., & David, J. (2016). A comparison of higher order thinking skills demonstrated in synchronous and asynchronous online college discussion posts. *NACTA Journal*, 60(1), 14-21.

Chao, C. Y., Chen, Y. T., & Chuang, K. Y. (2015). Exploring students' learning attitude and achievement in flipped learning supported computer aided design curriculum: A study in high school engineering education. *Computer Applications in Engineering Education*, 23(4), 514–526.

Ciampa, K. (2014). Learning in a mobile age: An investigation of student motivation. *Journal of Computer Assisted Learning,* 30(1), 82-96.

Clark, K. R. (2015). The effects of the flipped model of instruction on student engagement and performance in the secondary mathematics classroom. *The Journal of Educators Online,* 12(1), 91-114.

Cocquyt, C., Diep, A. N., Zhu, C., De Greef, M., & Vanwing, T. (2018) Contribution of social-constructivist and andragogical principles in blended learning to adult's social inclusion and social capital. *Andragoške studije,* 1, 47–78.

Couch, A. C. (2014). *Comparison of teaching approaches and strategies: how do the use of traditional teaching and flipped classroom teaching techniques affect the attitudes and attainment of science students in an international school in Hong Kong? University of Hong Kong* (Master thesis). Retrieved May 20, 2021, from http://dx.doi.org/10.5353/th_b5396412

Davie, S. (2017). *Mobile learning in early childhood education: A school-university partnership model* (Doctoral dissertation). Australia: University of Notre Dame Australia.

De León, L. (2018). *Learning child development through immersion in ill-structured problems using a virtual environment.* Leticia Springer International Publishing AG, Springer Nature.

Doerfert, D. L. (2011). *National research agenda: American Association for Agricultural Education's research priority areas for 2011-2015.* Texas: Texas Tech University.

Du, S., Fu, Z., & Wang, Y. (2014). The flipped classroom–advantages and challenges. *International Conference on Economic Management and Trade Cooperation* (pp. 17-20). doi:10.2991/emtc-14.2014.3

Duran, M. & Dokme, I. (2016). The effect of the inquiry-based learning approach on student's critical-thinking skills. *Eurasia Journal of Mathematics, Science & Technology Education,* 12(12), 2887-2908.

Duran, L. B., & Duran, E. (2004). The 5E instructional model: A learning cycle approach for inquiry-based science teaching. *The Science Education Review*, 3(2), 49-58.

Edmondson, A. C., & Harvey, J. F. (2017). *Cross-boundary teaming for innovation: Integrating research on teams and knowledge in organizations.* Human Resource Management.

Ferreira, M. J., Moreira, F., Pereira, C. S., & Durão, N. (2015). The role of technologies in the teaching/learning process improvement in Portugal. In *Proceedings of ICERI Conference 16th-18th November, Seville, Spain* (pp. 4600-4610). Retrieved February 5, 2021, from http://repositorio.uportu.pt/xmlui/bitstream/ handle/11328/1352/ ICERI_2015_2150_vFi nal.pdf?sequence=1

Fryer, L. K., & Bovee, H. N. (2018). Staying motivated to e-learn: Person- and variable-centred perspectives on the longitudinal risks and support. *Computers & Education*. http://doi.org/10.1016/j.compedu.2018.01.006

Fu, Q. K., & Hwang, G. J. (2018). Trends in mobile technology-supported collaborative learning: A systematic review of journal publications from 2007 to 2016. *Computers & Education*, 119, 129–143.

Gedik, N., Kiraz, E., & Ozden, Y. (2013). Design of a blended learning environment: Considerations and implementation issues. *Australasian Journal of Educational Technology*, 29(1), 1-19.

Gillies, R. M., & Nichols, K. (2015). How to support primary teachers' implementation of inquiry: eachers' reflections on teaching cooperative inquiry-based science. *Research in Science Education*, 45(2), 171–191.

Graham, C. R. (2004). Blended learning systems: definition, current trends, and future directions. C. J. & Graham, C. R. (Eds.). *Handbook of blended learning: Global Perspectives, local designs.* San Francisco, CA: Pfeiffer Publishing.

Grypp, L.& Luebeck, J. (2015). Rotating solids and flipping instruction. *Mathematics Teacher,* 109(3), 186–193.

Hall, T. (2017). Barriers and incentive to instructional technology use by high school faculty. Retrieved May 12, 2019, from https://search.proquest.com/docview/1916860112?pq-origsite=gscholar

Han, F., & Ellis, R. A. (2019). Identifying consistent patterns of quality learning discussions in blended learning. *The Internet and Higher Education,* 40, 12-19.

Han, X., Wang, Y., & Jiang, L. (2019). Towards a framework for an institution-wide quantitative assessment of teachers' online participation in blended learning implementation. *The Internet and Higher Education*, 42, 1- 12.

Harris, C., & Rooks, D. (2010). Managing inquiry-based science: challenges in enacting complex science instruction in elementary and middle school classrooms. *Journal of Science Teacher Education,* 21, 227–240.

Heaney, C. A., & Walker, N. C. (2012). The challenges and opportunities of teaching sport and exercise psychology at a distance. *Sport & Exercise Psychology Review*, 8(2), 65-71.

Herreid, C. F., & Schiller, N. A. (2013). Case studies and the flipped classroom. *J Coll Sci Teach*, 42(5), 62–66.

Hew, K. F., Huang, B., Chu, K. W. S., & Chiu, D. K. (2016). Engaging Asian students through game mechanics: Findings from two experiment studies. *Computers & Education*, 92, 221–236.

Hwang, G. J., Shi, Y. R., & Chu, H. C. (2011). A concept map approach to developing collaborative Mindtools for context-aware ubiquitous learning. *British Journal of Educational Technology,* 42(5), 778-789.

Jantakoon, T., & Piriyasurawong, P. (2018). Flipped classroom instructional model with mobile learning based on constructivist learning theory to enhance critical thinking (FCMOC MODEL). *Journal of Theoretical and Applied Information Technology,* 96(16), 5607-5614.

Johnson, C. S. (2017). Collaborative technologies, higher order thinking and self-sufficient learning: A case study of adult learners. *Research in Learning Technology*, 25, 1–17.

Keskin, S., & Yurdugül, H. (2019). Factors affecting students' preferences for online and blended learning: Motivational vs. Cognitive. *European Journal of Open, Distance and e-Learning,* 22(2), 72 – 86.

Kintu, M. J., Zhu, C., & Kagambe, E. (2017). Blended learning effectiveness: the relationship between student characteristics, design features and outcomes. *International Journal of Educational Technology in High Education,* 14(7), 1 – 20.

Lai, C. L., & Hwang, G. J. (2016). A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. *Computers & Education*, 100, 126–140.

Lau, W., & Yuen, A. (2013). Educational technology training workshops for mathematics teachers: An exploration of perception changes. *Australasian Journal of Educational Technology*, 29(1), 595-611.

Laru, J., Järvelä, S., & Clariana, R. B. (2012). Supporting collaborative inquiry during a biology field trip with mobile peer-to-peer tools for learning: a case study with K-12 learners. *Interactive Learning Environments*, 20(2), 37-41.

Lee, K. Y., & Lai, Y. C. (2017). Facilitating higher-order thinking with the flipped classroom model: a student teacher's experience in Hong Kong secondary school. *Research and Practice in Technology Enhanced Learning,* 12(8), 1-14.

Lee, S. J., Srinivasan, S., Trail, T., Lewis, D., & Lopez, S. (2011). Examining the relationship among student perception of support, course satisfaction, and learning outcomes in online learning. *Internet and Higher Education*, 14(3), 158–163.

Lepp, A., Barkley, J. E., & Karpinski, A. C. (2014). The relationship between cell phone use, academic performance, anxiety and satisfaction with life in college students. *Computer in Human Behavior*, 31, 343- 350.

Levy, P., & Petrulis, R. (2012). How do first-year university students experience inquiry and research, and what are the implications for the practice of inquiry-based learning? *Studies in Higher Education,* 37(1), 85–101.

Li, X. (2020). Students' acceptance of mobile learning: An empirical study based on blackboard mobile learn. Mobile Devices in Education: Breakthroughs in Research and Practice. DOI: 10.4018/978-1-7998-1757-4.ch022

Liu, Q., Peng, W., Zhang, F., Hu, R., Li, Y., & Yan, W. (2016). The effectiveness of blended learning in health professions: systematic review and meta-analysis. *Journal of Medical Internet Research,* 18(1), e2. doi: 10.2196/jmir.4807

Livingstone, S. (2012). Critical reflections on the benefits of ICT in education. *Oxford review of education,* 38(1), 9-24.

Lo, C. H., & Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: possible solutions and recommendations for future research. *Research and Practice in Technology Enhanced Learning*, 12(4), 1-22.

Longe, O. (2017). Graduate unemployment in Nigeria: Causes, consequences and remediable approaches. *American International Journal of Contemporary Research*, 7(4), 63-73.

Ma'arop, A. H., & Embi, M. A. (2016). Implementation of blended learning in higher learning institutions: A review of the literature. *International Education Studies*, 9(3), 41 – 52.

Mattar, J. (2018). Constructivism and connectivism in education technology: Active, situated, authentic, experiential, and anchored learning. *Revista Iberoamericana de Educación a Distancia*, 21(2), 201-217.

Mittal, N., Chaudhary, M., & Alavi, S. (2020). An evaluative framework for the most suitable theory of mobile learning. Managing Social Media Practices in the Digital Economy (pp.1-24). 10.4018/978-1-7998-2185-4.ch001.

Moyo, L., & Hadebe, L. B. (2018). The relevance of teacher education as a trajectory in developing and sustaining inclusivity in the digital classroom. *European Journal of Open Education and E-learning Studies,* 3(1), 1-17.

Mwapwele, S. D., & Roodt, S. (2016). The extent of usage of mobile devices for learning outside the classroom in a secondary school in Tanzania. *In Proceedings International Conference on Information Resources Management*, paper 65.

Nederveld, A., & Berge, Z. L. (2015). Flipped learning in the workplace. *J Work Learn,* 27(2), 162–172.

Obari, H., & Lambacher, S. (2015). Successful EFL teaching using mobile technologies in a flipped classroom. In F. Helm, L. Bradley, M. Guarda, & S. Thouësny (Eds.), *Critical CALL – Proceedings of the 2015 EUROCALL Conference, Padova, Italy* (pp. 433-438). Dublin: Research-publishing.net.

Ozdamli, F., & Cavus, N. (2011). Basic elements and characteristics of mobile learning. *Procedia - Social and Behavioral Sciences*, 28, 937– 942. http://doi.org/10.1016/j.sbspro.2011.11.173,

Porter, W. W., Graham, C. R., Spring, K. A., & Welch, K. R. (2014). Blended learning in higher education: Institutional adoption and implementation. *Computers & Education*, 75, 185–195.

Prince, M., & Felder, R. (2006). Inductive teaching and learning methods: definitions, comparisons, and research bases. *Journal of Engineering Education,* 2, 123–138.

Pulham, E., & Graham, C. R. (2018). Comparing K-12 online and blended teaching competencies: A literature review. *Distance Education,* 39(3), 411–432.

Raphael, C., & Mtebe, J. S. (2016). Instructor support services: An inevitable critical success factor in blended learning in higher education in Tanzania. *International Journal of Education and Development using Information and Communication Technology* (IJEDICT), 12(2), 123-138.

Rimini, M., & Spiezia, V. (2016). Skills for a digital world: Background report 2016 Ministerial Meeting on the digital economy. Paris: OECD.

Roehl, A., Reddy, S. L., & Shannon, G. J. (2013). The flipped classroom: an opportunity to engage millennial students through active learning strategies. *Journal of Family and Consumer Sciences*, 105(2), 44-49.

Rovai, A. P. (2002). Building sense of community at a distance. *The International Review of Research in Open and Distributed Learning*, 3(1). https://www.learntechlib.org/p/49515/

Saitta, E., Morrison, B., Waldrop, J., & Bowdon, M. (2016). Introduction: joining the flipped classroom conversation. In J. Waldrop & M. Bowdon (Eds.), Best practices for flipping the college classroom (1-16). New York: Routledge.

Sam, N. (2019). The 5 E's of Inquiry-Based Learning. *Journal of the American Association of School Librarians.* Retrieved from https://knowledgequest.aasl.org/the-5-es-of-inquiry-based-learning/

Seranica, C., Purwoko, A. A., & Aliefman, H. (2018). Influence of guided inquiry learning model to critical thinking skills. *Journal of Research & Method in Education,* 8(1), 28-31.

Shrain, K. (2012). Moving towards e-learning paradigm: Readiness of higher education instructors in Palestine. *International Journal on E-Learning,* 11(4), 441–463.

Slavin, R. E. (2014). Cooperative learning and academic achievement: Why does groupwork work? *Anales de Psicología/Annals of Psychology*, 30(3), 785-791.

Smy, V., Cahillane, M., & MacLean, P. (2016). Sensemaking and metacognitive prompting in ill-structured problems. *International Journal of Information and Learning Technology,* 33(3), 186 -199.

Song, Y., & Siu, C. K. (2017). Affordances and constraints of BYOD (Bring Your Own Device) for learning and teaching in higher education: Teachers' perspectives. *The Internet and Higher Education*, 32(1), 39-46.

Stockwell, E. R., Stockwell, M., Cennamo, M., & Jang, E. (2015). Blended Learning Improves Science Education. *Cell,* 162(5), 933-936.

Szpunar, K. K., Jing, H. G., & Schacter, D. L. (2014). Overcoming overconfidence in learning from video-recorded lectures: Implications of interpolated testing for online education. *Journal of Applied Research in Memory and Cognition*, 3(3), 161–164.

Talley, C. P., & Scherer S. (2013). The enhanced flipped classroom: Increasing academic performance with student-recorded lectures and practice testing in a "flipped" STEM course. *The Journal of Negro Education,* 82(3), 339-347.

Thomas, A., & Thorne, G. (2009). How to Increase Higher Order Thinking. Los Angeles: Center for Development and Learning.

Vaughan, M. (2014). Flipping the learning: An investigation into the use of the flipped classroom model in an introductory teaching course. *Education Research and Perspectives*, 41, 25-41.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge: Harvard University Press.

Wallace, A. (2014). Social Learning Platforms and the Flipped Classroom. *International Journal of Information and Education Technology,* 4(4), 293-296. http://dx.doi.org/10.1109/ICeLeTE.2013.6644373

Willging, P. A., & Johnson, S. D. (2009). Factors that influence students' decision to drop-out of online courses. *Journal of Asynchronous Learning Networks,* 13(3), 115–127.

Wishart, J. M. (2018). Ethical considerations in the incorporation of mobile and ubiquitous technologies into teaching and learning in educational contexts. Retrieved from https://www.researchgate.net/publication/321150203

Woltering, V., Herrler, A., Spitzer, K., & Spreckeisen, C. (2009). Blended learning positively affects students' satisfaction and the role of the tutor in the problem-based learning process: results of a mixed-method evaluation. *Advancement in Health Science Education*, 14, 725–738.

Wu, J., Tennyson, R. D., & Hsia, T. L. (2010). A study of student satisfaction in a blended e-learning system environment. *Computer & Education,* 55, 155–164.

Zohar, A., & Cohen, A. (2016). Large scale implementation of higher order thinking (HOT) in civic education: The interplay of policy, politics, pedagogical leadership and detailed pedagogical planning. *Thinking Skills and Creativity*, 21, 85–96.