# EVALUATION OF UBIQUITOUS COLLABORATIVE MOBILE LEARNING (UCML) MODEL: A FLEXIBLE INSTRUCTIONAL DESIGN PRINCIPLE FOR MOBILE INSTRUCTIONAL CONTENT DELIVERY

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**Abstract**
*The world of instructional delivery is experiencing transformation driven by the pervasiveness of mobile device and wireless communication technologies. The soul mate of responsive design considers scenario for instructional content with regard to the configuration and operation-ability of the adopted technological devices. The world of mobile technologies and wireless computing is presenting a challenge to fully explore the mobile internet and enhance it as a learning tool. This study was a designed-based quasi-experimental that set out to evolve a ubiquitous collaborative mobile learning (UCML) instructional design model. It involves the synergy of three different models to constitute a whole. The UCML model was used to design an instructional content for a mobile learning experience and experts (16) and students (18) conducted experimental validation. Purposive sampling technique was adopted for sample selection and researcher-designed questionnaire was used to sample all respondents. Three research questions were raised and answered using mean and standard deviation. The instrument had a coefficient of 0.96 and 0.72 using Cronbach Alpha for the instruments respectively. The result showed that the UCML instructional design model addressed the issues of interactivity, screen interface and feedback mechanism in a collaborative approach to online instructional delivery through mobile learning platform on the principle of bring your device (BYOD). Therefore, it was concluded that the UCML design model was appropriately evolved based on the instructional design principle.*

**Keyword:** Ubiquitous, Mobile Learning, Collaboration, Instructional Design, Instructional Design Model

## Introduction

The prevalence of mobile devices among citizens of the world has contributed immensely and changed the communication pattern. Hence, the education industry is not left out in engaging mobile devices for the day-to-day activities in the process of instructional delivery. Alsadi and AbuShawar (2009) stated that mobile devices enable educators to deliver materials to students based on their needs and preferences. Mobile devices used for education purpose via wireless communication can provide opportunity to transmit instructions in a learning environment where teachers and student are separated

by time or space or both, wherein the teacher provides course content through course management applications, multimedia resources, the internet, videoconferencing and so on. According to Evans (2009), mobile learning builds on the advantages offered by electronic learning by allowing learners to learn when and where they choose and expanding those advantages to a mobile platform user who carries it with them for learning on-the-move. Park (2011) defines mobile learning as using mobile devices for learning on the move across contexts. Traxler (2007) expresses the view that mobile learning is based on the principles and practices of technology-enhanced learning as well as other learning principles used in the classroom and community. Mobile learning was defined by Barbosa, Reinhard, Saccol and Schlemmer (2010) as a teaching and learning supported by mobile and wireless information technologies and involving the mobility of human subjects far from formal educational spaces or work places.

Cronje and El-Hussein (2010) extend the aspect of learning contexts in a more thought-provoking definition of mobile learning for the needs of instructional designers. They include not just the mobility of the technology and learner, but also the mobility of the learning, which allows for the context of the learning to be highly individualized. As mobile content consumption continues to rise, educators need to be prepared to deliver training to mobile learners (Park, 2011). Also, with the increasing prevalence of mobile learning, educators and instructional designers need to account for the increasingly personal context of education (Cronje & El-Hussein 2010). A new teaching and learning concept is fostering, and a new instructional design model is needed to facilitate mobile teaching and learning in education (Shih, 2005). The goal of instructional design is to help the teaching and learning process by ensuring that education experiences are optimized for learning goals, especially when different mix of media are used (Nichols, 2007). Some researchers argued that mobile learning will require a new approach for both teaching and learning (Ozdamli, 2011). As such, educators and instructional designers face a challenge of determining how to use these powerful new tools in learning applications (Cronje & El-Hussein, 2010).

To effectively support mobile learning, instructional principles must be identified, which is pedagogically sound and will address the mobile learning context in terms of usability (Gu, Gu, & Lafferty, 2011). Therefore, a set of instructional principles and design model is necessary in order to apply it to learning possibilities on mobile devices that allows for ability to take training whenever, wherever and have access to 'just-in-time' learning opportunity (Evans, 2009). Current instructional design models and methods were developed to design instruction for delivery on personal desktop computers that have large screens (Ally, 2005). According to Cronje and El-Hussein (2010), students learning via mobile delivery are not only remote from their instructor, they can fully control the information they choose to interact with on their device.

However, there is a trend towards the use of mobile devices to deliver learning materials, and for students to learn anytime and anywhere. The use of mobile devices for learning has implications regarding how learning materials are designed using learning theories and instructional design principles (Dillard, 2012). Meanwhile, Sharples, Taylor and Vavoula (2010) submitted that mobile device ownership is expanding, and mobile device capabilities are expanding to include features such as cameras, media players, and other functions previously only supported on multimedia computers. Learning using the support of mobile devices can also allow learners to use a single device which can be moved between classrooms and in contexts outside of education (Quinn, 2011). It was further asserted by Bruns, Cobcroft, Smith and Towers (2006) that mobile instructional design principles must account for how to use learning activities to engage learners, acknowledge the learning context, challenge learners, and provide opportunities for practice in order to contribute to quality learning experiences.

By considering learners' creative, collaborative, communicative and critical engagement, a framework for mobile learning can provide meaningful insight into a mobile learner's achievement of knowledge (Dillard, 2012). Muyinda (2007) posited that mobile learning instructional design models must take into account the ubiquitous use of personal and shared technology. It is therefore important to have an operational understanding of the context in developing a user interface that is both useful and flexible (Uden, 2007). A set of mobile learning instructional design principles which enable the development of mobile learning that is usable, effective, and has a high level of learner satisfaction is of paramount importance (Kukulska-Hulme, Pachler &Vavoula, 2009). According to Park (2011),

instructional designers need to learn about the concepts of mobile learning and how mobile technologies can be incorporated into their teaching and learning more effectively.

In the submission of Cagiltay, Gedik, Hanci-Karademirci and Kursun (2012), mobile instruction was designed to help students review the content and practice sample questions via their cellular phones in which it will be appropriate when it contains multimedia components rather than just text, and also when the instruction is spread out over time. With reference to the fore statement, it can be concluded that instructional design team needs to consult with and receive help from the subject matter expert on content, duration, scheduling, and any changes to face-to-face instruction in order for mobile learning to be effective and add value. Through designing an easy to navigate interface and increasing the use of multimedia over textual display, a much higher rate of efficiency will be achieved through a mobile platform (Haag, 2011). In this context, Arnedillo-Sánchez, Milrad, Sharples, and Vavoula, (2009) suggested reason to understand how people learn through mobile, pervasive, lifelong interaction of technology via understanding the implications of learning with mobile technology by accurately adopting a design model that will address all pertinent considerations or issues.

If mobile learning is not applicable and designed to match the needs of the learner, the learner can choose not to interact with it (Cronje & El-Hussein, 2010). The idea of ability to use mobile devices for learning while engaging in an ongoing task in a physical environment may enhance sense-making process by enabling students to step in and out of the tasks and reflect on these transitions (Connelly, Hazlewood, Rogers & Tedesco, 2009). Additionally, the quality of the interactions will also be guided by how comfortable the instructor is able to map-out strategies for guiding a discussion that integrates the information available on the digital device. In the explanation of Cronje and El-Hussein (2010), instructional designers often continued not to adapt their designs to consider the entire context in which a learner will use a particular mobile learning program, but instead, borrow ideas from their e-learning experiences which do not always translate well to mobile delivery. Mobile learning is not about repurposing laptop e-learning, so it fits on a smaller device which contains instructional contents that is concise, short burst of learning and performance support.

Also, designers and practitioners of education should clarify the design paradigm shifts that this mode of delivery has introduced into the world of practice in order to ensure mobile learning is effective and efficient and the continuing needs of their students are being met (Dillard, 2012). In ensuring mobile learning effectiveness and efficiency in consonant with students' needs, evaluation of the content-user interface and other associating parameters is pertinent in the assessment system to meet the changing demands of quality assurance and quality improvement for learning resources as argued to by Leacock and Nesbit (2007). However, Liu and Johnson (2005) are of the opinion that the accelerating quantity and complexity of online resources is focusing attention on the inconsistent in instructional content quality evaluation.

Evaluation instruments designed specifically for smaller digital resources are needed for three reasons; (a) the design of multimedia learning materials is frequently not informed by relevant research in psychology and education, (b) to mitigate the search problem and finally, (c) the quality criteria for evaluations have the potential to drive improvements in design practice (Leacock & Nesbit, 2007; Vargo, Nesbit, Belfer, & Archambault, 2003; Shavinina & Loarer, 1999). These three major reasons can result in easy access to many ready-made learning objectives of high quality, and making the process of shifting through repositories or the web to find high-quality resources less time-consuming. The efficacy of this technique could be directly dependent on the validity of the evaluation tool used to generate the quality ratings. However, in the explanation of Shelton (2011), evaluating quality standard in online learning is a complex and difficult concept that depends on a range of factors arising from the student's interaction, the context of curriculum, the instructional design approach and technology used for the delivery of online instruction. Shelton and Saltsman (2004) postulated that the mark of quality for an online education program is not its growth rate but the combination of retention rate, academic outcomes, and success in online student and instructor's support.

Few experienced evaluators, however, pick one model and adhere to it for all of their works; they are more likely to draw upon different aspects of several models (Owston, 2008). Each evaluation models presents a specific direction in evaluating quality of technology and instructional content as the case may be. Meanwhile, Bates (1995) ACTIONS model of quality online instructional content is specifically developed to evaluate instructional technologies in education (Access and flexibility, Costs, Teaching and learning, Interactivity and User-friendliness, Organizational Issues, Novelty, and Speed

are the stages). This model was designed to help with the selection of instructional technologies for delivery of instructional content and it was one of the first to address cost factors which affect both the institution and the student. Students, through mobile learning platform, can work together on a task, exchange their views, experiences, opinions, discuss and negotiate strategies, actions and results (Vasiliou & Economides, 2007).

These actions can provide students with opportunity to assist, explain, teach, understand, review and influence each other. By developing a learning community, it could also provide the opportunity to combine the special abilities of everyone to achieve a common goal in a collaborative means. In the submission of Vasiliou and Economides (2007), collaborative learning is a student-centered, task-based, activity-based learning approach that provides several advantages to the student. It can assists the student to enhance the skills of communication, interpersonal social relationship, cooperation of sharing and caring, openness, flexibility, adaptability, knowledge retention, higher-order of critical thinking, creativity, management, practicality, responsibility, trustworthiness of dependability, involvement, engagement of participation, commitment of persistency, motivation, confidence and self-efficacy. Meanwhile, it is an educational method in which students work together in small groups towards a common goal (Dillenbourg, Baker, Blaye & O'Malley, 1996; Hafner & Ellis, 2004).

Groups in collaborative learning techniques are dynamic in the context of activities engagement as identified by Cerbin (2010). In a training workshop organized in the Center for Advancing Teaching and Learningin 2010 at the University of Wincousin, five major collaborative learning echniques were identified; think-pair-share (TPS), reciprocal teaching (RT), think-aloud pair problem solving (TAPPS), group grid (GG) and group writing assignments (GWA). Each of the identified collaborative group aforementioned has their dynamics and extent of collaboration mode. Understanding online group dynamics present excellent effective collaborative activities (Dooly, 2008). According to Salmon (2000), online model provide an excellent group collaborative association with incorporation of five phases; access and motivation, online socialization, information exchange, knowledge construction and construction. This model can provide exceptional opportunity for effective communication within and among the various groups taking part in a ubiquitous collaborative mobile learning environment.

The instructor's cognitive, managerial skill and social presence play a vital role in relation to the learning progression where learners collectively engage in learning process. The extent of learning engagement through mental exercise, management of learning process and duration of social presence by students within the groups leads to the learning outcome (Jahng, Chan & Nielsen, 2010). This is measure via the knowledge construction, the quality of the task given and the course mark or score. In this perspective, level of interaction and communication when analyzed display the quality, quantity and share/transfer of knowledge for effective and efficient collaborative learning (Jahng, Chan and Nielsen, 2010). Hence, this study investigated the evolvement of Ubiquitous Collaborative Mobile Learning Model for the design and development of instructional content for mobile learning environment with reference to interactivity, screen design and appropriate feedback.

**Research Question**

The following are the research questions in which answers were sorted for in the experimental validation exercise:

1. Does the design principle of UCML address interactivity in a mobile learning environment?
2. Does the design principle of UCML address screen design for mobile learning environment?
3. Does the design principle of UCML provide appropriate feedbacks for a mobile learning environment?

**Methodology**

This study is a design-based research involving the experimental validation of a ubiquitous collaborative mobile learning model. The design and development principle were conducted in compliance with the Ubiquitous Collaborative Mobile Learning (UCML) Model evolved from the synchronization of four different models. The models were important in one way or the other for a complete mobile learning experience. The synchronized four models are SMSE by Shih (2005), ADDIE, Salmon online collaborative model and Bates (1995) evaluation models. The experimental validation took two forms; student and expert's validation. The validation was conducted through the adoption of UCML model for the design of the instructional content for the ubiquitous mobile learning

environment. The student samples consisted of 18 senior secondary school two (SSS II) of Nigerian educational system. The students were exposed to the mobile learning instructional content designed and developed based on UCML guidelines through the principle of BYOD (bring your own device). Samples were exposed to the treatment (textual and animated videos) for three weeks. In addition, 16 experts were also exposed to the mobile learning instructional content in practical terms as the students.

The expert validators were made up of five educational technologists, six subject matter teachers, three graphic designers and two web designers. A researcher-designed questionnaire was used to gather responses from both categories of validators and the response mode for the validators is a rating scale ranging from 0-5. The questionnaire was subjected to validation exercise with a reliability test conducted using Cronbach Alpha Reliability Coefficient which yielded 0.93 implying that the instrument is reliable. Mean was used to answer research questions and t-test was employed to analyze the hypothesis raised.

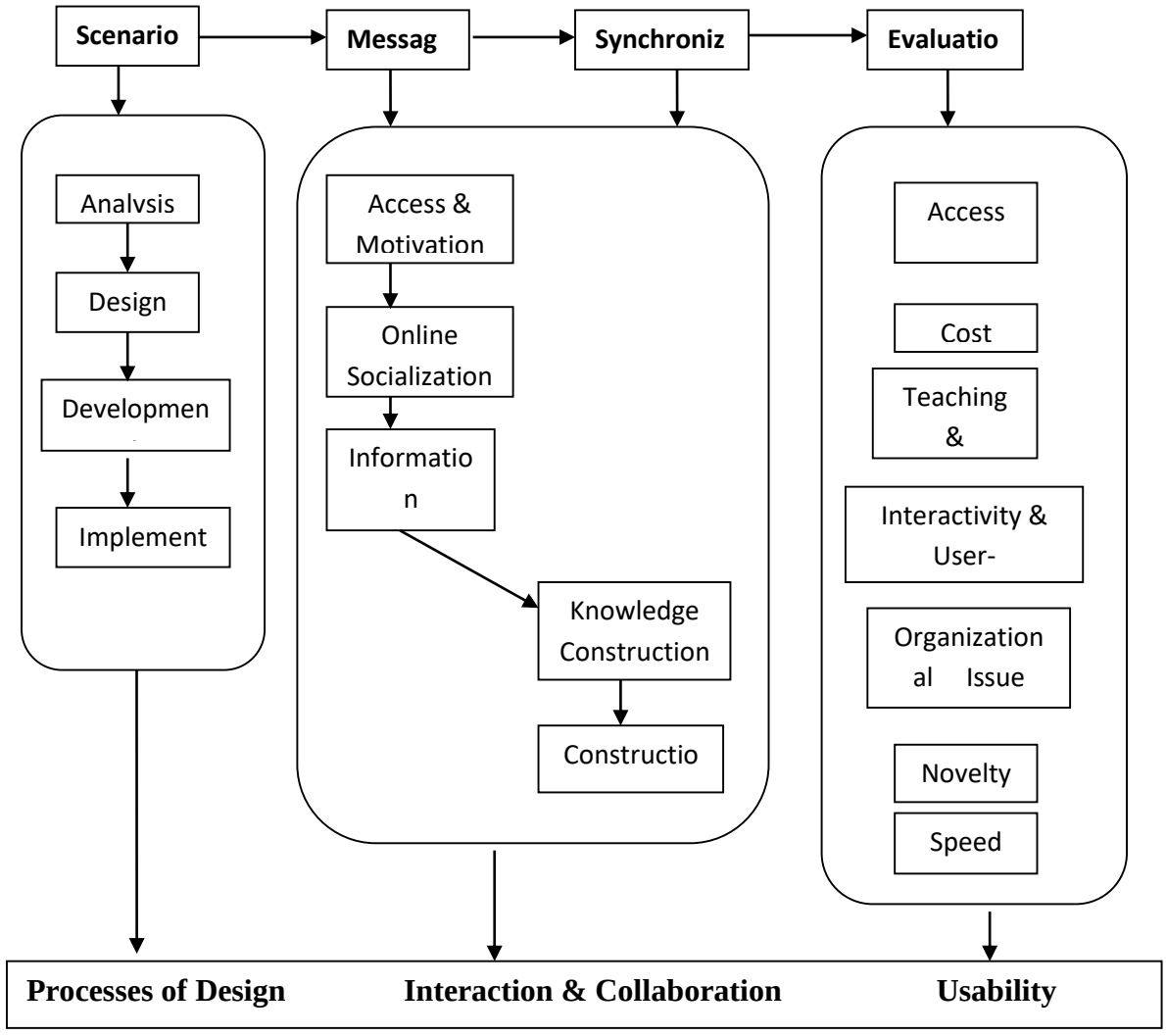


Figure 1: Ubiquitous Collaborative Learning Model (UCMLM)

## Results

**Research Question 1: Does the design principle of UCML address interactivity in a mobile learning environment?**

Table 1:
Ratings of Expert and Student's Validation of User Interactivity Component of UCMLM

| | User's Interactivity | Ratings | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | M | SD |
| 1 | The interactivity mode is appropriate for the maturity level of the students in a collaborative mobile learning environment | -- | -- | 02 | 13 | 19 | 4.5 | 0.62 |
| 2 | The window environment provides adequate opportunity for interaction in a collaborative mobile learning environment | -- | -- | 07 | 18 | 09 | 4.1 | 0.69 |
| 3 | The content is chunked into small segments in compliance with mobile learning etiquette | -- | -- | 09 | 11 | 14 | 4.1 | 0.82 |
| 4 | The groupings prompt students to collaborate effectively for knowledge construction | -- | -- | -- | 18 | 16 | 4.5 | 0.51 |
| 5 | The window environment allows learners to discover information through active exploration and participative collaboration | -- | -- | 04 | 19 | 11 | 4.2 | 0.64 |
| 6 | The "ask your tutor link" serves as help key to get procedural information | -- | -- | -- | 28 | 06 | 4.2 | 0.39 |
| 7 | Content map key for seeing a list of options available | -- | -- | 02 | 21 | 11 | 4.3 | 0.57 |
| 8 | Menu key for returning to the main page is appropriate | -- | -- | 01 | 26 | 07 | 4.2 | 0.46 |
| 9 | Quit key, for exiting the program is appropriate | -- | 06 | 09 | 18 | 01 | 3.4 | 0.82 |
| 10 | Comment key for recording a learner's comment is appropriate | -- | -- | 06 | 23 | 05 | 4.0 | 0.58 |
| 11 | The notification page is appropriate to link current task | -- | -- | -- | 21 | 13 | 4.0 | 0.58 |

The average mean for user interactivity component of UCMLM is 4.1 which serve as the benchmark. Therefore, it could be concluded that the design principle in the UCMLM addresses user interactivity for a mobile learning environment. This could be deduced from the mean of ratings as majority exceeds the benchmark (4.1) with exception of items 9, 10 and 11. In conclusion, it is an expressive opinion of the validators that the UCMLM design principle supports user interactivity in a mobile learning environment.

**Research Question 2: Does the design principle of UCML address screen interface design for mobile learning environment?**

Table 2:

Ratings of Expert and Student's Validation of Screen Interface Component of UCMLM

| | Screen Interface | Ratings | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | M | SD |
| 1 | Screens are designed in a clear and understandable manner | -- | -- | 11 | 21 | 02 | 3.7 | 0.57 |
| 2 | The design does not overload student's memory | -- | -- | 09 | 12 | 13 | 4.1 | 0.51 |
| 3 | The use of space is according to the principles of screen design | -- | -- | 11 | 13 | 10 | 4.0 | 0.80 |
| 4 | The design uses proper fonts in terms of style and size | -- | -- | -- | 19 | 15 | 4.4 | 0.50 |
| 5 | The use of text follows the principles of readability | -- | -- | -- | 17 | 17 | 4.5 | 0.51 |
| 6 | The colour of the text follows the principles of readability | -- | -- | -- | -- | 34 | 5.0 | 0.00 |
| 7 | There is consistency in the functional use of colours | -- | -- | -- | -- | 34 | 5.0 | 0.00 |
| 8 | The quality of the text, images, graphics and video links is good | -- | -- | -- | 21 | 13 | 4.4 | 0.50 |
| 9 | Presented pictures are relevant to the information included in the text | -- | -- | 05 | 18 | 11 | 4.2 | 0.67 |
| 10 | The use of graphics supports meaningfully the text provided | --- | -- | 08 | 21 | 05 | 3.9 | 0.62 |
| 11 | A high contrast between graphics and background is retained. | -- | 04 | 09 | 10 | 11 | 3.8 | 1.03 |
| 12 | The mobile learning web can be used for cross-platforms | -- | -- | -- | 11 | 23 | 4.7 | 0.47 |

The average mean for screen interface component of UCMLM is 4.2 which serve as the benchmark. Therefore, it could be concluded that the design principle in the UCMLM addresses screen interface for a mobile learning environment. This could be deduced from the mean of ratings as majority exceeds the benchmark (4.2). In conclusion, it is an expressive opinion of the validators that the UCMLM design principle supports screen interface in a mobile learning environment.

**Research Question 3: Does the design principle of UCML provide appropriate user's feedback mechanism for a mobile learning environment?**

Table 3:
Ratings of Expert and Student's Validation of User Feedback Mechanism Component of UCMLM

| User Feedback Mechanism | Ratings | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | M | SD |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | The window environment provides feedback immediately after a response | -- | -- | -- | 11 | 23 | 4.7 | 0.47 |
| 2 | The window environment provides feedback to verify the correctness of a response | -- | -- | -- | 19 | 15 | 4.4 | 0.50 |
| 3 | For incorrect responses, information is given to the student about how to correct their answers, or hints to try again | -- | -- | -- | 18 | 16 | 4.5 | 0.51 |
| 4 | Documentation exist regarding technical requirements for students' need | -- | -- | 09 | 11 | 14 | 4.1 | 0.82 |
| 5 | The updating, modifying and adding procedures are relatively easy for an average user | -- | -- | 06 | 23 | 05 | 4.0 | 0.58 |
| 6 | The wiki chat medium provides appropriate feeds among students and instructors | -- | -- | -- | 17 | 17 | 4.5 | 0.51 |
| 7 | The admin window environment is appropriate and adequate | -- | -- | -- | -- | 34 | 5.0 | 0.00 |

The average mean for user feedback mechanism component of UCMLM is 4.4 which serve as the benchmark. Therefore, it could be concluded that the design principle in the UCMLM addresses user feedback mechanism for a mobile learning environment. This could be deduced from the mean of ratings as majority exceeds the benchmark (4.4). In conclusion, it is an expressive opinion of the validators that the UCMLM design principle supports user feedback mechanism in a mobile learning environment.

**Discussion and Recommendation**

The design of instructional content for mobile learning environment requires simplicity in term of the screen interface, user interactivity and feedback mechanism. In the submission of Gu, Gu, and Lafferty (2011), to effectively support mobile learning, instructional principles must be identified, which is pedagogically sound and will address the mobile learning context in terms of usability. From the results analyzed, it was revealed that the UCML design principle addressed the user interactivity. Furthermore, Bruns, Cobcroft, Smith and Towers (2006) assert that mobile instructional design principles should account for the process of using learning activities to engage learners, acknowledge the learning context, challenge learners, and provide opportunities for practice in order to contribute to quality learning experiences. The finding of this study shows that the design principle of UCML addresses the screen interface for effective mobile learning environment. This was corroborated by Leacock and Nesbit (2007) that in order to ensure mobile learning effectiveness and efficiency in consonant with students' needs, content-user interface and other associating parameters is pertinent in meeting the changing demands of quality assurance and quality improvement for learning resources.

Finally, it was revealed that the design principle as well addressed the user feedback mechanism, which was evident in the result displayed in Table 3. Mobile learning instructional design models must take into account the ubiquitous use of personal and shared technology in order to have an operational understanding of the context in developing a user interface that is both useful and flexible (Muyinda, 2007; Uden, 2007). In addition, Kukulska-Hulme, Pachler and Vavoula (2009) is of the opinion that a set of mobile learning instructional design principles which enable the development of mobile learning that is usable, effective, and has a high level of learner satisfaction is of paramount importance. Hence, conclusively, the design principle of UCML addressed the issues of user interactivity, screen interface and user feedback mechanism. Based on the discussion, the following is recommended:

1. UCMLM can be used to design the interactivity level of users in a mobile learning environment.
2. UCMLM can be used to design the screen interface of a mobile learning environment for users for learning purpose.
3. UCMLM can be used to design the feedback mechanism for users in a mobile learning environment.

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