

## U-Learning – The Design and Evaluation of Evocative Learning based Method for Futuristic Ubiquitous Educational Learning Environment

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### Abstract

Technology has travelled a long way from an analogue world to a digital age, where our interaction in the virtual world is leading us towards virtual reality. Ubiquitous learning (UL) can be considered as a pattern in erudition grounded on ubiquitous latest technologies usage through smart devices. The research has gaged the level of awareness of ubiquitous learning and analyzed the contribution of various factors that are responsible for the rate of adoption of UL. The outcome of this research has led to coming up with a framework which if applied in any academic setup will lead to the effective delivery of the futuristic ubiquitous educational learning environment.

Keyword: Ubiquitous Learning, Learning environment, Mobile Learning, Ubiquitous Technologies.

### Introduction

A latest drift in the information and communication technology world is the Ubiquitous learning. This educational revolution owes its birth to the penetration of many smart devices, which have enormous computational and communication capabilities. Information, communication and computing technologies are considered as the main technologies which are leading towards UL. In recent years, with the development and implementation of ubiquitous technology, ubiquitous learning combined with tiny ubiquitous computing devices has provided great educational effect for users (Ye, Jing, & Cheng, 2008).

The advancements in computing technologies in combination with “always connected” digital world is supporting the expansion of ubiquitous learning. This has led to the procedure of learning from environment much easier. Ubiquitous world is leading the process of sharing of information to take place in a natural way, systematically with consistency and continuity. According to (Ogata, Li, Hou, & Uosaki, 2011), based on (Chen, Kao, Sheu, & Chiang, 2002), the key features of UL are permanency, immediacy, accessibility, placing of instructional happenings, adaptability and interactivity.

UL is a new and dynamic learning approach, which is an extension of the conventional learning methods. It has become possible because people can now afford the use of digital media. The ubiquitous learning advent has created novel environments for educationalists, trainers, students and education professionals. The heart of this approach is not based on technical specifications or logic of the smart devices, but it is based on entirely innovative ways as to how the knowledge is formed, kept, distributed and retrieved. A new educational pattern has begun to arise which is steering us to take a principal role to innovative technologies. The environment of UL is providing an interoperable, pervasive, and seamless learning architecture to connect, integrate, and share learning collaborators, learning contents, and learning services (Yang, 2006). It provides right learning collaborators, services and contents all at right time and at the right place. As the effectiveness and efficiency of UL heavily depends on learners’ surrounding context, hence it requires context models and contextual acquisition mechanisms for runtime information accumulation (Yang, 2006).

“Mobile phones and social media specifically act as edge crossing tools: such that the learners used these tools to produce multimodal illustrations that reflects the identities and experiences, hence to share it across their non-digital and digital social networks” (Monteiro, SandroGomes, & Neto, 2016). UL also involves learning analytics, a technique that was developed in the last few years to effectively utilize the huge volume of knowledge. Hence proving its usefulness; in supporting advanced learning initiatives. A significant feature is learner’s mobility and the learning analytics usage potential advantage to augment ubiquitous learning experience.

Ubiquitous Learning also involves keeping digital records. It allows them to record their activities on the social media and to share the knowledge. By the use of specific tools, one can concentrate on focused quizzes and find answers to the specific queries. Ubiquitous learning is significantly attracting interest, especially in relation to its applications in the academic settings.

Although, as per empirical evidence, broad applications of ubiquitous learning are limited at

present, however by utilizing the access to digital platforms, enrichment of traditional educational learning's is just around the corner. In future, will see different types of learning technologies adapted which will lead to a paradigm shift from old-style learning systems to ubiquitous methods of learning based on high technology.

## Literature Review

The ubiquitous learning (u-learning) implementation is a better opportunity in order to address the quality, accessibility, and affordability issues present in higher education sector in many countries (Subiyakto, Hidayah, Gusti, & Hikami, 2019). Mobile learning systems strengthen communication, time management, interaction among learners and content delivery in accord with the learners need. Time and place independence and personalization opportunity features of mobile technologies take learners' attention more (Gokben & Yakin, 2014).

In 2018, the total no of cell phone subscriptions has crossed more than ten billion subscribers (ITU, 2018). (Alhassan, 2016) contends that the highest m-learning added value is dependent on classroom interacting features to the other situations by using the network communication; (Pimmer, Mateescu, & Gröhhbiel, 2016) talks about connecting of digital mobile media with the increasing access for the traditional forms of higher education enrichment.

Search in Virtual and Study in Real: A Ubiquitous Query/Answer System developed by (Jing, Cheng, & Huang., 2017) uses digital objects in the ubiquitous environment providing learner an ability to acquire from more wide-ranging learning innards which include both real and virtual contents. They have discussed about the query/answer system of ubiquitous architecture with the ability to search and offer learning contents that can be real or virtual. They have come up with a matching algorithm to achieve the proposed solution. Need exists for learner-centric approach and prospects to take care of today's requirements thus raising scope of m-learning (Irby & Strong, 2015).

A method of learning where learner effectively begins to learn anywhere and anytime is termed as Ubiquitous learning (UL) (Keengwe, 2015). UL is based on learning platform, which is structured by Ubiquitous Computing Technology. UL environment is the integration of abstract resources as physical gadgets, humans, places, info-space etc. In other words, a mechanism in which at anytime, anywhere, by using any device anyone can have access to that mechanism

is called UL environment. (Aljohani & Davis, Learning Analytics in Mobile and Ubiquitous Learning Environments, 2012) Define the learning analytical techniques using advantages to boost mobile and ubiquitous learning situations from a hypothetical perception. It has come up with a mobile / ubiquitous learning probing model to examine data for mobile learners.

Using the appropriate data, one can augment exchanges between mobile devices, learning environments and the learners. The UL applications retrieve the contextual data about the learners, hence improving the learners and mobile devices interaction. The material for learning is provided which is based on collected contextual information. The specific contextual data is retrieved to facilitate the interaction using the mobile devices (Aljohani, Davis, & Loke, A comparison between mobile and ubiquitous learning from the perspective of human-computer interaction, 2012). The collection of the contextual data is of great significance in making learners more focused on vital tasks to allow saving of time. Mobile equipment's are considered as the latest technological tools that have changed/alterd the socio-cultural fabric and norms of the society in all the spheres of life (Pachler, Seipold, & Bachmair, 2015).

(Ogata, Li, Hou, & Uosaki, 2011) Have talked about computer braced ubiquitous learning by apprehending what the learners learn with the relative data. It proposes SCROLL, a logging system for ubiquitous learning. It assists learners for recording of their learning practices by using, audios, videos, photos tags, location, codes and sensor data.

In past few years' Mobile technology penetrated at an extraordinary rate. (Park, Nam, & Cha, 2011) Contended m-learning to be relatively an innovative topic of research and its efficacy has yet not been entirely explored. "Ubiquitous computing evolution catalyzed because of wireless telecommunications advances, open networking, computing control increase, enhanced battery capacity, and cropping up of flexibility of architecture of software" (Lyytinen & Yoo, 2002). This has led to UL to let embed, in our daily lives, specific learning activities.

The definition and characteristics of ubiquitous learning: A discussion by (Yahya, Ahmad, & Jalil, 2010) describes new learning paradigm that is reinforced by technologies in ubiquitous computing. It provides fundamental information related to u-learning. Comparison of characteristics and definition of u-learning is also discussed to propose an irrefutable u-learning definition altogether.

In Effecting E-Learning with U-Learning Technology in Nigerian Educational System, (Boyinbode & Akintola, 2009) talk about learner centered paradigms through the use of communication and computing mechanisms and discusses the use of ubiquitous learning in the Nigerian educational system in order to improve the e-learning initiative.

As narrated by (Hwang, Tsai, & Yang, 2008), no obvious definition exists of UL because of the speedy variations taking place in learning environments. Hence, the researchers have come up with diverse definitions of the term UL. UL environment provides a learning mechanism consisting of collaborators, contents, and the services. UL relates to providing ways for the identification of right learning collaborators and having the right content. As we look at affordance of the ubiquitous computing, we should have a close look to its fallouts. There is a necessity to toil towards bridging the digital rift wherever people cannot pay for buying the state-of-the-art and smart gadgets despite the falling prices (Cope & Kalantzis, *New Media, New Learning*, 2007). In the academic sector, the propagators of ubiquitous computing are working hard to make the technology affordable to the masses.

It also must ensure right services-at right time-at right place. These are based on the learner's environment (Yang, 2006). (Yang, 2006) has extensively talked about context aware ubiquitous learning Environments. He has discussed as to how this newly designed environment can fully support the needs of peer-to-peer collaborative learning.

(Cope & Kalantzis, *Ubiquitous Learning: An Agenda for Educational Transformation*, 2006) Explores the facets of this suggestion to acquire old things by using innovative technologies. "Emergence of ubiquitous computing creates new conditions for education professionals and students". It finds new ways in which the meaning is created, stored, delivered and accessed. The transformation is seen from evolutionary perspective as it has empowered human beings to get involved in interactions, which are not dependent on the constraint of physical contact (Geser, 2004). (Scholtz & Consolvo, 2004) discusses about the computing applications toward developing a framework for the evaluation of ubiquitous computing applications, it comes up with a framework for evaluating pervasive applications, which offer a dynamic way of looking at usability and acceptance issues.

Looking at the perspective of the learners', context can be defined in terms of how learners are affected by adjacent environment. From viewpoint of services, it is stated as the adjacent environment, which affects the delivery of learning services and their implementation. Additionally, with sensing technologies development, it has become likely to gather relevant data including location and time with the use of various technologies like Wi-Fi, Global positioning systems (GPS) etc. This distinguishes the UL environment from the mobile learning (ML) environment. The learning tools for UL are the devices and networks detection, tracking, social activities services & accessing the content. As defined by (Lyytinen & Yoo, 2002).

As per the literature review, there has been observed a shift from e-learning to ubiquitous learning (K. & K.G., 2008). This has led to identifying the main characteristics/variables of ubiquitous learning (Chen, Kao, Sheu, & Chiang, 2002) and (Zolkefley, Tahir, Lokman, Aziz, & Sharif, 2015) as permanency, accessibility, immediacy, interactivity, context awareness and adaptability.

### **Research Problem**

The real problem is as to how one can come up with a ubiquitous learning conceptual framework that can transform existing learning methodologies into futuristic virtual domains? Conventional methods of learning will become ineffective in future with the adoption of new ubiquitous learning mechanisms and tools. The resolution of this problem lies in developing a sustainable learning conceptual framework for ubiquitous learning environment.

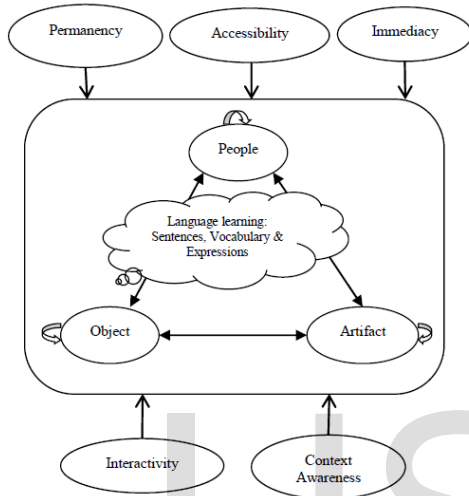
### **Research Objectives**

Main research aims to encompass the following contents and answer to the subsequent questions throughout.

- To study and analyze the existing technologies relating to ubiquitous ecosystem with specific emphasis on ubiquitous learning.
- Developing a ubiquitous learning framework to discover relationship between different independent and dependent variables affecting ubiquitous learning adoption.
- Applying statistical analysis on the collected questionnaires and by validating the developed research hypothesis.
- Developing a new innovative ubiquitous learning framework based on the research findings.

**Research Framework, Methodology and Design**

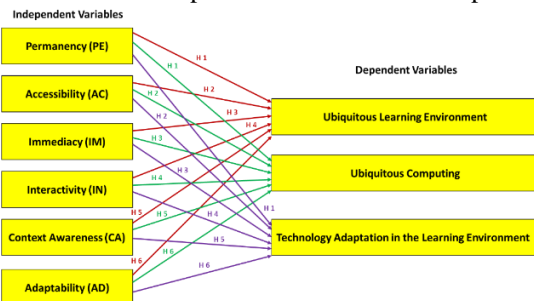
The research work, grounded on defined objectives has come up with a research framework which is based on independent and dependent variables which can ensure effective execution of the ubiquitous learning in an intensive knowledge environment. (Zolkefley, Tahir, Lokman, Aziz, & Sharif, 2015) has proposed a conceptual model based on type of interaction in ubiquitous language learning environment.



**Figure 0: Ubiquitous Language Learning Environment interaction types**

Source: (Zolkefley, Tahir, Lokman, Aziz, & Sharif, 2015)

The variables identified in the above model are accessibility, immediacy, permanency, context Awareness and interactivity. In Perceived model, adaptability has been added. The model with adaptability. The six independent variables are permanency, accessibility, immediacy, interactivity, context Awareness and adaptability. Dependent variables are selected as Ubiquitous Learning Environment, Ubiquitous Computing (Scholtz & Consolvo, 2004) and Technology Adaptation in the Learning Environment. The research has assessed level of awareness of UL and analyzed contribution of different factors responsible for its rate of adoption.



**Figure 2: Model of Research**

Validity and reliability of the method is ensured during data collection. Measurement of the internal consistency is done by through Cronbach’s alpha by measuring the scale reliability. Pearson correlation coefficient and regression analysis is used for finding relationships between the variables. Validity Test, Cronbach’s Alpha, Frequency Distribution (data), Descriptive Statistics, Pearson Correlation and Regression Diagnostic Analysis were done. For study analysis, SPSS (Statistical Package for Social Sciences) was used. Following are the defined six hypotheses.

**H1:** In the learning environment, Permanency has its effects on UL environment, technology adaptation and ubiquitous computing.

**H2:** In the learning environment, Accessibility effects UL environment, technology adaptation and ubiquitous computing.

**H3:** In the learning environment, Immediacy effects UL environment, technology adaptation and ubiquitous computing.

**H4:** In the learning environment, Interactivity effects UL environment, technology adaptation and ubiquitous computing.

**H5:** In the learning environment, Context Awareness effects UL environment, technology adaptation and ubiquitous computing.

**H6:** In the learning environment, Adaptability effects UL environment, technology adaptation and ubiquitous computing.

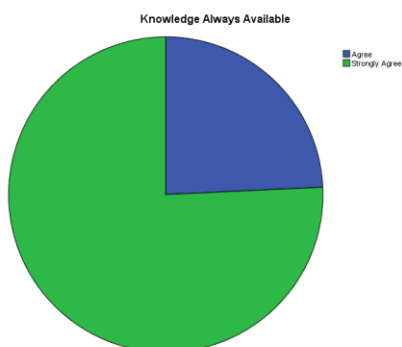
The core data collection phase employed survey questionnaires. A cross-sectional survey with self-consummation surveys technique was used for data collection carefully selected questionnaires were asked from selected participant separately. The results of data validity evaluation were collected (Saunders, Lewis, & Thornhill, 2009) and the questionnaire were also shown for review to some subject experts. The validity of construct was taken care of both the theory and the measuring method. (Cooper & Schindler, 2008). The samples were gathered from National University of Modern Languages, Bahria University and National University of Science and Technology. Total no of questionnaires was 300. 100 questionnaires were distributed at each university. The gender distribution was 50% male and 50% females in each university approximately. Regression analysis and PPMC (Pearson Product Moment Correlation) analysis was carried out to produce the nature and magnitude of existing relationship among variables of the research and for testing of the hypothesis relationships. Descriptive statistics i.e. percentages and frequencies were computed (MCQ’s and

organizational data) to describe variables main characteristics. Likert scale kind of questions were used for calculating Mean scores.

### Data Analysis, Findings and Discussion

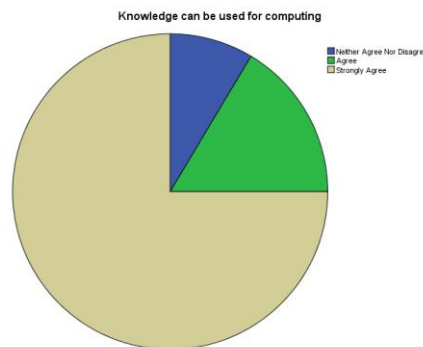
Total questionnaires distribution among participants was 300, from which 268 were appropriately filled up and given back representing approximately 89.33% of response rate. Reliability statistics refer came out to be 0.75 for 30 items with standardized item's Cronbach's Alpha being 0.765. Every item extended above a 0.70 value which shows the strong reliability of the scale of measurement and questionnaire strength. Descriptive statistics consisted of number of observations under each item with minimum, maximum and the mean values through the use of software and the standard deviation by presenting each items variation. 268 items for each variable dimension were observed through the questionnaire ranging values from 2 to 5 and a variation of almost 0.5 to 0.65. Pie charts for each item to decipher further the segregation present in the data and their corresponding values acquired through the survey are presented.

The first pie chart is regarding knowledge available where participants of the study expressed that on average the presence of knowledge on a knowledge platform is perpetual. Utmost contributors agreed strongly, and few approved with the statement. None of the observations were found in disagreement with the statement.



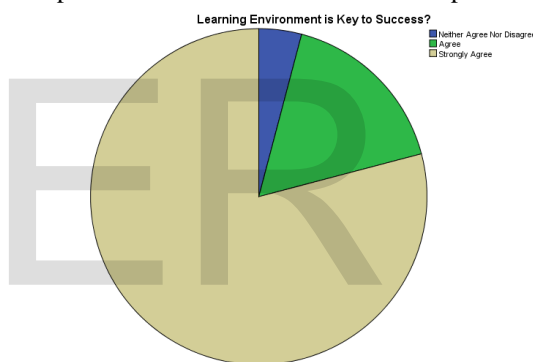
**Figure 3: Convenience in Knowledge Availability**

The following pie chart shows the answers collected for item about asking the participants about the availability of the knowledge on knowledge platform and its use for computing. Majority of the answers were found in agreement whereas a few were neutral in their response. Almost an equal answer proportion affirmed the statement.



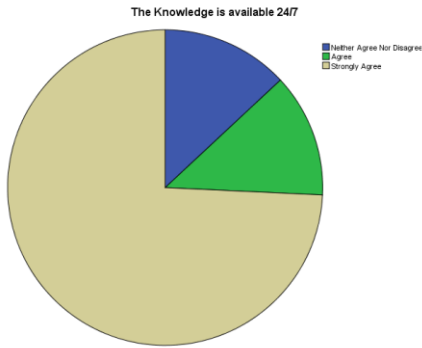
**Figure 4: Knowledge Utilized in computing**

When participants were asked whether in the learning environment the key to success is the adaptability of new technologies to access the knowledge, no matter how many years back the knowledge was uploaded, the following responses were collected. As it is presented in the pie chart, utmost contributors strongly approved the statement. A marginal proportion of respondents were neutral about their response.



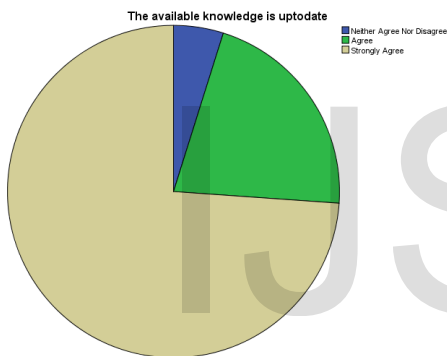
**Figure 5: Learning environment as key success indicator**

One of the characteristics of a ubiquitous learning environment is that the knowledge is available all the time and is available to engage the learner. The question was asked that whether the availability of knowledge is 24/7 or not. The following pie chart shows a majority showing strong agreement with the statement. No disagreement of the statement is present in collected responses.



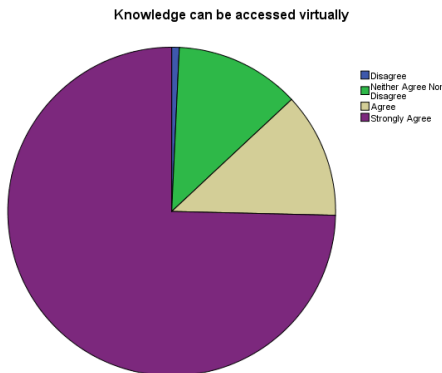
**Figure 6: The Knowledge is available 24/7**

The knowledge availability is essential for helping learner to learn and make decisions but for effectiveness the knowledge requires to be up-to-date. The following pie chart shows the responses from respondents who strongly agree in our study that the knowledge platform should be up to date.



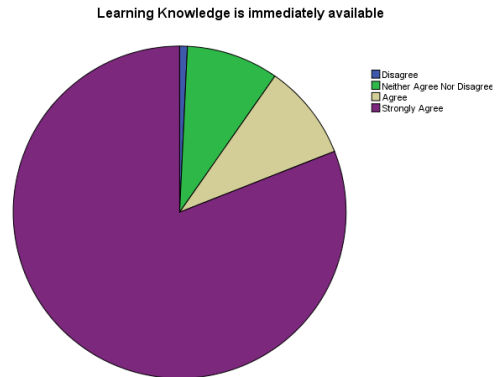
**Figure 7: The available knowledge is up to date**

The available knowledge is up to date enabling the use of latest computing techniques. Respondent's Majority strongly approved the statement whereas a marginal number of responses showed a disagreement regarding its Accessibility.



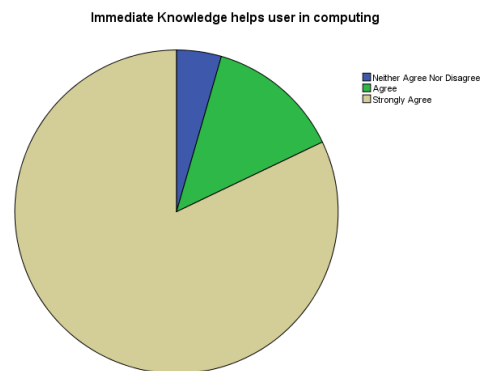
**Figure 8: Knowledge can be accessed virtually**

The virtual knowledge may be available to user but the immediate requirement to access is also essential so that the learning knowledge is available immediately from anywhere is a question that was asked from the respondent. Most of them agreed with the statement that learning knowledge should be available immediately whereas a slight proportion has presented a disagreement pertaining to the statement.



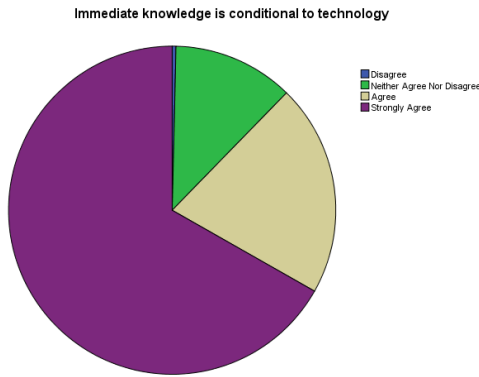
**Figure 9: Learning Knowledge is Immediately Available**

The immediate knowledge availability is crucial because it helps a user to compute and make prompt decisions based upon the available data. The immediate knowledge helps the user in computing was strongly agreed by most of the respondents of the study whereas agreed by a few. Neutral reply was observed from a marginal number of respondents.



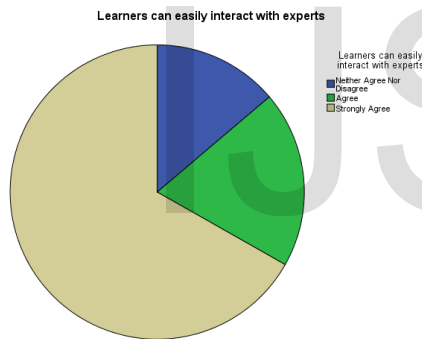
**Figure 10: Immediate Knowledge helps user in computing:**

The next item related to the availability of knowledge in guaranteed fashion if one has the proper technological tools to access that knowledge. A major chunk of the responses falls in strong agreement with the statement whereas minute disagreement is also present in the responses collected.



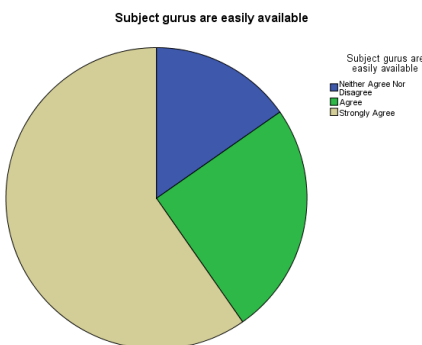
**Figure 11: Immediate Knowledge is conditional to technology**

The interaction between learners and experts in guaranteed fashion is possible only if one has the proper technological tools for knowledge exchange through interaction. A major chunk of the responses falls in strong agreement with the statement whereas a substantial number lie in agree, neither agree nor disagree category in the responses collected.



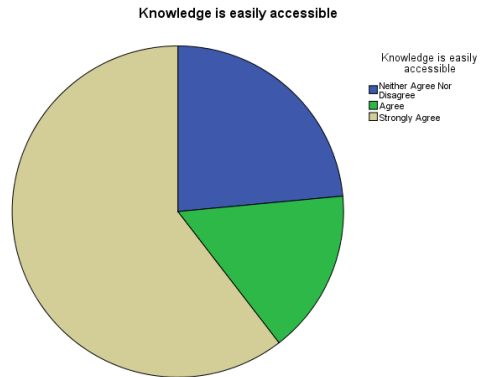
**Figure 12: Learners can easily interact with experts**

The next item related to the availability of subject gurus in guaranteed fashion if one has the proper technological tools to access that knowledge. From the responses accumulated a major chunk of the responses falls in strong agreement with statement.



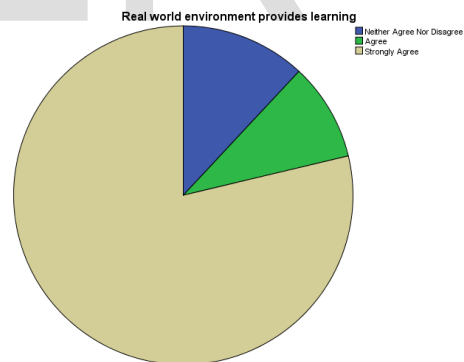
**Figure 13: Subject gurus are easily available**

The next item related to the easy accessibility of knowledge in assured fashion is possible if proper technological tools are available to access that knowledge. A major chunk of the responses falls in strong agreement with the statement whereas no disagreement is present in the responses collected.



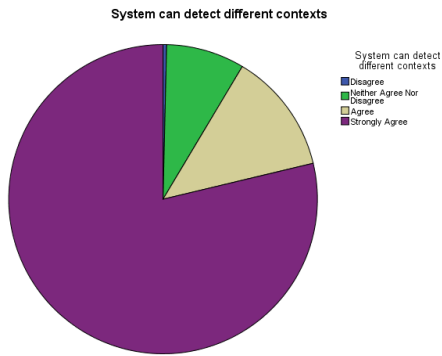
**Figure 14: Knowledge is easily accessible**

The real-world environment is essential for building a ubiquitous setting. The question asked from respondents that if unified learning in the ubiquitous settings is provided in the real-world environment. Most of the respondents strongly agreed, agreed, or were neutral in answering the question.



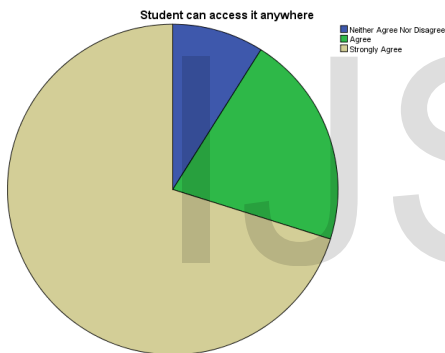
**Figure 15: Real world environment provides learning**

The system can detect different contexts and ensure the availability of relevant knowledge in guaranteed fashion with proper technological tools to access that knowledge. A major chunk of the responses falls in strong agreement with the statement whereas minute disagreement is also present in the responses collected.



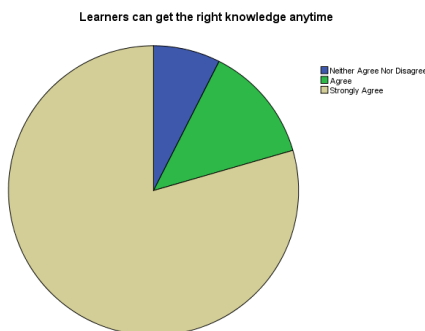
**Figure 16: System can detect different contexts**

The system can sense or detect different context of learners through the learning progression and implement system activity with the user was the question asked from the respondents regarding student access to the proposed system. Most of the answers were found in the agreement or simply agreed while few responses were neutral to the statement. No disagreement was found in the responses.



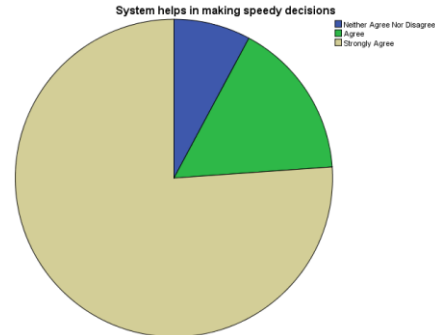
**Figure 17: Student can access it anywhere**

The respondents were asked that with the advent of smartphones or various applications, students can play with these gadgets anywhere they are. Most responses were found in the agreement of the statement whereas an almost equal proportion was found in agreement.



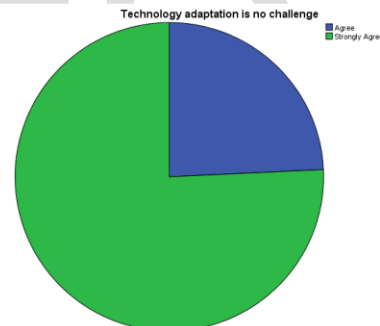
**Figure 18: Learners can get the right knowledge anytime**

The fundamental use of a system is to drive knowledge towards effective decision making. A system helps a user to make such decision or not was asked from respondents who mostly strongly agreed with the statement. Many responses were found in agreement and almost an equal proportion of responses were found as neutral to the statement in question.



**Figure 19: System helps in making speedy decisions**

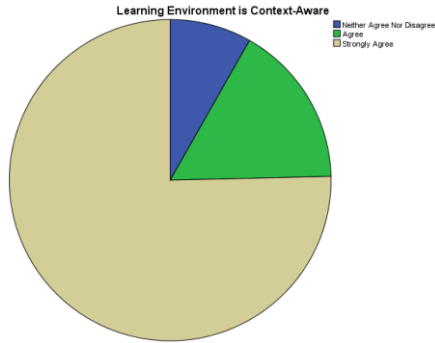
The apparent usefulness and affluence of usage help technology adaption of a knowledge management platform; however, the technology adaption of ubiquitous system would be a challenge. The answerers exhibited as either agreed or strongly agreed.



**Figure 20: Technology adaptation is no challenge**

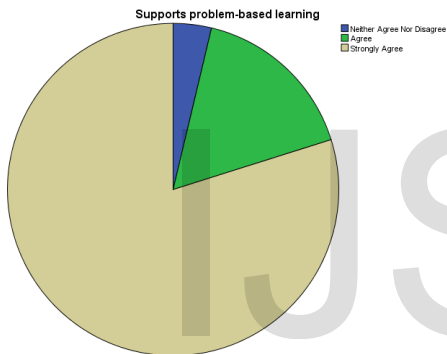
The context defines intensity of a problem and the available opportunities for the presentation of solution. A learning environment is either context aware or not was asked from the respondents. The answers were more inclined towards agreement. Only a few of the respondents gave a neutral response whereas no negative responses were received.





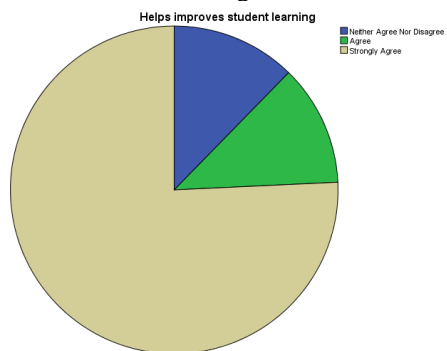
**Figure 21: Learning environment is context-aware**

The effectiveness of modern learning systems is made effective through use of problem-based learning. In order to present the solution, the concept involved has a certain context with certain constraints. The question regarding problem-based learning received major responses in agreement. Only a few responses were found neutral of the statement.



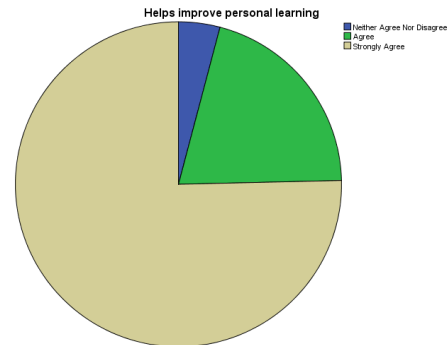
**Figure 22: Supports problem based learning**

A learning system is effective if it helps a student to learn and continuously increase the learning capacity. The responses were collected from respondents regarding the statement that whether the learning system will help the students in their learning or not. The answers showed major agreement and strong agreement by the respondents. Only few answers were found to be neutral. No disagreements were observed.



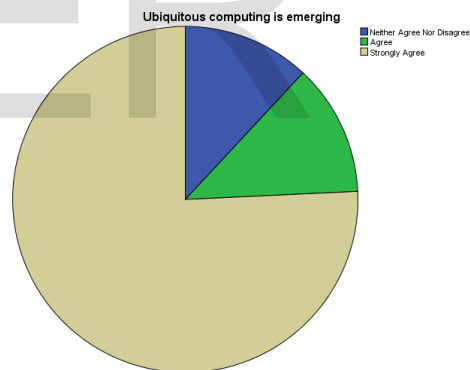
**Figure 23: Helps improve student learning**

A learning management should not be limited to academic use by the student but should also extend to help user in improvement in personal learning and development. The respondents when asked about personal learning showed strong agreement and general agreement to the statement, whereas a few responses were neutral.



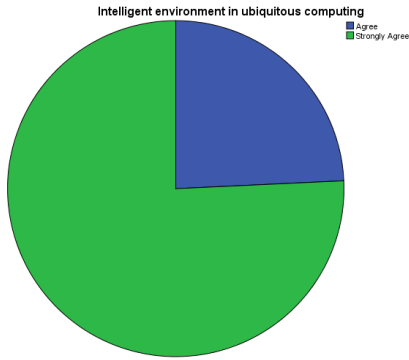
**Figure 24: Helps improve personal learning**

The learning system is not an old age concept but rather a latest development which integrated the modern technology with modern learning techniques and should be perceived as an emerging technology. The respondents in response of that whether ubiquitous computing is emerging or not answered in agreement with only a few of them remaining neutral.



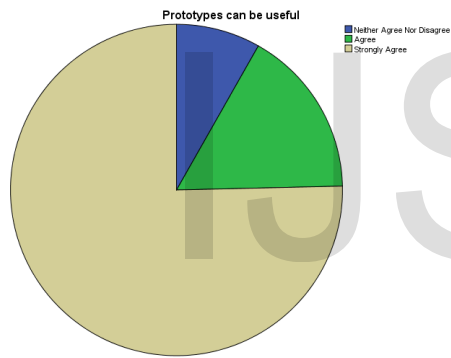
**Figure 25: Ubiquitous computing is emerging**

Whether intelligent environment in ubiquitous computing is essential for the emerging technology to be successful or not was the question asked from the respondents. All the respondents answered in strong affirmation or affirmation about the statement. However, there was no disagreement observed in responses.



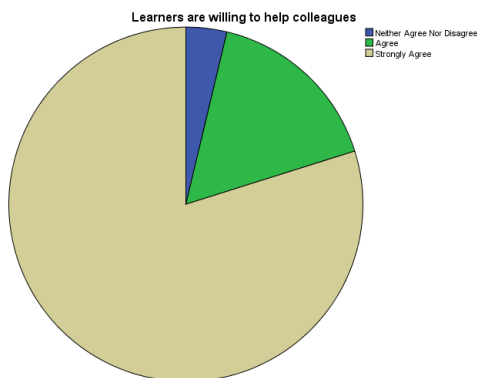
**Figure 26: Intelligent environment in ubiquitous computing**

Most of the technology projects are initiated as prototypes and then they are scaled to a real time project in order to understand the bugs and to remove any problems. When asked from the respondents whether they believed that the prototypes should be made or not. Most of them strongly agreed that prototypes will be helpful and should be made. No disagreement with the statement was found in the data.



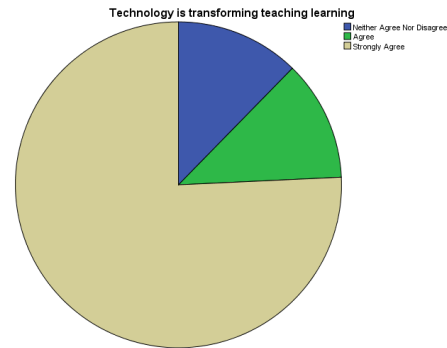
**Figure 27: Prototypes can be useful**

Peer help is one of the important factors in understanding, using, and improving a learning management system. The respondents strappingly agreed that the peers want to help colleagues in ubiquitous learning. No disagreement was found in the answers.



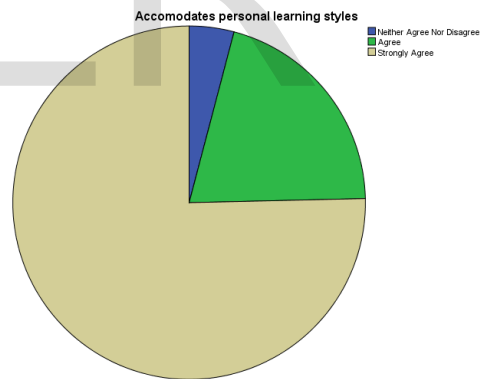
**Figure 28: Learners are willing to help colleagues**

Innovation in technology derives the advent of the society that is knowledge-based and hence transforms teaching and learning in post-compulsory education; specifically, in universities. When respondents were asked about the statement, most of them strongly agreed. An equal proportion of the responded agreed and neutral about the statement.



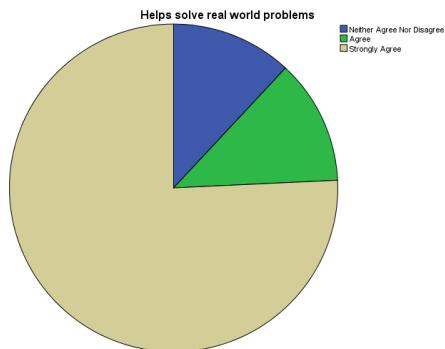
**Figure 29: Technology is transforming teaching learning**

It was asked from respondents that technological adaptation helps facilitate personal learning styles of the student or not. Majority of the participants strongly approved that the technological adaptation helps in accommodating personal learning styles of the student. The following pie chart depicts the responses.



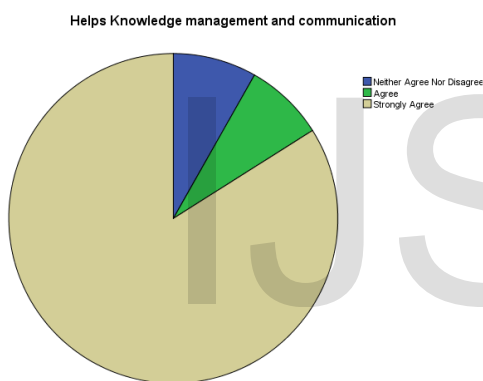
**Figure 30: Accommodate personal learning styles**

In response of the statement that technology is being used for the strategic development to solve real world problems, most of respondents strongly agreed. An equal proportion of the respondents were found in agreement and neutral about the statement that technology is being used for the strategic development to solve real world problems.



**Figure 31: Helps solve real world problems**

When respondents were asked whether learners can use resources and technology tools to manage and communicate knowledge or not? Most of them strongly agreed that learners can use resources and technology tools for communicating and managing knowledge. The following pie chart shows the responses ratio.



**Figure 32: Helps Knowledge management and communication**

Correlation matrix was obtained through running a Pearson correlation test in SPSS. Pearson's  $r$  value of 0.737 indicated that permanency is directly correlated with accessibility. Permanency is also highly correlated with all three dependent variables Ubiquitous learning environment, Ubiquitous computing, and adaptation of technology in the learning setting with Pearson's  $r$  values of 0.732, 0.922, and 0.674 respectively. Accessibility is highly correlated with Permanency, Ubiquitous learning environment, and technology adaptation in the learning environment with correlation values of 0.737, 0.859, 0.683, and 0.791 respectively. There is a weak relationship between accessibility and immediacy, context awareness, and adaptability. Immediacy has a weak correlation with all the variables with a highest correlation value of 0.291 where it is correlated with the technology adaptation of the learning environment. Context awareness is also weakly related with all other

variables except adaptability where it has a direction relationship of  $r=0.409$  strength. The ubiquitous learning environment is highly correlated with accessibility, permanency, and the technology adaptation of learning environment. Whereas ubiquitous computing and the technology adaptation of the learning environment are highly related with permanency, accessibility and ubiquitous learning environment.

The influence of dependent and independent variables on each other calculated through regression models in SPSS. It was found that almost 73% variation in Ubiquitous Learning Environment is explained by Permanency. The proportion of Ubiquitous-Computing which is explained by Permanency is higher than other values in the regression analysis, a 92%. A 67.4% of Technology Adaption in Ubiquitous Learning Environment is explained by Permanency. The regression values of accessibility and other variables shows that 85.9% of Ubiquitous Learning Environment is explained by accessibility, 68.3% of Ubiquitous-Computing, and 79.1% of Technology Adaptation. Only marginal proportions of variation in dependent variables are explained by immediacy. The highest  $R$  value 0.291 is the value of effect of immediacy on Technology adaptation on learning environment. Effect of interactivity on ULE, UC and TALE is indicated by the consequences that interactivity does not suggestively effect on depending variable as the  $R$  values are now higher than 0.12 in any of the cases. The effect of context awareness on Ubiquitous Learning Environment, Ubiquitous Computing, and Technology adaptation in Learning Environment have been measured. Like interactivity, context awareness has no noteworthy effect on any of the dependent variables. In any of the dependent variable no more than 16% variation has been explained by context awareness which may be contributed to chance. It was also found that adaptability has a weak effect on Ubiquitous learning environment and technology adaptation whereas it has a strong effect on Ubiquitous computing. Almost 51% variation in Ubiquitous computing is being explained by adaptability.

Models of multiple regressions were included for the sake of understanding of collective effect of the study variables on each other separately. The regression results were obtained from SPSS including  $R$  and  $R$ -Squared summary, ANOVA, and regression coefficient values to understand the impact of individual variable and its behavior in regression analysis.

## Conclusions

Conventional methods of learning will become ineffective in future with the adoption of new ubiquitous learning mechanisms and tools. The resolution of this problem lies in developing a sustainable learning conceptual framework for the environment of ubiquitous learning.

The researcher has come up with a framework which takes care of the dimensions of permanency, accessibility, immediacy, interactivity, context awareness and adaptability. The previous research lacked their integration. The framework gauges the level of awareness regarding ubiquitous learning and has concluded after thorough analysis that the above-mentioned factors have a great impact on the adaptation of ubiquitous learning. The designed framework will act as a yardstick or a benchmark for any company wishing to apply the same framework with tailor made modifications to fit into their respective work environments.

The study contributed to the understanding of the existing technologies relating to ubiquitous ecosystem with specific emphasis on ubiquitous learning. It has further come up with a ubiquitous learning framework which can be adopted by any entity wishing to establish ubiquitous learning in its echo system. Developing a new innovative ubiquitous learning framework based on the research findings is innovative and can be adopted or tailor made thus providing a basic benchmark standard.

## Future Work

The framework should be extended to other regions of the country to come up with a new framework which can help in designing and coming up with a future policy pertaining to ubiquitous learning.

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