U-Learning – Design and Evaluation of Evocative Learning Based Method for Futuristic AI Embedded Ubiquitous Training and Development Environment

Syed Wasiq Safdar

syedwasiqsafdar@gmail.com

Abstract

With the advancement of technology and the Artificial Intelligence (AI) revolution just round the corner, people social lives have changed so are the ways in which people interact with others using smart devices and also the way they do learning. The situation has become more critical with COVID pandemic spreading around the world forcing people to conduct most of their activities on-line. In these changing times, people are shifting towards ubiquitous learning environments where human interactions are becoming very mush rare. Ubiquitous learning makes use of computers, mobile devices and wireless networks in our day-to-day life. These communication and networked infrastructures provide them with a mechanism to exchange knowledge and learn from distant places while on the move at anytime and anywhere. This has entirely changed the way people are now learning and sharing knowledge.

For ubiquitous learning, a framework needs to be put in place which also embeds the applications of artificial intelligence in addition to providing people with a unified platform which can address users' needs in the ubiquitous environments. Being evolving technology, such frameworks are not available at present thus requiring implementing some innovative workable sustainable schemes. The existing themes are based on mobile learning hence there is a need to integrate it with AI applications in order to achieve a ubiquitous environment.

The research work will access the existing levels of awareness relating to ubiquitous learning and will look at various variables which will form the basis for the development of a framework which if implemented by any organization will lead to effective delivery of the futuristic ubiquitous Training and Development Environment.

Background

Recent developments in the digital age are leading towards a revolution which no one has seen before. With new technologies coming in the market every day, people are redefining the ways in which they interact, work and learn. Ubiquitous learning paradigms are evolving and providing extreme computational capabilities through the use of smart devices and embedded applications. With the development of ubiquitous technologies, ubiquitous learning in integration with ubiquitous computing devices has provided great educational change affecting the users in unique ways (Ye, Jing, & Cheng, 2008).

Due to the advancements in the field of digital electronics, new devices are coming up which are smarter and much faster in every way thus providing users with an always connected environments thus leading to faster knowledge exchange. This has also redefined the learning requirements and the learning needs. According to (Ogata, Li, Hou, & Uosaki, 2011), based on (Chen, Kao, Sheu, & Chiang, 2002), the key features of ubiquitous learning are Permanency/Continuance,Immediacy/Speediness,Accessi bility/Availability, placing of instructional happenings, Flexibleness and Interactivity/Interactional.
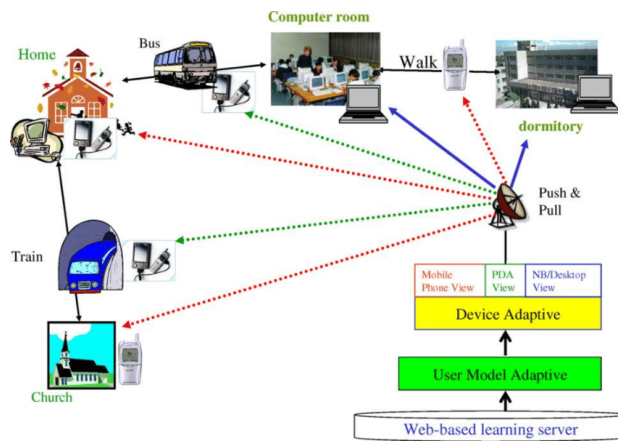
Fig 1: UL Environment – Conceptual Design
Source: (Chen, Kao, Sheu, & Chiang, 2002)

Here it can be seen that the user can move at any place, anytime and 24/7 but is always connected to the world wide web through wireless or landline networks and can access the web based learning servers. These web servers are placed in the cloud environment and their physical placements do not matter as long as they are providing the users with learning platforms and capabilities in an effective way. Cloud computing has further revolutionized the world with new solutions and providing different kind of services as shown in the below figure.
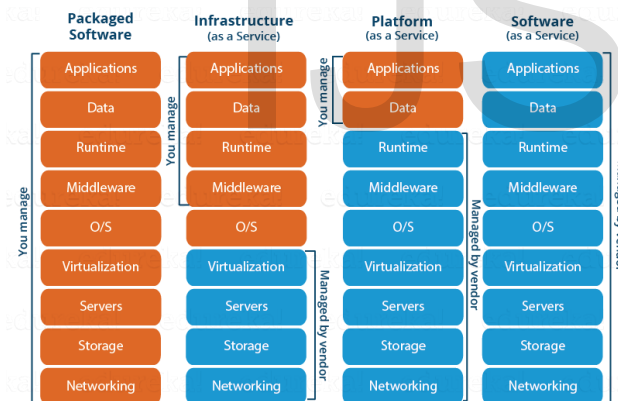

Fig 2: The cloud computing model
Source: (Xorlogics, 2017)

The above model shows the cloud services structure. Cloud computing services can be differentiated in the following manner.

- IaaS (Infrastructure as a service)
- PaaS (Platform as a service)
- SaaS (Software as a service)

IaaS outsources the infrastructure through data centers, virtualization, servers, networks and by providing the storage facilities.
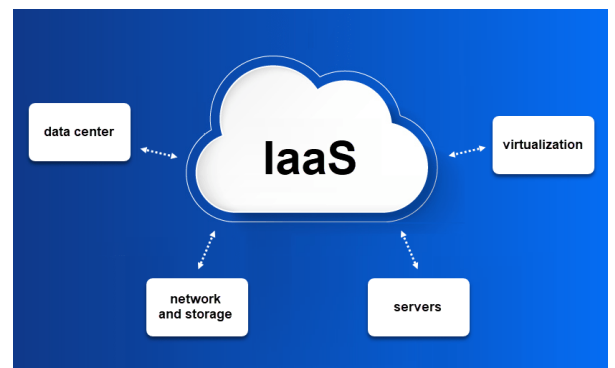

Figure 1.1: Infrastructure as a Service (IaaS)
Source: (Herald, 2019)

PaaS consists of hosting of operating system and discretionary elementary services that allows users to execute their various particular applications.
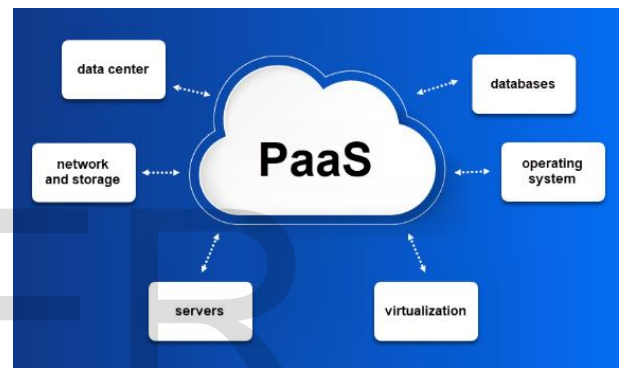

Fig 3: Platform as a Service (PaaS)
Source: (IndiaMART, 2019)

In case of Software as Service (SaaS), applications use software services using the cloud infrastructure. The cloud has public, private and hybrid space for the specific users. It can include project management, marketing automations, Customer Relationship Management, Invoice applications etc.

Fig 4: Software as a Service (SaaS)
Source: (IndiaMART, 2019)

With these structures in place, now we can look at the ubiquitous learning environment which has redefined how

people have changed their styles of learning. It has provided dynamic environments for educationalists, trainers, Leaners and education professionals. It is extensively based on the use of smart devices used entirely in innovative ways taking advantage of the fact as to how the knowledge is formed, kept, distributed and retrieved. A new educational paradigm has emerged which is forcing users to adopt new and innovative technologies embedded in ubiquitous and AI environments.
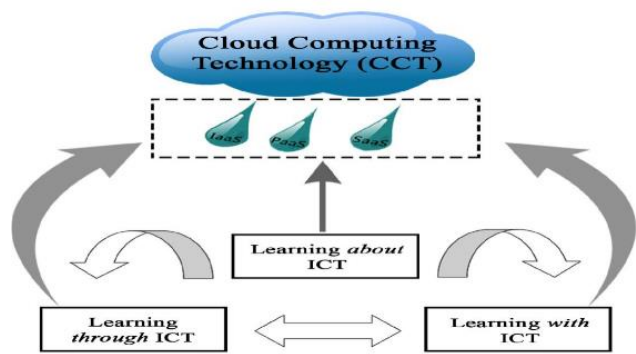

Fig 5: Information and Communication Technology (ICT)
Enabled Lifelong Learning
Source: (Hasibuan, 2013)

The information and communication (ICT) along with Cloud Infrastructures has redefined the overall learning environment. It is providing an interoperable, pervasive, and seamless learning architecture to connect, integrate, and share learning collaborators, learning contents, and learning services (Yang, 2006). It also provides right learning collaborators, services and contents all at right time and at the right place, hence it requires context models and contextual acquisition mechanisms for runtime information accumulation (Yang, 2006).

Analytics is an essential part of the ubiquitous learning. It is because of the fact that it provides the learner with mobility and the learning analytics while utilizing the potential advantage which is augmenting the ubiquitous learning experience.
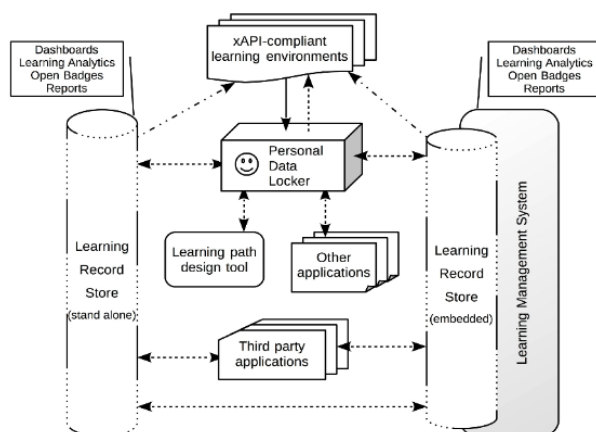

Fig 6: Ubiquitous Learning Analytics

Source: (Karoudis & Magoulas, 2016)

Similarly, the use of smart mobile devices provides the right tools to the users. Mobile devices when used to access social media applications provides a digital transformation thus creating social networks thus enhancing users exposure to wider and broad spectrums (Monteiro, SandroGomes, & Netoa, 2016).

Fig 7: UL Smart Mobile Devices
Source: (Lentini, 2012)

Broad applications of ubiquitous learning are limited at present, however with the implementation of AI applications, access to digital platforms, enrichment of traditional educational learning's are showing rapid increase. Futuristic learning technologies if adapted will lead to a paradigm shift from traditional learning systems to ubiquitous methods of learning based new technologies.

Research Problem

Without having a conceptual framework for the implementation of ubiquitous environment with embedded AI applications, the learning paradigm will continue to use traditional learning and training & development infrastructures which are eventually fizzling out. If the new technologies are not embraced through a well-defined framework, the learning and academic paradigms will be greatly affected. The resolution of this problem lies in developing a sustainable learning, training & development conceptual framework for ubiquitous learning AI embedded environment which will serve as a benchmark for systematic sustainable implementations.

Research Objectives

Following are the main research objectives.

- To study and analyze the existing technologies relating to ubiquitous ecosystem with specific emphasis on ubiquitous learning in the training and development environment.
- Developing a ubiquitous learning framework for training and development to discover relationship

between different 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 for training and development.

Literature Review

The learning tools for UL are the devices and networks detection, tracking, social activities services & accessing the content. As defined by (Lyytinen & Yoo, 2002). (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. 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).

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 Leaners". It finds new ways in which the meaning is created, stored, delivered and accessed.

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.

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.

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 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. (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.

(Aljohani & Davis, Learning Analytics in Mobile and Ubiquitous Learning Envirnments, 2012) defines 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.

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).

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/altered the socio-cultural fabric and norms of the society in all the spheres of life (Pachler, Seipold, & Bachmair, 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.

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-eccentric approach and prospects to take care of today's requirements thus raising scope of m-learning (Irby & Strong, 2015). (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, & Gröhbiel, 2016) talks about connecting of digital mobile media with the increasing access for the traditional forms of higher education enrichment.

In 2018, the total no of cell phone subscriptions has crossed more than ten billion subscribers (ITU, 2018). "The ubiquitous learning (u-learning) implementation is a better opportunity in order to address the quality, Accessibility/Availability, and affordability issues present in higher education sector in many countries" (Subiyakto, Hidayah, Gusti, & Hikami, 2019).

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.

Research Direction

As per the literature review, there has been observed a shift from e-learning to ubiquitous learning (K. & K.G., 2008). The observed shift is shown below:
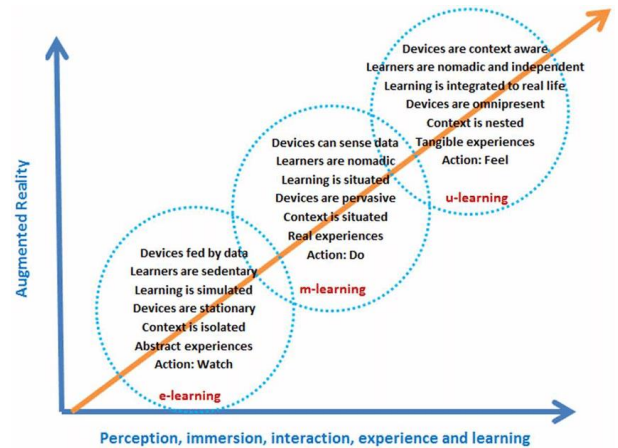

Fig 8: Comparison / flow of Learning Trends
Source: (Moreira, Mesquita, & Peresb, 2017)

This has led to identifying the following main characteristics/variables of ubiquitous learning

Aspect	u-Learning	m-Learning	e-Learning
Concept	Learn the right thing at the right place and time in the right way	Learn at the right place and time	Learn at the right time
Permanency	Learners can never lose their work.	Learners may lose their work. Changes in learning devices or learning in moving will interrupt learning activities	Learners can lose their work
Accessibility	System access via ubiquitous computing technologies System access via ubiquitous computing technologies	System access via wireless networks	System access via computer network
Immediacy	Learners get information immediately	Learners get information immediately in fixed environments with specified mobile learning devices	Learners cannot get information immediately
Interactivity	Learners' interaction with peers, teachers, and experts effectively through the interfaces of u-learning systems	Learners can interact with peers, teachers, and experts in specified learning environment	Learners' interaction is limited
Context awareness	The system can understand the learner's environment via	The system understands the learner's situation by	The system cannot sense the learner's environment

Tab 1: Comparative Analysis between E-Learning, M-Learning and U-Learning
Source: (Chen, Kao, Sheu, & Chiang, 2002) and (Zolkefley, Tahir, Lokman, Aziz, & Sharif, 2015).

- *Permanency/Continuance*

By Permanency/Continuance it is meant that there should not be any loss of work unless, it is deleted by them on their own thus recording the processes continuously.

- *Accessibility/Availability*

By Accessibility/Availability, we mean that all the information, data, documentations, audio-visual data or videos can be accessed from anywhere. The availability of

the information is grounded on the apprentice's requirements, such that learning being self-absorbed.

- *Immediacy/Speediness*

The learner is able to take hold of the info they need on immediate basis thus leading learners to solve the problem quickly.

- *Interactivity/Interactional*

Through Interactivity/Interactional easy interaction of learners with experts, Trainers or aristocrats. Hence, the subject/topic gurus are easily contacted, and the information is made accessible easily.

- *Context Awareness/Context Sensitive*

In this case, the learning is in fact embedded in our daily routines or lives. The knowledge required is available or is presented in a natural form.

- *Adaptability/Flexibleness*

By Flexibleness, we mean that the learner can get hold of the exact information at exact place and in exact way.

The research work, grounded on these variables and have extended it to include AI learning paradigm which is an extension to the ubiquitous learning and have come up with a research framework which is based variables which can ensure effective execution of ubiquitous learning in an intensive knowledge based training and development environment (Zolkefley, Tahir, Lokman, Aziz, & Sharif, 2015). The AI learning environment is shown below.

Fig 9: AI in Learning and Development

Research Methodology and Design

- *Research Framework*

Based on the above defined variables of Permanency/Continuance,Accessibility/Availability,Immediacy/Speediness,Interactivity/Interactional, Context Awareness/Context Sensitive and Concept/Flexibleness(Zolkefley, Tahir, Lokman, Aziz, & Sharif, 2015), a conceptual model can be developed for ubiquitous learning in training and development function while embedding AI based environment.

- *Research Model*

On the basis of the research framework, the following is the proposed research model.
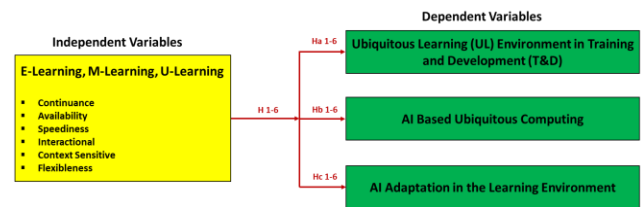
Fig 10: Model of Research

The six independent variables identified under the E-Learning, M-Learning, U-Learning in the above model are Permanency/Continuance,Accessibility/Availability,Immediacy/Speedines,Interactivity/Interactional,ContextAwareness/Context Sensitive and Flexibleness. In Perceived model, Flexibleness has been added. The model with Flexibleness added is shown in figure above. The three dependent variables selected are Ubiquitous Learning (UL) Environment in Training and Development (T&D), AI Based Ubiquitous Computing and AI Adaptation in the Learning Environment.

The research will assess level of awareness of UL and will analyze contribution of different factors (variables) responsible for its rate of adoption. The outcome of the research work will lead towards coming up with a framework which if applied in any academic/learning/training setup will lead to the effective delivery of the futuristic ubiquitous training and development AI embedded environment.

The dependent and independent variables relation needs to be studied. There are many approaches to data analysis. First, the validity and reliability of the method is essential in research data collection. Reliable measuring method gives the similar extents when one repetitively measures the similar objects or the events that remain unchanged.

Similarly, Cronbach's alpha may be defined as the measurement of the internal consistency i.e. how much in close relationship a collection of items is in a group. It is a measure of the scale reliability. If we look at the frequency distribution of an observation, it is the total number of occurrences of observation in a given data.

In statistics, Pearson correlation coefficient measures linear correlation between two variables. Regression analysis is also used for finding relationships between the variables. It comprises of many techniques for modeling & analyzing variables i.e. both dependent and independent. In the PLS's regression, in place of determining hyper planes where variance is maximum between independent variables and the response, by projection of predicted variables a linear regression model is revealed.

- ***Research Hypotheses***

H1$_{a,b,c}$: In the learning environment, Permanency/Continuance has its effects on Ubiquitous Learning Environment in Training and Development (Ha1), AI Based Ubiquitous Computing (Hb1) and AI Adaptation in the Learning Environment (Hc1).

H2$_{a,b,c}$: In the learning environment, Accessibility/Availability effects Ubiquitous Learning Environment in Training and Development (Ha2), AI Based Ubiquitous Computing (Hb2) and AI Adaptation in the Learning Environment (Hc2).

H3$_{a,b,c}$: In the learning environment, Immediacy/Speediness effects Ubiquitous Learning Environment in Training and Development (Ha3), AI Based Ubiquitous Computing (Hb3) and AI Adaptation in the Learning Environment (Hc3).

H4$_{a,b,c}$: In the learning environment, Interactivity/Interactional effects Ubiquitous Learning Environment in Training and Development (Ha4), AI Based Ubiquitous Computing (Hb4) and AI Adaptation in the Learning Environment (Hc4).

H5$_{a,b,c}$: In the learning environment, Context Awareness/Context Sensitive Ubiquitous Learning Environment in Training and Development (Ha5), AI Based Ubiquitous Computing (Hb5) and AI Adaptation in the Learning Environment (Hc5).

H6$_{a,b,c}$: In the learning environment, Concept/Flexibleness Ubiquitous Learning Environment in Training and Development (Ha6), AI Based Ubiquitous Computing (Hb6) and AI Adaptation in the Learning Environment (Hc6).

The research is based on the existing body of knowledge. The researcher reviewed the literature by going through previous studies resulting in the development of a conceptual framework by following established scientific processes. Fundamental laws of hypothesis are used on which are based observations in order to determine the validity of the conceived hypothesis hypotheses. The research work used various empirical tests. The targeted population was studied in order to generalize the researched findings. Following tests were performed in the research work:

1. Validity Test
2. Cronbach's Alpha
3. Frequency Distribution (data)
4. Descriptive Statistics
5. Pearson Correlation
6. Regression Diagnostic Analysis

For study analysis, package of SPSS was used by the researcher. SPSS is used to find Cronbach's Alpha Coefficient aiming to find how much reliable is the method for the collected data (questionnaire's). However, before we apply Cronbach's Alpha Reliability, it should be ensured that all independent variables, measuring the dependent variables are in the same direction; i.e., there exists no negatively items in the developed questionnaire. The core data collection phase employed survey questionnaires. In this research, a cross-sectional survey with self-consummation surveys was regarded as the most suitable technique for data collection. In this way, they were utilized to accumulate the required knowledge in ubiquitous learning, and to distinguish the impacts of the various factors and their speculated relationships.

Study research design was evocative and comprise of transverse design. This evocative study is linked with characteristics explanation related to population of the subject. The relationships discovery between several variables was carried out for determining whether variables were unrelated or independent. If related, it stays necessary to determine the existing relationship strength. Carefully selected questionnaires were asked from selected participant separately. Moreover, research studies are carried out to denote at that time a snapshot of the research. (Cooper & Schindler, 2008).

The method validity was measured through questionnaire's testing by the use of data collected by preliminary study. The preliminary test was conducted for the refinement of the questionnaires so as the respondents do not feel a problem in giving answers to the questions, the clarity of questions was established and there existed no problem regarding the accurate recording of the data. The result of data validity evaluation will be collected (Saunders, Lewis, & Thornhill, 2009). In addition to the above, the questionnaire was also shown for review to some subject experts.

Similarly, the internal validity is defined as the research method measurement ability of what it is planned to measure and consists of many types. Validity of the content is defined as the degree to which the method offers ample investigative questions coverage. The validity based on a certain criterion explains the success of measures utilized for the predictions / estimations. Lastly, the validity of construct takes care of both the theory and the measuring method which is being used. (Cooper & Schindler, 2008).

Reliability was tested by calculating Cronbach's Alpha, which can take any value ranging from one (complete internal consistency) to zero (no internal consistency) whereas 0.7 is defined as an acceptable

limit. As per (George & Mallery, 2003)**,** the following rules apply.

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Tab 2: Cronbach Alpha (Reliability Limits)

- *Target Population*

The samples were gathered from the following three organizations considering their use of technology and Training and Development setups;

1. PTCL/UFone Group
2. Zong
3. Telenor

Total no of questionnaires distributed were 150. Fifty (50) questionnaires were distributed at each organization.

- *Data Collection*

In the research study primary data gathering procedures were used.

- *Data Analysis & Presentation*

Regression 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 to describe variables main characteristics. Likert scale kinds of questions were used for calculating Mean scores. The below table shows the statistical tests those will be performed.

Tab 3: Hypothesis Statistical Tests

- *Questionnaire*

The below questionnaire was developed against each independent and dependent variable.

Tab 4: Developed Questionnaire

Data Analysis, Findings and Discussion

Reliability statistics were carried out with every item extends above a 0.70 value which shows the strong reliability of the scale of measurement and questionnaire strength. Descriptive Statistics pertaining individual variables which represents herewith contains the number of observations under each item, the minimum, maximum and the mean value found through the use of software and the

standard deviation presenting each item variation. 122 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.

Presented below are the statistics for each item to decipher further the segregation present in the data and their corresponding values acquired through the survey. 5-Point Likert scale was used i.e. 1. Strongly Disagree, 2. Disagree, 3. Neither Agree nor Disagree, 4. Agree and 5. Strongly Agree. The pie charts below show the requisite percentiles against each response.

Is the required information always available in the ubiquitous learning environment in Training and Development?
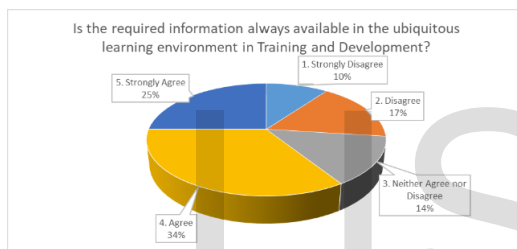

Fig 11: Availability of Information

The information available can be used for AI based ubiquitous computing.
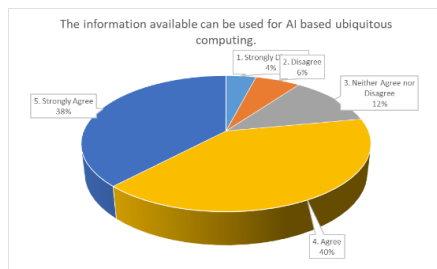

Fig 12: AI use of Information

In the AI enabled learning environment for Training and Development, the key to success is the Flexibleness of new technologies to access the information, no matter how many years back the information was uploaded.
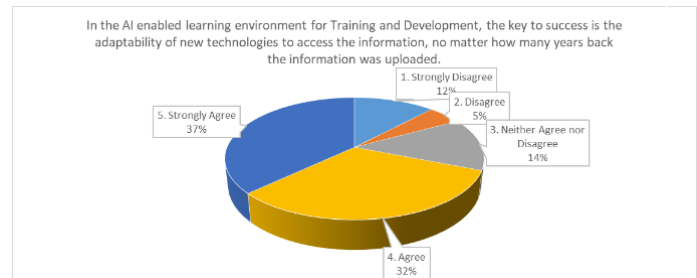

Fig 13: Technology Adaptation
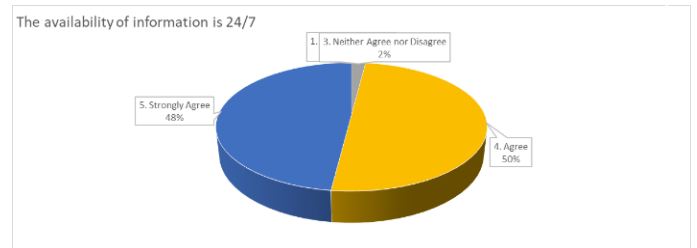
The availability of information is 24/7

Fig 14: 24/7 Availability

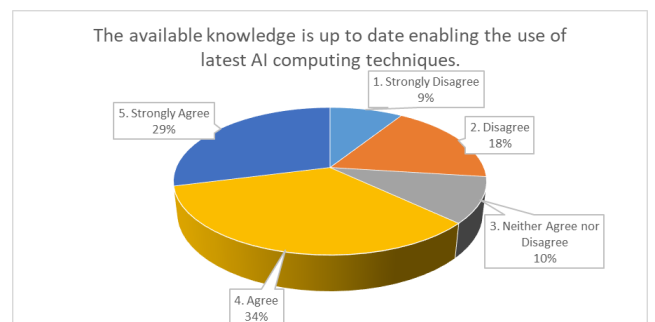***The available knowledge is up to date enabling the use of latest AI computing techniques.***

Fig 15: Up to Date Information

The information can be assessed through the use of smart phones, landline networks, wireless networks and other innovative products in the Training and Development learning environment.
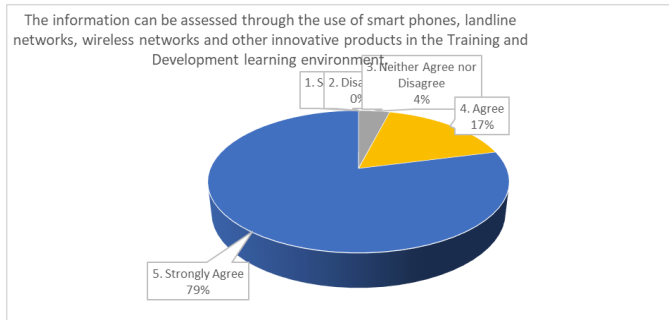
Fig 16: Access to Information

The learning information is available immediately from anywhere.
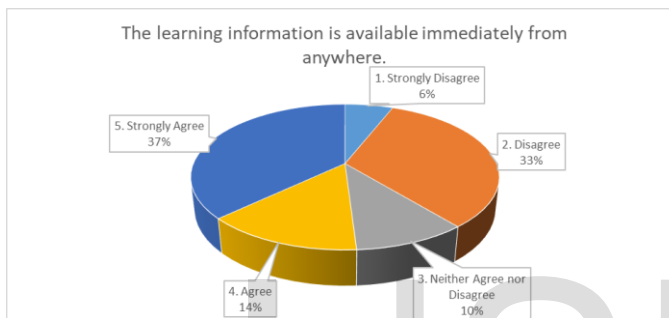
Fig 17: Immediate availability of Information from anywhere

Immediate availability of information helps the users to use online computing resources from live networks.

Fig 18: Online Computing Resources availability

Immediate availability of information can be guaranteed if one has the proper technological tools (including AI) to access that information.

Fig 19: Proper Technological Tools

Learners can easily interact with experts, Trainers, or peers

Fig 20: Interaction with Experts, Trainers or Peers

Subject gurus/experts are easily available

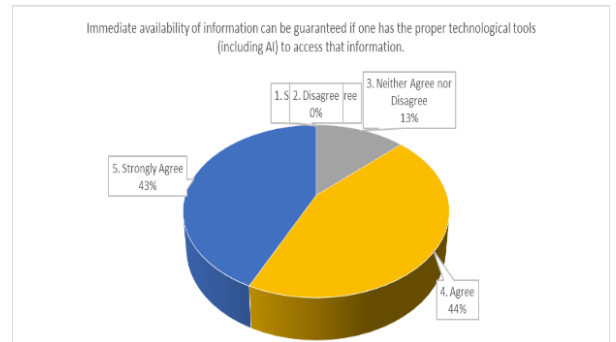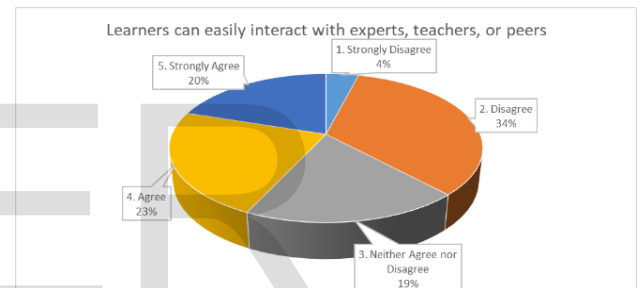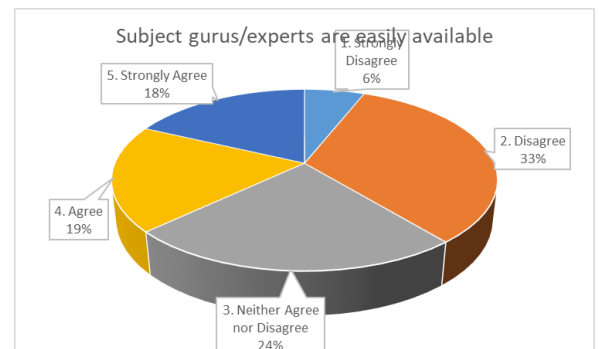Fig 21: Availability of subject Gurus-Experts

Knowledge is easily accessible
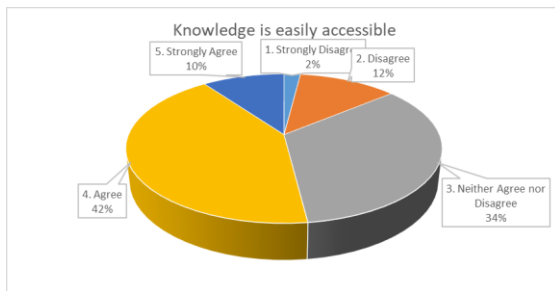
Fig 22: Knowledge availability

Real world environment provides seamless learning in Training and Development functions the ubiquitous settings.
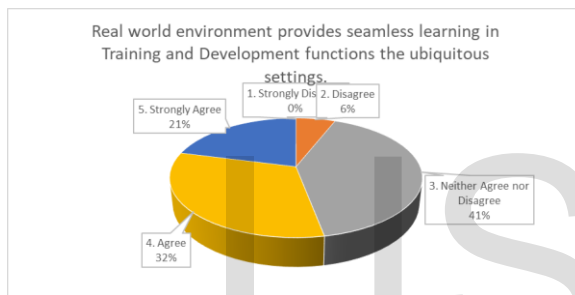
Fig 23: Seamless Learning

The system can sense or detect different context of learners during the learning process and implement the activity of the system with the user.
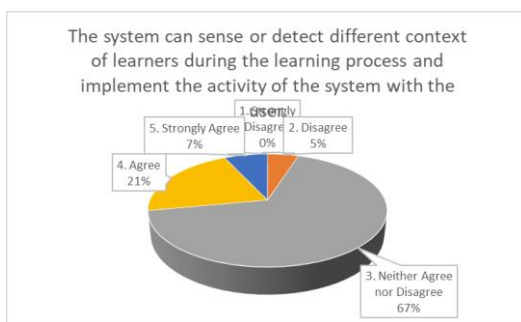
Fig 24: Contextual Learning

With the advent of smartphones or various applications, trainees can play with these gadgets anywhere they are.
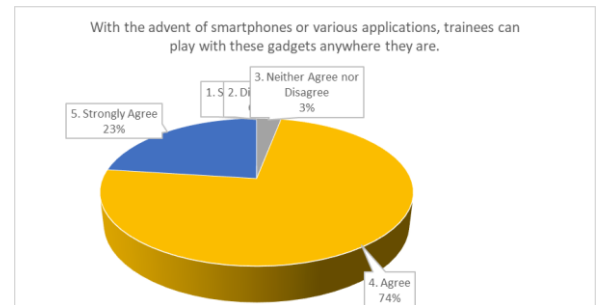
Fig 25: Gadgets availability

Learners can get the right information at the right place in the right way.
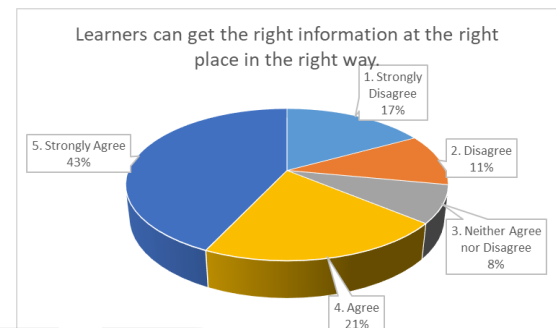
Fig 26: Right Information availability

The availability of information at the right place in the right way helps learners and trainers take speedy decisions based on conceptualized and adaptable parameters.
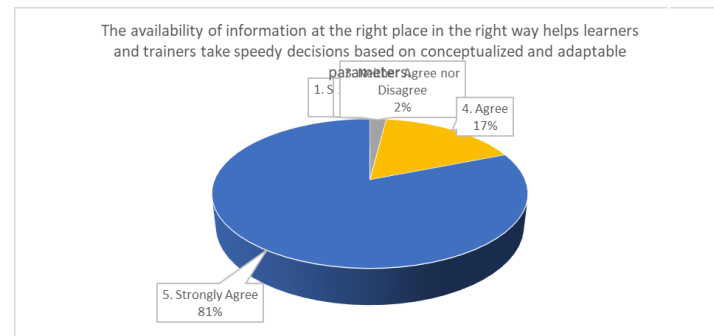
Fig 27: Decision Based Learning

The adoption of new technologies (including AI) is no longer a barrier to change the learner's concepts and mind-set.
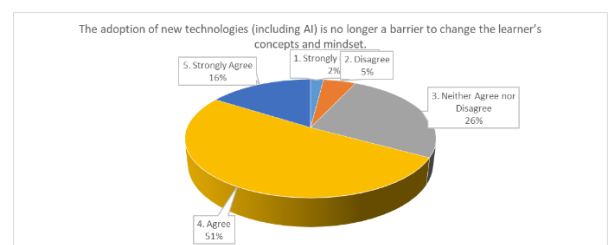
Fig 28: Changing Learners Mindset

The learning environment under Training and Development is context-aware, which provides adaptive and personalized support to the learners in the right way, in the right place and at the right time.
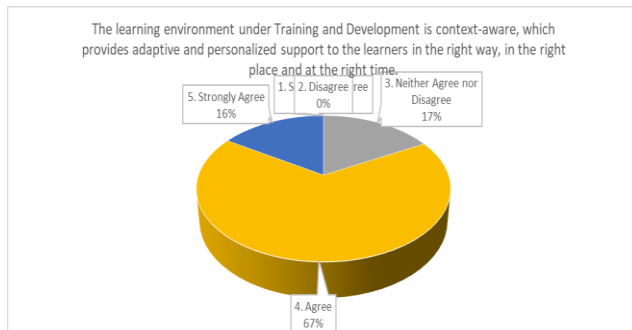
Fig 29: Context Aware Learning

Ubiquitous learning environment supports problem-based learning.
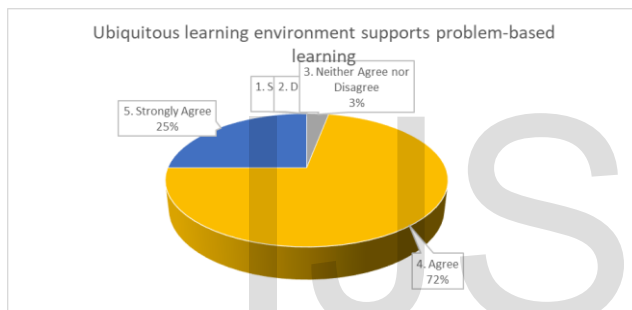
Fig 30: Problem Based Learning

Ubiquitous learning improves trainees learning of critical concepts and ideas.
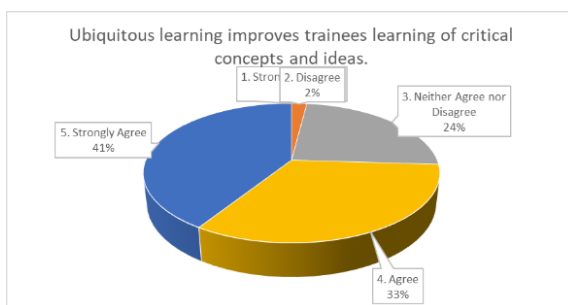
Fig 31: Critical Concepts and Ideas Learning

Ubiquitous learning environment helps accommodate trainees personal learning styles.
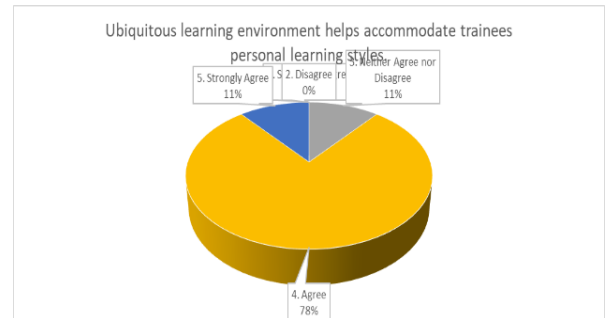
Fig 32: Trainees Personal Learning Styles

Ubiquitous computing under AI is currently emerging as an important element of wireless communication and sensing technologies.
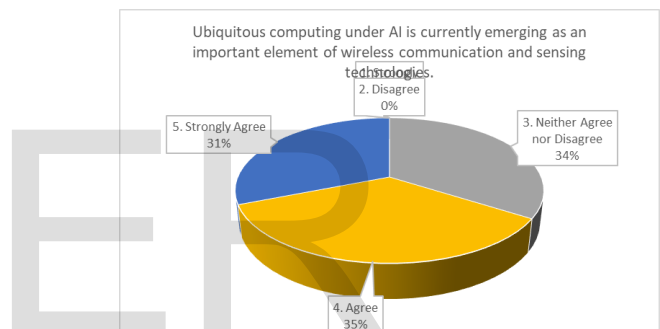
Fig 33: UL/AI in Wireless and Sensing Technologies

Intelligent AI based environment in ubiquitous computing is mainly achieved through Permanency/Continuance, Accessibility/Availability, Immediacy/Speediness, context-awareness and Flexibleness.
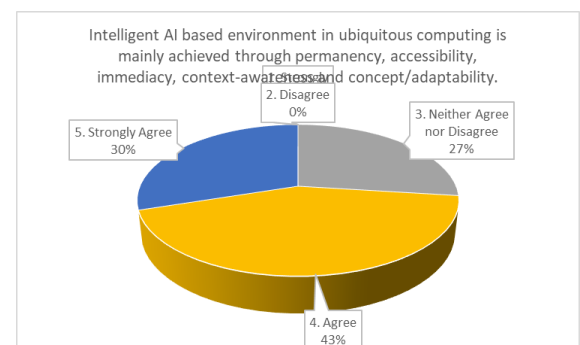
Fig 34: Permanency/Continuance, Accessibility/Availability, Immediacy/Speediness, Context-Awareness and Flexibleness

Fig 37: Technological Innovation in AI and Information Society

Combining physical, contextual, and functional prototyping techniques to generate compound prototypes and situated experience prototypes, or para types, can be particularly useful for mobile and ubiquitous computing AI applications.
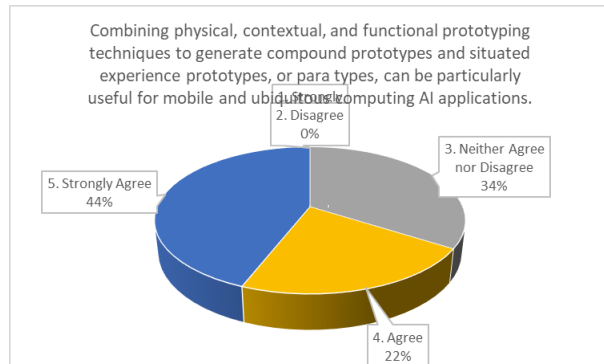
Fig 35: Prototypes

Learners are willing to help colleagues or other trainees as much as they can when they face problems using AI based ubiquitous computing scenarios.
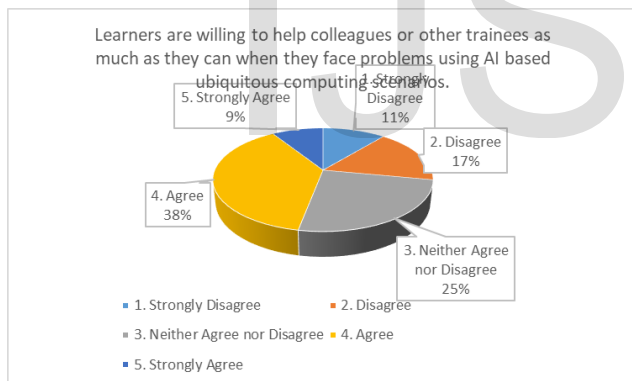
Fig 36: Helping Colleagues or other Trainees

Technological innovation is driving the emergence of AI and information-based society and this is transforming training, teaching and learning in post-compulsory education; especially in training establishments.
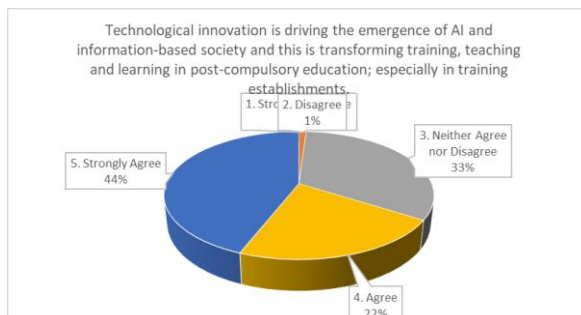
Technological adaptation helps accommodate trainees personal learning styles.
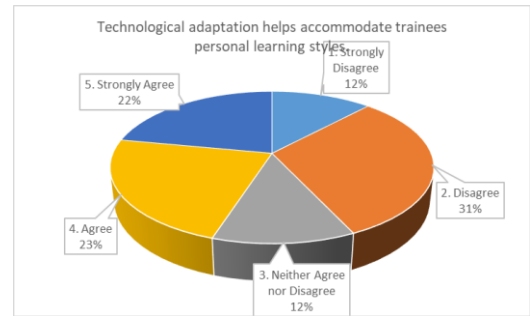
Fig 38: Learning Styles Adaptations

AI embedded technology is being used in the development of strategies for solving problems in the real world.
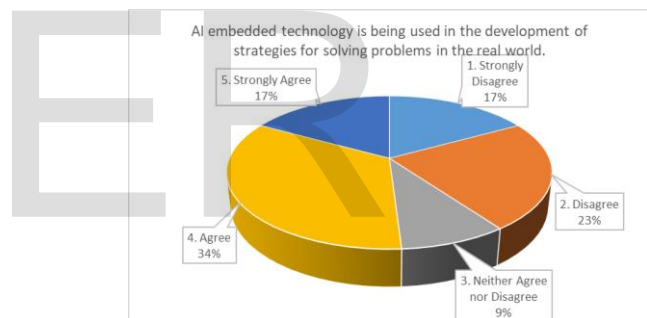
Fig 39: Embedded AI Technology for Problem Solving

Trainees can use AI based technology tools and can utilize resources for managing and communicating information.
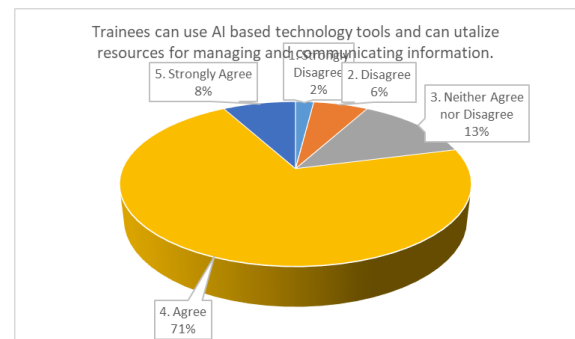
Fig 40: AI Based Tools

Descriptive indicators of main variables of the study were done. The variables had multiple dimensions measured through questionnaire items. The results obtained from questionnaires were converted to composite results in order

to use them in correlation and regression analyses. Standard Deviations and Mean of 122 cases of each variable were analyzed. Correlation matrix was obtained through running a Pearson correlation test in SPSS. There were a few prominent correlations found in the matrix such as Pearson's r value of 0.737 indicates that Permanency/Continuance was directly correlated with Accessibility/Availability. Permanency/Continuance was 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/Availability was highly correlated with Permanency/Continuance, 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 was a week relationship between Accessibility/Availability and Immediacy/Speediness, Context Awareness/Context Sensitive, and concept/adaptability. Immediacy/Speediness had a weak correlation with all the variables with a highest correlation value of 0.291 where it was correlated with the technology adaptation of the learning environment.

Context Awareness/Context Sensitive was also weakly related with all other variables except Flexibleness where it has a direction relationship of r=0.409 strength. The ubiquitous learning environment was highly correlated with Accessibility/Availability, Permanency/Continuance, and the technology adaptation of learning environment. Whereas ubiquitous computing and the technology adaptation of the learning environment were highly related with Permanency/Continuance, Accessibility/Availability and ubiquitous learning environment.

Similarly, the linear regression analysis was carried out. It explains the influence of dependent and independent variables on each other calculated through regression models in SPSS. Permanency/Continuance and other variables Regression values expressed results regarding regression analysis explaining the effect of Permanency/Continuance. Almost 73% variation in UL Environment was explained by Permanency/Continuance. Proportion of Ubiquitous-Computing which was explained by Permanency/Continuance which was higher than other values in the regression analysis, i.e. 92%. A 67.4% of Technology Adaption in Ubiquitous Learning Environment was explained by Permanency/Continuance.

Accessibility/Availability and other variables Regression values expressed the regression values of Accessibility/Availability and other variables. The regression analysis showed that 85.9% of Ubiquitous Learning Environment is explained by Accessibility/Availability, 68.3% of Ubiquitous-Computing, and 79.1% of Technology Adaptation. Effect of Immediacy/Speediness on dependent variables explained the effect of Immediacy/Speediness on dependent variables. Only marginal proportions of variation in dependent variables explained by Immediacy/Speediness. The highest R value 0.291 is the value of effect of Immediacy/Speediness on Technology adaptation on learning environment.

The Regression Analysis regarding effect of IN on ULE, UC and TALE had values regarding regression analysis pertaining to effect of Interactivity/Interactional on ULE, UC and TALE. As was indicated by the consequences that Interactivity/Interactional does not suggestively effect on depending variable as the R values were higher than 0.12 in any of the cases. Context Awareness/Context Sensitive Effects the effect of Context Awareness/Context Sensitive on Ubiquitous Learning Environment, Ubiquitous Computing, and Technology adaptation in Learning Environment have been measured. Like Interactivity/Interactional, Context Awareness/Context Sensitive had no noteworthy effect on any of the dependent variables. In any of the dependent variable no more than 16% variation had been explained by Context Awareness/Context Sensitive which may be contributed to chance.

Flexibleness Effects depicts the result related to Flexibleness and its effect on Ubiquitous Learning Environment, Ubiquitous Computing, and Technology Adaptation in Learning Environment. Flexibleness had a weak effect on Ubiquitous learning environment and technology adaptation whereas it had a strong effect on Ubiquitous computing. Almost 51% variation in Ubiquitous computing was explained by concept/adaptability.

Findings

- 35% of the respondents agreed to the fact that the required information is always available in the ubiquitous learning environment in Training and Development.
- The information available can be used for AI based ubiquitous computing was agreed by 78% of the respondents. 12% were not sure depicting their lack of knowledge about AI.
- In the AI enabled learning environment for Training and Development, the key to success is the Flexibleness of new technologies to access the information, no matter how many years back the information was uploaded. It showed strong agreement.
- The availability of information 24/7 was supported by almost everyone as key to success.
- The availability of knowledge that is up to date is perceived as challenge to majority.
- The information can be assessed through the use of smart phones, landline networks, wireless networks and other innovative products in the

Training and Development learning environment was agreed upon by overwhelming 96%.

- The learning information is available immediately from anywhere showed mixed views with 57% respondents not sure about it.
- Immediate availability of information helps the users to use online computing resources from live networks was strongly agreed.
- Immediate availability of information can be guaranteed if one has the proper technological tools (including AI) to access that information. This was agreed upon by majority of the respondents.
- Learners can easily interact with experts, Trainers, or peers showed disagreement owing to the ground reality about their availability.
- Subject gurus/experts are easily available was in line with the previous observation regarding question mark on their availability.
- Knowledge is easily accessible was agreed upon by majority.
- Real world environment provides seamless learning in Training and Development functions the ubiquitous settings as agreed by most of them.
- The question related to if the system can sense or detect different context of learners during the learning process and implement the activity of the system with the user cannot be comprehended by majority 67% with limited understanding of the users because of non-exposure.
- With the advent of smartphones or various applications, trainees can play with these gadgets anywhere they are but around 23% were not exposed to its advantages.
- Learners can get the right information at the right place in the right way experienced a mixed response.
- The availability of information at the right place in the right way helps learners and trainers take speedy decisions based on conceptualized and adaptable parameters was agreed upon by more than 80% for the respondents.
- On the question of adoption of new technologies (including AI) is no longer a barrier to change the learner's concepts and mind-set was agreed upon more than 50% of the respondents.
- The learning environment under Training and Development is context-aware, which provides adaptive and personalized support to the learners in the right way, in the right place and at the right time.
- Ubiquitous learning environment supports problem-based learning was supported by 72% of the respondents.
- Ubiquitous learning improves trainees learning of critical concepts and ideas.

- Ubiquitous learning environment helps accommodate trainees personal learning styles.
- Ubiquitous computing under AI is currently emerging as an important element of wireless communication and sensing technologies was not totally agreed upon by the respondents because of non-exposure to benefits of AI in the coming future.
- Intelligent AI based environment in ubiquitous computing is mainly achieved through Permanency/Continuance, Accessibility/Availability, Immediacy/Speediness, context-awareness and concept/Flexibleness was accepted and agreed upon by majority of the respondent i.e. 73%.
- Combining physical, contextual, and functional prototyping techniques to generate compound prototypes and situated experience prototypes, or para types, can be particularly useful for mobile and ubiquitous computing AI applications.
- Learners are willing to help colleagues or other trainees as much as they can when they face problems using AI based ubiquitous computing scenarios.
- Technological innovation is driving the emergence of AI and information-based society and this is transforming training, teaching and learning in post-compulsory education; especially in training establishments.
- Technological adaptation helps accommodate trainees personal learning styles had a mixed response with 43% disagreeing to it.
- AI embedded technology is being used in the development of strategies for solving problems in the real world was not agreed upon by 49% of the respondents. This owes to people not familiar with AI implementations.
- Trainees can use AI based technology tools and can utilize resources for managing and communicating information was agreed upon by the majority of respondents i.e. 79%.

Conclusion

The researcher has come up with a framework which takes care of the dimensions of Permanency/Continuance, Accessibility/Availability, Immediacy/Speediness, Interactivity/Interactional, Context Awareness/Context Sensitive and Flexibleness. The previous research lacked their integration. The framework gages 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 embedded AI with specific emphasis on ubiquitous learning for Training and Development functions of the selected organizations. It has further come up with a ubiquitous AI embedded learning framework which can be adopted by any entity wishing to establish AI based ubiquitous learning in Training and Development functions 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 organizations and regions of the country to come up with new frameworks which can help in designing and coming up with a future policy pertaining to AI embedded ubiquitous learning in Training and Development Environment.

References

Alhassan, R. (2016). Mobile Learning as a Method of Ubiquitous Learning: Students Attitudes, Readiness, and Possible Barriers to Implementation in Higher Education. *Journal of Education and Learning; Vol. 5, No. 1; 2016*, 14. Retrieved from https://files.eric.ed.gov/fulltext/EJ1097795.pdf.

Aljohani, N. R., & Davis, H. C. (2012). Learning Analytics in Mobile and Ubiquitous Learning Envirnments. *11th World Conference on Mobile and Contextual Learning* (p. 8). Finland: mLearn 2012.

Aljohani, N. R., Davis, H. C., & Loke, S. W. (2012, October). A comparison between mobile and ubiquitous learning from the perspective of human-computer interaction. *International Journal of Mobile Learning and Organisation, 6*(3-4), 218-231.

Boyinbode, O., & Akintola, K. (2009, May). Effecting E-Learning with U-Learning Technology in Nigerian Educational System. *The Pacific Journal of Science and Technology, 10*(1), 7.

Chen, Y.-S., Kao, T.-C., Sheu, J.-P., & Chiang, C.-Y. (2002). IEEE International Workshop on Wireless and Mobile Technologies in Education. In H. U. Marcelo Milrad (Ed.), *A mobile scaffolding-aid-based bird-watching learning system* (pp. 15-22). Tokushima, Japan: IEEE Computer Society Press.

Cooper, D. R., & Schindler, P. S. (2008). *Business research methods* (10 ed.). New York: The McGraw-Hill/Irwin.

Cope, B., & Kalantzis, M. (2006). Ubiquitous Learning: An Agenda for Educational Transformation. *6th International Conference on Networked Learning. ISBN No: 978-1-86220-206-1.* (pp. 206-1). Illinois at Urbana-Champaign: College of Education, University of Illinois at Urbana-Champaign.

Cope, B., & Kalantzis, M. (2007). New Media, New Learning. *The International Journal of Learning, 14*(1), 75-79.

George, D., & Mallery, P. (2003). *SPSS for Windows Step by step: A Simple Guide and Reference 11.0 Update* (4 ed.). Boston: Allyn & Bacon.

Geser, H. (2004, March). Towards a Sociological Theory of the Mobile Phone. *Sociology in Switzerland: Sociology of the Mobile Phone. Online Publications, Zuerich, March 2004 (Release 3.0).*, 47.

Gokben, A. G., & Yakin, I. (2014, January). The Status of Mobile and Ubiquitous Learning: A Content Review of the Recent Research. *Ubiquitous Learning: An International Journal*, 12.

Hasibuan, P. Z. (2013). *Ubiquitous Learning: Revolutionizing Education System.* Indonesia: Education, Technology.

Herald. (2019, April 18). *Industry.* Retrieved from Reports Harald: https://reportsherald.com/infrastructure-as-a-service-iaas-market-emerging-trends-and-their-impact-on-present-and-future-development/

Hwang, G.-J., Tsai, C.-C., & Yang, S. J. (2008). Criteria, Strategies and Research Issues of Context-Aware Ubiquitous Learning. *Journal of Educational Technology & Society, 11 (2)*, 81-91.

IndiaMART. (2019, April 18). *Indiamart.* Retrieved from Cloud Solutions: https://www.indiamart.com/geminisolutionsltd/cloud-solutions.html

IndiaMART. (2019, April 18). *Platform as a Service (PaaS) in New Delhi, Gandhi Vihar by R & M Brother Services | ID: 12394089491.* Retrieved from IndiaMART: https://www.indiamart.com/proddetail/platform-as-a-service-paas-12394089491.html

Irby, T. L., & Strong, R. (2015, March). A Synthesis of Mobile Learning Research Implications: Agricultural Faculty and Student Acceptance of Mobile Learning in Academia. *NACTA Journal . Jun2015, Vol. 59 Issue 2, p10-17. 8p*, 8. Retrieved from https://www.nactateachers.org/index.php/volume-59-number-1-march-2015/2271-a-synthesis-of-mobile-learning-research-implications-agricultural-faculty-and-student-acceptance-of-mobile-learning-in-academia.

ITU. (2018, May 6). *ITU.* Retrieved from International Telecommunication Union: https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

Jing, L., Cheng, Z., & Huang., T. (2017). *Search in Virtual and Study in Real: A Ubiquitous Query/Answer System.* Tokyo: JSPS (Japan Society for the Promotion of Science).

K., B. O., & K.G., A. (2008, November). A Sensor-Based Framework for Ubiquitous Learning in Nigeria. *International Journal of Computer Science and Network Security (IJCSNS), 8*(11), 401-405.

Karoudis, K., & Magoulas, G. D. (2016, October). Ubiquitous Learning Architecture to Enable Learning Path Design across the Cumulative Learning Continuum. *Informatics, 3*(4), 15.

Keengwe, J. (2015). *Promoting Active Learning through the Integration of Mobile and Ubiquitous Technologies* (Vol. 6). University of North Dakota, USA: IGI Global.

Lentini, J. (2012, April 4). *Mobile Learning as a form of eLearning. | 20103364jlentin*. Retrieved from https://20103364jlentini.wordpress.com/: https://20103364jlentini.wordpress.com/2012/04/04/mobile-learning-as-a-form-of-elearning-6/

Lyytinen, K., & Yoo, Y. (2002, December). Issues and Challenges in Ubiquitous Computing. *Communications of The ACM - CACM. 45. 10.1145/585597.585616.*, 4.

Monteiro, B. S., SandroGomes, A., & Netoa, F. M. (2016, 2 15). Youubi: Open software for ubiquitous learning. *Computers in Human Behavior, 55*, 1145-1164. Retrieved from ResearchGate.Net.

Moreira, F., Mesquita, A., & Peresb, P. (2017). Customized X-Learning Environment: Social Networks & knowledge-sharing tools. *Procedia Computer Science. 121*, pp. 178-185. Barcelona, Spain: Elsevier B.V.

Ogata, H., Li, M., Hou, B., & Uosaki, N. (2011). SCROLL: supporting to share and reuse ubiquitous learning log in the context of language learning. *Research and Practice in Technology Enhanced Learning. 6.*, 14.

Pachler, N., Seipold, J., & Bachmair, B. (2015). *Mobile Learning | Some Considerations.* London: londonmobilelearning.

Park, S. Y., Nam, M.-W., & Cha, S.-B. (2011, October). University students' behavioral intention to use mobile learning: Evaluating the technology acceptance model. *British Journal of Educational Technology 43(4)*, 592-605. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-8535.2011.01229.x.

Pimmer, C., Mateescu, M., & Gröhbiel, U. (2016, October). Mobile and ubiquitous learning in higher education settings. A systematic review of empirical studies. *Computers in Human Behavior, 63*, 490-501.

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students* (5 ed.). London: Prentice Hall / Financial Times.

Scholtz, J., & Consolvo, S. (2004, April). Toward a Framework for Evaluating Ubiquitous Computing Applications. (V. Stanford, Ed.) *IEEE Pervasive Computing, 3*(2), 82-88.

Subiyakto, A., Hidayah, N. A., Gusti, G., & Hikami, M. A. (2019, February). Readiness and Success of Ubiquitous Learning in Indonesia: Perspectives from the Implementation of a Pilot Project. *Information (2078-2489), 10*(2), 79.

Xorlogics. (2017, July 31). *The Lessons of Cloud Computing*. Retrieved from Xorlogics: http://www.xorlogics.com/2017/07/31/the-lessons-of-cloudcomputing-what-have-we-learned-so-far/

Yahya, S., Ahmad, E. A., & Jalil, K. A. (2010). The definition and characteristics of ubiquitous learning: A discussion. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2010, Vol. 6, Issue 1, pp. 117-127., 6*(1), 117-127.

Yang, S. J. (2006, January). Context Aware Ubiquitous Learning Environments for Peer-to-Peer Collaborative Learning. *Journal of Educational Technology & Society 9(1), 9*(1), 188-201.

Ye, X., Jing, L., & Cheng, Z. (2008). 2008 IEEE 8th International Conference on Computer and Information Technology Workshops. *A Ubiquitous Learning System Using Co-learning Ubiquitous Pet for Enhancing Educational Effect* (pp. 494-500). Sydney, Australia: IEEE. Retrieved from https://ieeexplore.ieee.org/document/4568553/.

Zolkefley, M. K., Tahir, Z. M., Lokman, A. M., Aziz, A. A., & Sharif, S. M. (2015). A Conceptual Model of Ubiquitous Language Learning Environment (ULLE). *5th International Conference on Computing and Informatics, ICOCI 2015* (pp. 81-88). Istanbul, Turkey: Universiti Utara Malaysia.