IMPACT OF UBIQUITOUS LEARNING ENVIRONMENT ON STUDENT ENGAGEMENT AND SATISFACTION IN FLIPPED CLASSROOMS UBIQUITOUS LEARNING ENVIRONMENT

SAADIA HASSAN ADULLAH HAMMZA

Computer Science, College of Science and Humanities, Slayel, Saudi Arabia
E-mail: s.hamza@psau.edu.sa

Abstract - The development of open learning environment depends on changing structures, digitalization of society, and tightening of resources. In the similar context, the present study aims to investigate the impact of ubiquitous learning environment (ULE) on Student Engagement and Satisfaction in Flipped Classrooms. The study has also provided systematic and transparent information regarding the development process. ULE was produced in the histo-technology context based on the review. The data gathered from 115 students was collected electronically and analyzed statistically. The results showed decreased popularity of ULE in the higher education institutions. Moreover, the level of engagement and satisfaction was increased among the students with the use of ULE with significant improvements in their knowledge. The study concludes with the fact that ULE is effective and valid, in comparison to the conventional environment in biomedical laboratory science degree.

Keywords - Ubiquitous Learning Environment (ULE), Flipped Classrooms, Biomedical Laboratory Science Degree

I. INTRODUCTION

Over the years, the focus on digitalization of education has increased and studied extensively. Various activities are enabled by digitalization for the transformation of conventional services towards digital technologies, resources and devices to render effective opportunities [1,2]. An extension of electronic and mobile learning is observed in ubiquitous learning environment (ULE), as it transcends educational barrier in class activities [3]. This offers studying anywhere, anytime, without any limitations and restrictions [4].

Universities are enabled to fulfil the needs of students and offer online learning by undergoing multiple improvements in the digital information to be used for educational purposes [5]. The modernization of pedagogy, teaching methods, and learning environments by digitalization brings about prominent improvements. The development of effective teaching methods and adequate learning environments is promoted by the educational centers for raising the level of education and competitiveness [6].

Based on the ubiquitous computing, ubiquitous learning is considered as an expansion of electronic and mobile learning with tight integration and increased mobility within the learning environment [7]. Learning while moving is allowed by seamless communication between users, devices, and learning spaces that attaches the students to the current learning environment with highly accessible and ubiquitous digital resources for communicating and knowledge creation [8].

There is significant variation in the composition of ULE. Usually, the authentic learning spaces, digital technologies, resources, and devices are combined under one-unit learning environment to develop ULE. Personalized, flexible, and interactive learning is enhanced by ULEs, which favors the transition of theory to practice [9].

Digitalized learning processes and seamless interactions are supported by ULE. Previous studies have demonstrated the importance of flexibility, personalization, increased accessibility, permanence, and interactivity in developing ULEs [1,10]. However, the ULEs are not widely accepted and used in health and medical science.

Flipped classrooms offers blended learning by including aspects of traditional and advanced learning environments. According to Bergmann and Sams [11], this type of classroom provides basic materials to the students beforehand, which help them in understanding of that particular material in class later. For instance, internet is used during lectures for communicating with students outside class and provide materials to the students for further preparations. The provided materials may include different videos, articles, or online courses. Although, flipped classrooms provide interesting study of engagement among the students, it is also a great challenge to provide the best learning experience to the students. However, studies focusing on student engagement and learning in ULE are lacking. Moreover, previously flipped classrooms have mainly focused on student and teacher experiences and their engagement. The strong competence of teachers, self-directed learning activities, instructional lecturing, hands-on training, and teacher-centered in-class activities provide the basis for formulating effective teaching methods. In the field of histo-technology, the teachers have taken significant advantage from

different conventional methods, used previously. Therefore, there is need to study the development and effectiveness of ULE and its impact on student engagement and satisfaction. Similarly, systematical and transparent information about the development phase is narrated that has remained unexplained previously within the higher education sector. There is need to focus on level of satisfaction among the students, along with their engagement capabilities. Therefore, the present study aims to investigate the impact of ULE on Student Engagement and Satisfaction in Flipped Classrooms.

A. Student Engagement

Different aspects such as emotion and behavior are included in student engagement, which is affected by different teaching styles and learning environments [12]. It is believed that adequate engagement of students has significant impact on their learning experiences and outcomes. The perceived benefits of learning and development of students define the significance of their engagement in higher education.

It is narrated that student engagement improves student performance and increase their satisfaction level with close association to higher quality learning outcomes [13]. Effective student engagement is associated with positive retentions and improves experiences and outcomes of disabled students [14,15]. It creates collaborative and active learning environment, along with the peers, which provide stronger voice to the students with significant impact on their learning.

It is not just that the students benefit through engagements, rather the educational institutions also provide the best learning environment to decrease the number of dropouts and lead to better level of satisfaction among the students [14]. This is because a great amount of effort put in by the students, who remain engaged with the environment and peers, and they are likely to remain persistent with their studies and never give up. Universities can make use of the data about engagement of students to improve their teaching practices and make appropriate adjustments in the learning environment to increase the engagements.

Information related to increasing engagement of students is useful in preparing, designing and delivering lectures and other learning activities for getting better learning outcomes. This information would also be useful for the staff and teachers for identifying students, who are likely to fail or either drop out at some point [16]. Designing and implementing early interventions would be helpful for the struggling students.

The traditional teaching methods such as delivering face to face lectures are mainly focused for increasing student engagement. However, the increased popularity of distant learning and online courses has developed the interest in engagement in online learning environments as well [17]. Therefore, flipped classrooms integrated with traditional as well as online learning environment are gaining immense popularity.

B. Student Satisfaction

Multiple models are used for evaluating the effectiveness of educational activities (Figure 1);

- Model by Kirkpatrick [18] that is used for objective evaluation of the educational settings.
- Model by Phillips [19] used for evaluation.
- Model by Kaufman et al. [20] used to study impact of education on society

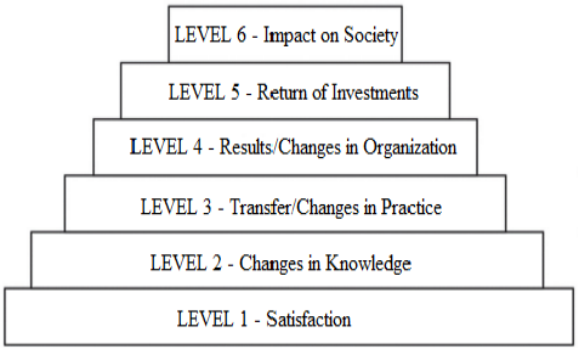


Figure 1. Model to evaluate effectiveness of educational activities [18-20]

Based on the pyramid shown in figure 1, the evaluation of educational setting is conducted at two levels. At the organizational level, evaluation of change in practice, investments, cost effectiveness, and contribution to the organizations is conducted. The assessment of impact of ULE at higher level is concerned with the entire society; for instance, at the government level. The present study has focused on student engagement and level of satisfaction among the students.

The level of satisfaction among the students is directly associated with expertise of teachers, relevance of instructions, flexibility, self-directed opportunities, interactivity, facilities, feedback, convenience, and customized contexts [21, 22]. The implementation of technology enhanced learning methods that help in achieving the desirable level of satisfaction in educational environment [22]. The level of satisfaction among students can be defined based on the pedagogical aspects, perceived enjoyment, satisfaction of technological aspects, and instructions/feedbacks. Multiple methods such as quizzes, interviews, questionnaires, and observations are conducted to assess the level of satisfaction among the students [22, 23]. Quantitative method like written exams, along with practical testing are used to assess the changes in knowledge by focusing on their scores and grades [24].

C. Study Aim

ULEs are known to provide new era of learning environments that support seamless learning,

regardless of the place and time. The development of flexible and content personalized environment is the necessity of digital learning environment. It is important to understand the meaning of interaction, interactivity, and collaboration among the students and their peers. Therefore, it is believed that an effective learning environment for students can be built by incorporating authentic learning space, functional objects, mobile devices, social media tools, ubiquitous digital learning resources, sensing technologies, wireless networks, and cloud-based approaches. Student engagement and level of student satisfaction needs to be assessed based on technological, pedagogical, feedback, and instructions. The theoretical framework considered in this study is presented in figure 2.

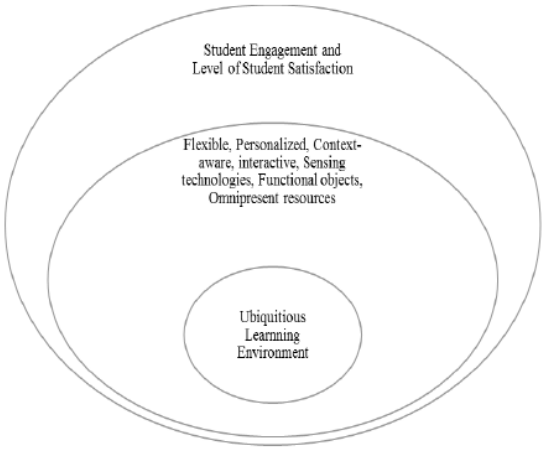


Figure 2. Research Model

This study mainly focuses on the impact of ULE on student engagement and level of satisfaction in biomedical laboratory science degree. The study also provides systematic and transparent information on the development process during the developmental and evaluation phases. Different methods including; observations in class, logging traffic to the course's website, and interviews were conducted to collect data. The study results would clarify the engagement and level of student satisfaction in ULE setting.

II. METHODS

The overall study was conducted in two phases;

- Development phase – involves defining the ULE criteria, along with the framework used for development.
- Evaluation phase – involves the analysis made in the final version of ULE.

These phases were in accordance with the Medical Research Council Model that is used for developing complex intervention. This helped in analyzing the perceptions of students, along with positive effects and developmental needs.

A. Developing ULE

Multiple software was used for custom-made production of ULE, based on the vision and previous knowledge of the researcher. The presence of flexible and interactive learning environment is important to replicate the real-life learning situations. The main criteria involved in the selected method included; time consumption, easy use, costs, agile development, and content production. Various digital objects such as texts, audios, and videos were embedded in the environment. Other functional objects included; sensing technologies, mobile devices, and quick response barcodes. Figure 3 has illustrated the overview of ULE.



Figure 3. Overview of ULE

The final version of ULE was implemented in histo-technological context. The present study has mainly focused on histo-technological processes, tissue morphology and cell structure, techniques of tissue sampling, and laboratory processes.

B. Implementing ULE

The scheduling of weekly program, along with the intervention duration was set for around eight weeks based on the local curricula. All the learning devices and resources were free to use in the ULE; whereas, the communicative tools were used to support the interactions. Here, there was absence of functional objects, communicative tools, panorama image, and mobile devices.

C. Study Procedure

Total of 200 students were enrolled in the program; however, only 115 of them willingly participated in the study. The study participants were divided into control and experimental group. The control group comprised of 61 students; whereas, the experimental group comprised of 54 students. The average age of students was 26.5 years, with no significant difference in their background information. The students were included in the study after receiving verbal consent, where they were explained about the study protocol, resources, and methods.

Considering the development phase, the intervention phase lasted for 5 weeks with minor changes made in the final version of ULE. The programmer optimized technical usability and cloud-based approaches were used to strengthen the interactivity. The optimized version with shortened videos was implemented in the final study design.

An electronic questionnaire was used to collect data about student engagement and level of satisfaction. The subscales used in data analysis included; level of student satisfaction, self-motivation, engagement, and perceived enjoyment. A total of 25 items were included in the questionnaire based on the Likert scale for determining the positive aspects and developmental needs of a learning institution.

D. Data Analysis

The data analysis was conducted in three phases including, preparation phase, organization, and reporting phase.

- Preparation phase – include reading of raw data multiple times and compare it against the research questions.
- Organization – involves analysis unit to define the formalized categories.
- Reporting phase – presenting charts in an organized form under higher categories.

III. RESULTS

The study has mainly focused on the perception of students regarding the implementation of flipped classrooms that include ULE and conventional environment in an educational setting. The level of student engagement and satisfaction was assessed in control and experimental groups.

The overall mean for in experimental group was 3.8; whereas, the control group achieved mean value of 4. In the experimental group, the students showed maximum engagement and satisfaction with the used technology, with mean value of 4.2. The use of pedagogical methods received mean value of 4. Decreased level of engagement and satisfaction was observed in enjoyment (3.7) and self-motivation (3.8). The instruction and feedback subscale with mean value of 3.6 showed decreased level of engagement and satisfaction among them.

Considering the control group, the lowest estimations were evaluated for enjoyment with mean value of 3.8. There were small differences between groups in every subscale. The instruction and feedback subscale were observed to show statistically significant difference between both the groups with p-value >0.001. The mean value for experimental and control group for instruction and feedback subscale was equal to 3.6 and 4.1, respectively (Table 3).

Week	Aim	Measurement
1 to 3	Diagnosis and patient treatment Normal cell structure and tissue morphology	Finding pathological basis of diseases Neoplasms investigated through organ pathology
4 and 5	Assessing tissue sampling techniques	Techniques of tissue sampling
5 to 8	Laboratory processes	Strategies for safety and quality management

TABLE I. RESULTS FOR LEARNING OBJECTIVES

The results of present study have shown positive aspects of ULE, along with the developmental needs. The positive aspects include; flexible learning content, use of digital learning resources, diversity, personalized and flexible timetables. On the contrary, technological usability and instructions required significant development. The responses obtained from the students highlighted the need of detailed instruction, technical support, structured course planning, and general supervision.

The study results clarify that level of engagement and satisfaction among the students was higher in the experimental group, in comparison to the control group. Student engagement and level of satisfaction was increased for all subscales in both the groups; rather than significantly higher only in experimental group in any of the subscale.

IV. DISCUSSION

Based on the theoretical and empirical knowledge, the development process was transparent and systematic. Few of the previous studies stated that majority of the ULEs are custom-made for specific tenacities, without involvement of practical implications, transparent reporting, and possibility of reimplementing [25-28].

Comparing the study results with the scoping review, it is stated that the produced learning environment is effective as it provides pervasive and seamless learning opportunities with increased flexibility and accessibility. The user present at definite position is responsible for providing and controlling the context-aware and personalized learning contents. The present study shows that ULE supports the interaction between teachers and peers. The results also confirmed personalization, flexibility, and context-awareness at a relevant level. Learning among the students is supported by personalized contents, information sharing strategies, clear objectives, detailed scheduling, along with the aspects of context-aware.

The interaction between teachers and students require critical development that is consistent with the results deduced in the previous studies [29-31]. These studies have also stated relevance with personalization, interaction, and feedback. The undeniable benefits included with ULE include self-regulated learning situations, enhanced interactions, and personalized services. The implementation of ULE is likely to be interfered by lacking in technological literacy among the teachers and educators [32]. The lack of technological literacy may cause problems in technical usability of different applications. A study conducted by Senik and Broad [33] listed the main barriers in successful implementation of ULE including; lack of interest, lack of resources, resistance to innovation, and preference of conventional methods.

The development of ULE requires the assistance of many experts that use various technologies, approaches, and methods in its development. In the field of education, the use of ULE is considered as very interesting and relevant. This method is known among the most interesting methods across the world for educational use with inculcated technologies.

The results of present study have demonstrated that the level of engagement and satisfaction increased among the students in flipped classroom with ULE. Comparison of changes in ore-test and post-test scores showed increased level of student engagement in both the groups (p-value = 0.01). Significant differences were observed in the pre-test scores between both the groups. According to the present study, the students from experimental group scored significantly lower in the start, unlike the students from the control group. Students are likely to face many challenges while learning in a non-linear environment. The environment is significantly challenged based on the level of motivation among the students and their learning styles. Increase in knowledge about ULE causes biasness, which is followed by critical misinterpretations. However, the results of present study are not observed as anything more indicative due to small sample size.

Previous studies, similar to present study have regarded satisfaction as a relevant quality factor [34, 35]. It is not possible to explain the definition and assessment of satisfaction as a multidimensional issue. In the present study it was observed that students were keen to learn and use new technologies. They literally enjoyed adequate instruction and provided instant feedbacks, when provided with supportive guidance. These results were supported by few of the previous studies as well [36, 37]. These studies have shown that timely response along with adequate instructor feedback has significant impact on the level of student satisfaction. One of the studies have also shown that level of satisfaction among the students increase as the result of using high quality resources and learning materials [28]. Rodriquez et al. [38] showed recommended distribution of versatile learning resources that helps in gaining maximum knowledge among the students.

Surprisingly, it is shown that level of satisfaction among the students was high in conventional setting as compared to the ULE. This might be because of increase in the cognitive load. Similarly, previous studies have also confirmed significant interactions between use of new technologies and increase in cognitive load [25, 26].

V. CONCLUSION

The present study has mainly focused on the environment setting of flipped classrooms after introducing ULE. The results demonstrated gradual increase in the ULE's popularity in higher education institutions. A logical framework was provided through systematic process to develop, evaluate, and generate new scientific knowledge for supporting the teachers in near future. The study has provided a concrete example of classrooms after introducing technological constructs and important factors for effective learning environments.

Regardless of the space and time, ULE provide flexible opportunities to the students for studying and learning real-life learning situation in a digital way. Increased level of engagement, motivation, and satisfaction among the students increases their learning capabilities in an easy to use environment. The feedback received from the students provided the basis leading towards continuous developments in future. Moreover, it tends to offer new strategies and perspectives to the educators in pedagogical development.

The implementation of ULE in health care organizations is likely to offer new pathways leading to enhanced student learning in future. The orientation of student in their respective work placements may be supported based on real-life learning situations. Based on the study results, it is believed that the implementation of ULE in the workplace environment would impose significant positive impact on the coaching patterns of work-life.

VI. RECOMMENDATIONS

The use of ULE within a society is likely to provide flexible and effective possibilities to widen and rearrange the setting of higher education institutions. The learning activities are supported by reduced resources that are targeted accurately using novel approaches. The education export, along with building up of new clusters of knowledge is increasingly supported by the development of ULE in higher educational institutions. This type of environment ensures to generate positive learning experiences and performances that increase level of engagement and satisfaction among students and their peers, unlike the use of conventional methods.

The study recommends the use of ULE in all the fields; although, the present study has mainly focused on histo-technological setting. It is known that ULE has been implemented in institutions dealing with oral health, radiography, and midwifery by following the development process of this study.

The basic recommendations provided by the study are as follows;

- The permanent adoption of ULE in histo-technological setting is likely to provide effective, supportive, and diverse learning experiences.
- Student interaction is confirmed based on further development and optimization of ULE.
- In future, it is expected that conventional learning environment would be transformed

into a personalized, flexible, context-aware, and interactive learning environment.

- Future studies need to consider larger sample size in diverse setting to strengthen the study results.

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