Enhancing Learner Interest & Motivation in an AR supported Experiential Learning Classroom

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Abstract. The rising exposure of learners to diverse digital and web technologies in their everyday lives has been raising concerns among the educationists as a growing gap has been noticed between students' living styles and the passive teaching & learning methodologies they experience in the classrooms. Therefore the target of current discussions among the researchers is towards upkeeping the learner interests and motivation through enhancements of the classrooms. There are suggestions for the inclusion of interactive & immersive digital tools in the learning process so as to maintain the learner engagement. While Augmented Reality (AR) has been an interesting and immersive technology being used in several educational fields, its way of inclusion in the classroom environment has been limited. Therefore this study aimed at constructing an enhanced learning environment incorporating AR technology into an experiential learning classroom using Kolb's Experiential Learning Model (ELM). The undergraduate students of a digital marketing course from a Malaysian university were chosen as the sample for this mixed mode research study, including both qualitative & quantitative methods. Based on the exposure of the students to this tech supported learning space, the data was collected through surveys, interviews and open ended questions. The data analysis & results showed significant feedback towards an improved learning interest, motivation and student engagement, and thus leads to an eminent support for inclusion of immersive technologies like AR for enhanced learning processes, guided by ARELC (Augmented Reality supported Experiential Learning Classroom), a learning framework to help the educators construct an interesting, immersive, motivational and interactive learning environment.

Keywords: Augmented Reality, Experiential Learning, Digital Technologies, Student Motivation, Engagement

1 Introduction

Education has been an area of intense research & development since time immemorial. While many interesting innovations are becoming part of our 21st Century classrooms, the introduction and inclusion of diverse types of digital technologies for supporting teaching and learning is seeing an upward trend. This is in conjunction with the growing gap between the students' rising exposure to diverse technologies in their everyday lives and thus lack of such experiences in their learning environments. A significant difference between the learners' current living styles and the passive teaching methodologies they experience has been a rising concern for the educationists, thereby raising the demands for the inclusion of some interesting technologies that can render lasting and impactful learning experiences and upkeep with the changing living & learning environments [1].

While such demands have been raised in the past few years, the potential of digital technologies in providing an undisrupted and quality flow of education was further

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challenged by the oncoming of Covid-19 pandemic in the year 2020 [2]. A mega shift of teaching and learning mode to online became inevitable during this pandemic time, thus leading to complete reliance on the use of web applications and technologies to remain connected with the learners worldwide. The ongoing educational challenges such as maintaining learner interest, student engagement & interaction, upkeeping student motivation, and most of all keeping them connected through collaborations, were further highlighted. This added to the demand for the creation of enhanced constructive classrooms wherein the role of a lecturer shifts to being a facilitator while at the same time the students also understand the importance and requirement of a quality and long lasting education and thereby feeling motivated towards the classroom learning.

For fulfilling these educational requirements, there is a suggestion for the inclusion of interactive, immersive and other digital tools within the classroom environments for maintaining learner involvement in the learning process [3] and making the students prepared for such learning methodologies in case of unprecedented times ahead.

1.1 Inclusion of AR in Education

Research indicates that the inclusion of online, web and immersive technologies in education is fast gaining momentum for content delivery and fulfilling certain parts of projects. As per the Education Horizon Report of 2022, immersive technologies like Augmented Reality (AR), Virtual Reality (VR) & Mixed Reality are seen to be creating an engaging impact in the field of education as they support understanding of deep concepts through interaction between the real and virtual worlds along with the user [1], thus rendering an enhanced and an interactive experience. Of all these extended realities, the inclusion of AR in curriculum of subjects such as STEM, Business, Law, History & Geography, to name a few, has been seen mostly in the form of games and overlay of extra information such as study of solar systems; architecture styles; human anatomy & biology, etc [4]. Its positive outcomes have been noted in the form of increased student motivation, enhanced learner interest through direct interaction with the study material and concepts, better investigation skills, in depth understanding of spatial structures and improved engagement [5].

Though a number of benefits of AR have been noticed and mentioned, yet its other dimensions need to be explored in the field of education. Not many instances have been recorded of AR being part of the class environment to render contextually rich visual learning experiences that can help in an impactful understanding of the concepts, thus leading to lifelong learning & knowledge retention. Therefore this study aimed at incorporating AR technology into an experience based learning environment using "Kolb's Experiential Learning Model (ELM) (1984)" as the underlying pedagogy to develop a framework for the construction of immersive classrooms and also answering the research question, *"How does AR technology leads to enhanced learner interest & motivation in an experiential learning classroom?"*.

1.2 Theoretical Underpinning

To address the raised concerns on teaching and learning, this study undertook the fabrication of an enhanced, constructive, experiential learning environment involving the amalgamation of AR technology with Experiential Learning Model (ELM) (refer to Fig 1.), which was introduced by a famous educational theorist David Kolb in the year

1984. This model comprises 4 stages of learning via experiencing leading to substantial knowledge construction. These stages are "Concrete Experience (CE)", "Reflective Observation (RO)", "Abstract Conceptualization (AC)" and "Active Experimentation (AE)".

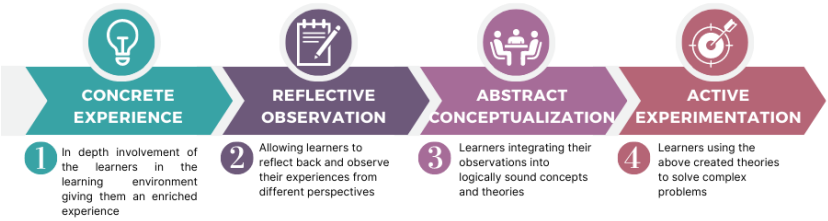

Fig 1. David Kolb's Experiential Learning Model (ELM)

The use of ELM has been quite prominent in education over the time as it supports effective knowledge transfer and retention while maintaining an exciting, engaging & constructivist learning environment [6]. It supports a self-directed learning process, shifting the role of a teacher to a facilitator and also converting the classroom into a student centred learning environment [7]. Identifying the situations or problems, then reflecting on the previous understanding, applying solutions and then experimenting with those solutions is what constitutes an experiential learning cycle. Its positive outcomes has been reported in the form of enhanced learner engagement, motivation and interest, problem solving and critical thinking [8].

Keeping these perspectives in view, the ELM theory, along with the inclusion of AR applications such as Assemblr Edu and Spark AR, was used for facilitating a learning environment that supported the enhancement of learner interest and motivation in the classroom.

2 Methodology

For this AR supported Experiential Learning Environment, 22 undergraduate students of a Malaysian university, undergoing a digital marketing course, were exposed to this tech supported learning space. The Experiential Learning Model's 4 Learning elements were mapped to the learning environment (as seen in Table 1).

Table 1. The 4 ELM elements mapped to the learning environment

"Experiential Learning Elements (Kolb, 1984)"	Enhanced Classroom Learning Activities
"Concrete Experience"	"Students made to collaborate and work in teams on authentic and real projects to explore their basic understanding of the use of concepts in real world" "Use of AR apps and web 2.0 tools to render extra information to the students for in depth knowledge"
"Reflective Observation"	"Use of real world scenarios of application of concepts to let students think and visualize the problems leading to deep understanding"

	"Use of formative assessments to help students reflect back on their learning"
"Abstract Conceptualization"	"Lecturer, who is now the facilitator, evaluates the students based on their performance" "Constructive feedbacks, perspectives and guidance given to the students on the concepts in which they are required to re-evaluate their conceptual understanding"
"Active Experimentation"	"Through the use of AR applications, students are asked to test their understanding by constructing their ideas and giving relevance to their knowledge and understanding".

The implementation of ELM model's 4 elements in class has been explained in the below Figure 2.

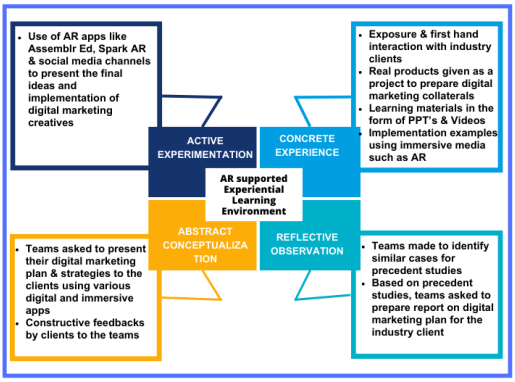

Fig 2. Implementation of ELM model's 4 elements along with AR in class

The implementation of these stages in the class has been further reflected in the form of a collage in below Figure 3.

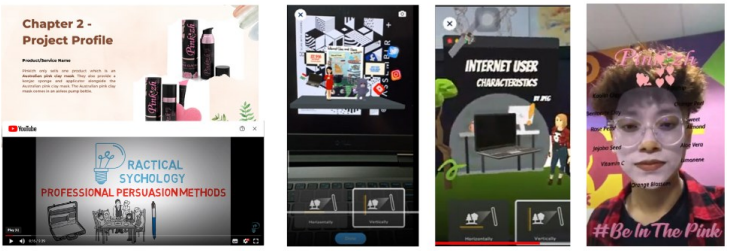

Fig.3. Marketing Students' Implementation of ELM model's 4 elements along with AR in class

To study the impact of AR supported experiential learning classroom, a mixed mode methodology was employed to gauge the experience and perception of 22 students during a 14 week long trimester. Various data collection instruments such as surveys, interviews and open ended questions were designed to record their responses.

3 Analysis & Results

The impact of AR supported learning environment was evaluated on the basis of a 5-point Likert Scale survey questionnaire in which: 5 = Strongly Agree; 4 = Agree; 3 = Undecided; 2 = Disagree, and 1 = Strongly Disagree. This was followed by some open ended questions and interviews from the students. Through the survey we looked into the following constructs, including, Enhanced Learner Interest [4], [9]; Increased Motivation [5], [13]; Improved Collaboration [12], [14] & Enhanced Critical Thinking [11] and [15].

Starting with the Enhanced Learner Interest, the results in the Table 2. clearly indicate that 90.91% (Mean = 4.14) felt interested & engaged in the learning process while 86.37% (Mean = 4.14) of students could retain their attention while learning their course content and 86.36% of them (Mean = 4.18) expressed their desire of completing their activities involving the use of technologies. All these results and supporting comments are in conjunction with [4] and [9] in their research.

Table 2. Survey results on the Enhanced Learner Interest

"Enhanced Learner Interest"			
Item	**Mean (M)**	**Std. Dev (SD)**	**% (p)**
1. "Overall the experience of implementing the learning on real projects was quite interesting & insightful"	4.14	.889	90.91
2. "I was able to maintain my attention while learning the required content"	4.14	.941	86.37
3. "I would like to have more of my course subjects studied through interactive experiences"	4.18	.958	86.36
4. "I felt active & involved in the learning process of this class"	4.05	.950	81.82
5. "I was able to generate interesting assignment/project outputs through the use of online tools & immersive applications that we were exposed to"	4.00	.976	77.27
Student Comments *1. "The use of AR for learning activities helped me maintain my interest and interact with my teammates in understanding and discussing".* *2. The overall experience had me engaged through the course filled with activities and case studies that i hope i can apply on my future work* *3. "The interactions helped me and others in sharing our knowledge and experiences".*			

Moving onto the next construct i.e. Motivation (refer to Table 3.), 91% of the students (Mean = 4.23) felt motivated on collaborating with their classmates while completing projects using variety of tools & technologies. 86.36% (Mean = 4.05) and 81.82% of them (Mean = 4.00) also agreed that they felt motivated and confident in their level of understanding after going through such deep experiences of learning. This indicates

high motivation among students while experiencing the learning of certain concepts using AR, which supports the research by [5] and [13].

Table 3. Survey results on the Increased Motivation

"Increased Motivation"			
Item	**Mean (M)**	**Std. Dev (SD)**	**% (p)**
1. "I feel motivated towards collaborating with my classmates on completing a project using variety of tools & technologies"	4.23	.922	90.91
2. "I feel motivated after going through such deep experience of learning"	4.05	.899	86.36
3. "I observed internal changes in confidence level & knowledge"	4.00	1.024	81.82
4. "I feel like crafting more authentic solutions to real life based problems posed"	4.05	.999	77.27
5. "I was able to come up with new ideas while working on different assignments"	3.86	.941	72.73
Student Comments 1. *"I am confident enough to apply all these new ideas I got from the course. It helps give a new kind of perspective for marketing & advertising"* 2. *"I think very well, I was able to apply new knowledge on stuff. I always wanted to try (example AR filter)".*			

The next construct I.e. Collaboration (refer to Table 4.), indicated 95.5% (Mean = 4.32) of the students wishing to experience more such collaborations through immersive technologies in future while 86.36% (Mean = 3.95) and 86.37% (Mean = 4.05) of them felt that the collaborations through activities were well planned and helped them & their team in problem solving. These results along with supporting student comments indicate that they could collaborate well with their teams in different learning activities with the assistance of immersive technologies such as AR, as suggested by [12] and [14] in their research.

Table 4. Survey results on Improved Collaboration

"Improved Collaboration"			
Item	**Mean (M)**	**Std. Dev (SD)**	**% (p)**
1. "I would like to experience more of such collaborations through technologies in future"	4.32	.894	95.45
2. "The collaboration while learning helped me & my team in assisting each other in mutual knowledge exchange & problem solving"	4.05	.999	86.37
3. "The collaboration through certain activities was well planned and systematic"	3.95	.844	86.36

4. "The experience of collaborating through online applications & immersive technologies was quite interesting"	3.95	.899	81.82
5. "I feel empowered and more confident to work in a team"	3.95	1.133	68.18
Student Comments 1. *"My team were able to collaborate well with the tools & technologies that was provided".* 2. *"Yes, we were able to collaborate using the technologies it was easy to customize, create solutions and apply to our projects".*			

Critical Thinking was the last construct taken into consideration (refer to Table 5.). While 95.46% of the students (Mean = 4.27) felt that the course activities provided them with enough work so they could come up with multiple solutions, while 86.36% of the learners (Mean = 4.05) felt that the projects, activities & tasks were challenging for them to come up with interesting and authentic solutions. All these results and supporting comments depict good experience of approaching and solving challenging problems and activities using immersive technologies, which is further supported by [11] and [15] in their research.

Table 5. Survey results on the Enhanced Critical Thinking

"Enhanced Critical Thinking"			
Item	**Mean (M)**	**Std. Dev (SD)**	**% (p)**
1. "The course activities provided me with enough work on the topic so I could come up with multiple solutions"	4.27	.883	95.46
2. "I was able to reflect back on my level of understanding through the guided assignments and activities"	4.00	.873	86.37
3. "The projects, activities & tasks were challenging making me come up with interesting and authentic solutions"	4.05	.899	86.36
4. "I felt the course challenged my understanding levels"	4.23	1.020	81.82
5. "I am able to identify and apply information from this course to address and potentially improve real world problem(s)"	3.95	.899	81.82
Student Comments *1."I think I am able to generate ideas from new collective knowledge and this can be done through brainstorming, looking for connections between different source of information, and experimenting with different ideas"* *2. "I did pretty well to generate ideas but it took some time for certain ideas to be completed and i was pretty satisfied with the output"*			

4 Discussions

The data analysis & results showed substantial and positive impact towards experiential learning environment using Kolb's (1984) ELM Model, with the support of AR. The students' comments reporting significant interest and engagement while learning their concepts, notably supports the quantitative results. Therefore, in answering the research question, *"How does AR technology leads to enhanced learner interest & motivation in an experiential learning classroom?"* the data results of this research study indicates some major outcomes, which are as follows:

1. The learning process, involving experiencing the examples of real world application of concepts, supported by AR, very well **maintained the learner interest and engagement,** thus giving them first-hand experience of inclusion of AR in our everyday lives and supporting the advantages of AR in education by [4] and [9].
2. Another important outcome of the analysis and comments based on the interesting, engaging and realistic experiences of the students, making them feel confident about their learning, was **Motivation** which supports the research findings by [5] and [13].
3. A substantial experience was also noticed in the form of good team **Collaborations** among students, especially when using AR for constructing interesting outputs during class activities and in return a feedback from them for experiencing more such collaborations ahead in their future learnings, which is in conjunction with the research on AR by [10], [12] and [14].
4. **Critical Thinking** also saw a progressive increase as students were noted working on case studies, then analyzing the intended approaches and solving complex activities to preparing the final implementation of their project outcomes in the form of AR representations, which supports the research by [11].
5. The data analysis also showed a positive support for the **use of "David Kolb's ELM Model (1984)", as a pedagogical base, with the support of AR** and other similar immersive technologies in constructing enhanced learning environments.

Based on this study's data analysis, results & discussions, a learning framework (ARELC) Augmented Reality supported Experiential Learning Classroom (refer to Fig 4.), underpinned by Experiential Learning Model (ELM) and supported by AR, is suggested as a guideline for those educationists who are looking to enhance their classroom environments, making it more immersive, engaging, interesting and motivating experience for their students with the use of technologies such as Augmented Reality.

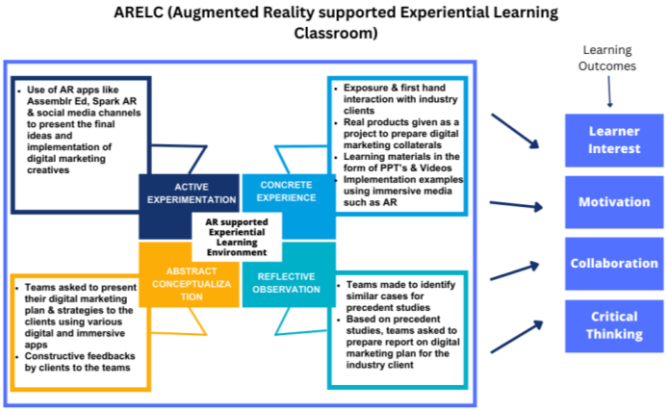

Fig 4. The ARELC framework for AR supported Experiential Learning environment

5 Conclusion

This research study aimed at creating a constructivist, engaging learning environment so as to bridge the identified gap between the students' rising exposure to diverse technologies in their everyday lives and lack of such experiences in their learning environments, thereby raising the demands for the inclusion of some interesting technologies that can render lasting and impactful learning experiences and upkeep with the changing living & learning environments.

Therefore, this study sought to build a learning environment with Kolb's 4 ELM elements as the pedagogical base supported by an immersive technology such as AR. Although AR's inclusion has been reported in many education but very little substantial evidence is available as its pedagogical inclusion in curriculum, helping the students have deep meaningful learning experiences. Keeping this in perspective, this study aimed to answer the RQ, *"How does AR technology leads to enhanced learner interest & motivation in an experiential learning classroom?"* To answer this RQ, 22 students of a digital marketing course were exposed to an experiential learning environment which was supported by AR apps such as Assemblr Edu and Spark AR. Students experiences were analyzed through survey questionnaires and open ended comments.

From the data collected and analyzed, it can be concluded that with the inclusion of immersive technologies like AR in the class environment, students had engaging and interesting experiences of learning making them feel confident through exposure to real life projects and experimenting and presenting their AR outputs to the clients. They expressed enhanced motivation (in conjunction with research by [5]), enhanced learner interest (connects with research by [15]) improved collaboration and critical thinking (connects with research by [10] & [12]).The learning framework, ARELC, generated as the output of this research study can be used as an effective guideline for the educationists for enhancing their learning environment using technologies such as AR.

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