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ETR-AR: Augmented Reality Intervention in A Web-Based Card Game of The Emerging Technology Revolution Concepts

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Abstract : In this new era of remote learning, technology knowledge is vital as it provides endless possibilities of using various technologies to be incorporated into the teaching and learning processes. One of the technologies is augmented reality (AR). AR is an overlay of computer-generated information on the real world in real-time. By integrating AR, it helps to improve the students' knowledge retention as the interactive content is more attractive than the typical static content. This project proposed ETR-AR, a web-based card game with AR intervention to assist learners in overcoming the problems in understanding the concepts of the emerging technology revolution in the Computer Application in Management curriculum offered in Universiti Utara Malaysia, Malaysia. ETR-AR consists of two main parts which are the web interface and card-based AR with 3D, developed using HTML, PHP, JavaScript, and CSS, and A-Frame and Augmented Reality JavaScript (AR.js). ETR-AR was evaluated by 32 undergraduate students enrolled in the course. It was found that 93.75% of respondents agreed that the web application can increase their knowledge of the concepts and 96.88% found that the AR elements of the cards attracted them. Based on tests that were conducted on the respondents, 37.5% showed an improvement in their marks after using ETR-AR as a revision method. ETR-AR can attract learners through its additional element of AR and gamification.

Keywords: Augmented Reality, Card Game, Educational Technology, E-learning

1. Introduction

Gamification is the application of game features, mainly video game elements, into a non-game context to promote motivation and engagement in learning [1]. Nowadays, gamification-based education is more interesting and attractive to students. During the pandemic, students are staying at home and having online classes. Students might feel demotivated on joining the lecture and the activities remotely. Gamification-based education is a way to overcome this problem as it attracts students to learn and easier to understand the lecture. Gamification concepts and techniques are used to engage and

motivate the players to behave in a particular way in the pedagogical context [2]. Through gamification, a reward system can be their motivation to involve in remote learning, such as competing to gain high marks. The basics of any game involve working within a set of rules to achieve an objective, involves engagement, learning, and problem-solving.

Augmented Reality (AR) overlays computer-generated information in the real world in real-time [3]. Gamification-based interventions with AR are more attractive as they get a different experience than playing normal games [4]. AR in education can serve several purposes. It helps students easily acquire, process, and remember information visually. AR makes learning itself more engaging and fun. AR has been adopted and used in many learning applications such as SHREWS [5], a Computational Thinking game to train and aid students in problem-solving methods through the use of AR characters, cards, and maps that contain various tasks to be executed. MechE [6] is an AR game in Physics that uses cards with AR to enhance the visual in learning. It covers the concept of force and motion, electricity and electromagnetism, and fluid, heat, and thermodynamics. Through the card game, students need to define and explain the right terms required. In mathematics, MathBuilder [7] is an example of a collaborative AR game. It uses the concept of a role-playing game to construct AR buildings in a virtual city through completing mathematics questions among the students in groups through the use of cards and maps. The findings revealed that the AR environment's engagement mechanisms improve the learning experience. Through these AR games, it helps to improve the students' sense of collaboration, motivation, and enjoyment in learning as it is more interactive.

Based on the benefits of AR found previously, in the context of this study, Emerging Technology Revolution with Augmented Reality (ETR-AR) is proposed. ETR-AR is a web-based card game with AR intervention to assist learners in overcoming the problems in understanding the concepts of the emerging technology revolution in the Computer Applications in Management curriculum that is offered as an elective in Universiti Utara Malaysia. Through this game, students are given exposure to the technological aspects of the evolution, current and forecast the future trends, so that they can categorize, present, and apply the appropriate technological applications into different businesses and management to contend with the increasing demand for the latest technology skills, knowledge and information technology (IT) skills related to their field of study.

2. Methodology

The methodology used to develop ETR-AR is Rapid Application Development (RAD). The first phase is requirements planning, finding the current problem of students in understanding the concepts of the emerging technology revolution, and proposing the use of gamification with the AR element. The project requirements are finalized based on a survey conducted on the acceptability and usability of this approach on the users, which are the students.
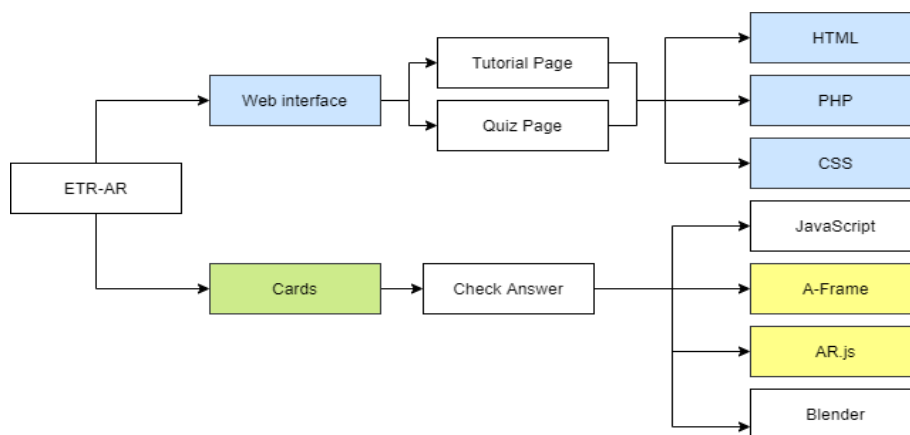

Figure 1: ETR-AR structure of the user design

The second phase is the user design (Figure 1). There are two parts in the user design development. The first part is the web interface of ETR-AR as shown in Figure 2. It is developed using HTML, PHP, JavaScript, and CSS, and the second part is on the AR element. A-Frame and Augmented Reality JavaScript (AR.js) are used for the AR part of the game. The 3D objects that overlay the real-world environment when the AR marker is scanned are created using Blender.
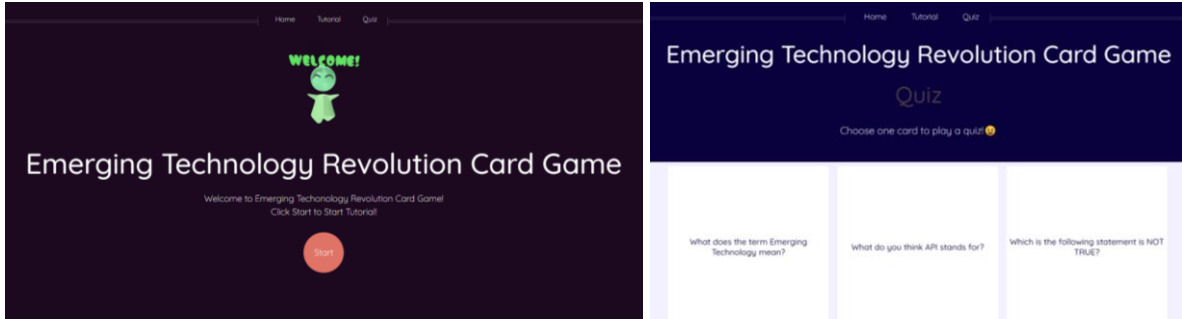

Figure 2: ETR-AR web interface

To play this game, students are recommended to first read the tutorial cards on the emerging technology revolution. Then, they can test their understanding through the quiz provided on the website. To check the answers, the AR marker on the screen can be scanned using another device. AR is implemented as part of the game on the cards to hide the answers from the players. The answers can only be viewed when the AR code is scanned, as shown in Figure 3. An AR model in the form of 3D will appear showing the result. Players can gain more knowledge from several sources through the AR code without revealing any information before playing the game. By adding the AR implementation, the board can be designed with basic look-and-feel visuals, and changes to the game can be done through AR.
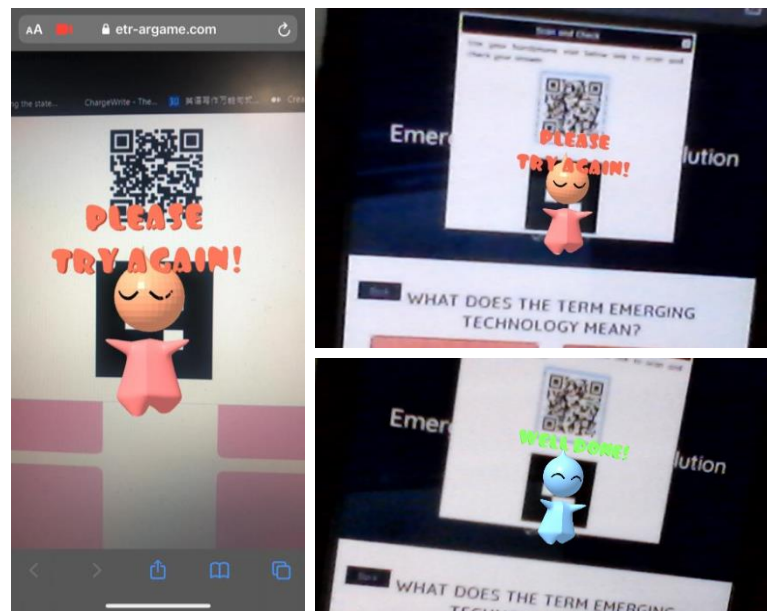

Figure 3: ETR-AR 3D objects

ETR-AR is tested to ensure it satisfies the requirements. The next phase is rapid construction, where this phase is testing the beta version of the game, see whether there are changes needed to meet user requirements. ETR-AR is evaluated by the students who are currently taking Computer Application in Management subject. The evaluation aims to ensure the functionalities of the web application are working and to compare whether students before and after using this web application have improved

their knowledge on the concepts of the emerging technology revolution before ETR-AR is ready to be officially launched.

3.   Results and Discussion

ETR-AR was tested by 100 students currently taking Computer Applications in Management subject. The participants consisted of students from semester 1 to semester 6, ranging from the age of 18 to 26 from different degree programs. Out of the 100 participants, 32 participants evaluated ETR-AR. The evaluation aims to ensure the functionalities of the web application are working and to compare whether students' knowledge before and after using this web application has improved their knowledge on the concepts of the emerging technology revolution before ETR-AR is ready to be officially launched.
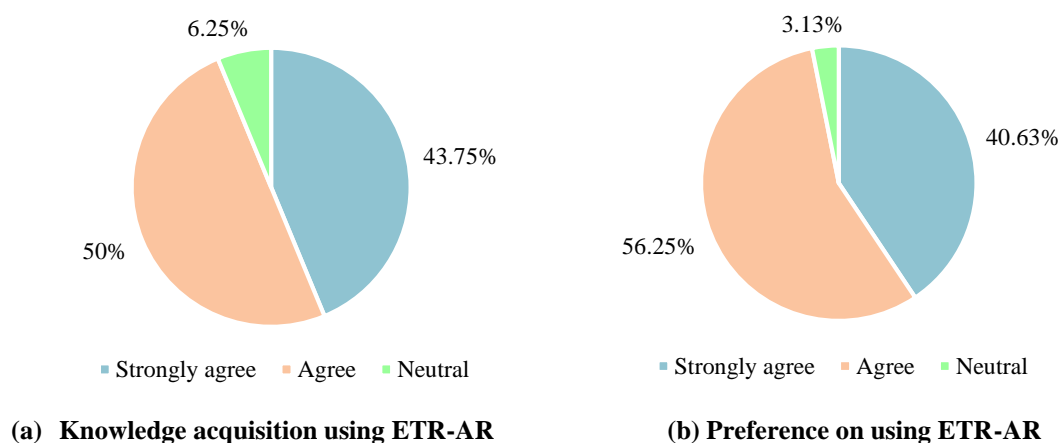

(a) Knowledge acquisition using ETR-AR	**(b) Preference on using ETR-AR**

Figure 4: Respondents' evaluation results on ETR-AR

From the evaluation as shown in Figure 4, it was found that the respondents rated ETR-AR positively. In particular, it was found that 93.75% of respondents agreed that the web application can increase their knowledge of the concepts and it is more attractive (96.88%) to use the cards with AR elements as shown in Figure 3. Based on tests that were conducted on the respondents, 37.5% showed an improvement in their marks after using ETR-AR as a revision method. 18 (56.25%) of the respondents agreed that ETR-AR enhances the respondent's effectiveness in understanding the concepts of the emerging technology revolution and 14 (43.75%) of them are strongly agreed with it. 16 (50%) of the respondents agreed and 14 (43.75%) of them strongly agreed that using ETR-AR can help them understand the concepts quickly.

In addition, the respondents agreed that they will most likely recommend the web application to their friends as ETR-AR is working the way they want, satisfied and they feel they need it in their learning. ETR-AR is a web application that can be used to quickly refresh the students' knowledge that they have gained during lectures through the explanation from the tutorial cards and quiz questions. ETR-AR is a promising card game that can be used as part of the students' learning.

4.   Conclusion

Gamification-based education uses gaming concepts and techniques to engage and motivate the players to behave in a particular way in the pedagogical context. The integration of AR in gamified education helps to improve the students' knowledge retention as the interactive content is more attractive than the typical static content. ETR-AR is a web-based card game with AR intervention that was developed to assist and enhance students' understanding of the concepts of the emerging technology revolution in the subject of Computer Application in Management. The findings from ETR-AR showed positive acceptance and promising results for the card game to be utilized as a part of the learning method in the course.

Acknowledgement

References

[1]   R. S. Alsawaier, "The effect of gamification on motivation and engagement," The International Journal of Information and Learning Technology, 2018.

[2]   C. Perryer, N. A. Celestine, B. Scott-Ladd, & C. Leighton, "Enhancing workplace motivation through gamification: Transferrable lessons from pedagogy," The International Journal of Management Education, 14(3), 327-335, 2016.

[3]   E. L. Corinna & M. Andrew, "Augmented Reality Everywhere," Retrieved from https://www.scientificamerican.com/article/augmented-reality-everywhere/. 2021.

[4]   N. Nordin, N. R. Mohd. Nordin and W. Omar, "Monopoly-based Game with Augmented Reality Intervention in Higher Education," in 10th Knowledge Management International Conference, KMICe, 2021.

[5]   F. Saraiva, L. V. Lima, C. Araújo, L. G. Magalhães, & P. R. Henriques, "SHREWS: A Game with Augmented Reality for Training Computational Thinking," in 2nd International Computer Programming Education Conference, ICPEC 2021, 2021.

[6]   H. N. Ismalina, T. Amarul, A. Z. N. Yusra, M. N. N. Zahidah, K. P. Rakeish, M. N. T. Nasuha, & P. Vikneswaran, "MechE: The design and evaluation of augmented reality card game for physics," AIP Conference Proceedings, 2030(1), 20-21, 2018.

[7]   A. van der Stappen, Y. Liu, J. Xu, X. Yu, J. Li, & E. D. Van Der Spek, "MathBuilder: A collaborative AR math game for elementary school students," in Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts, 731-738, 2019.