A Systematic Literature Review: The Conceptual of Educational Game Design with Augmented Reality

Irma Shayana Samaden¹, Ibrahim Ahmad², Mohd Edzwan Zahri³, Sazilah Salam² and Ismahafezi Ismail¹

¹Universiti Sultan Zainal Abidin, Malaysia, irm@unisza.edu.my, ismahafezi@unisza.edu.my
²Universiti Teknikal Malaysia, Malaysia ibrahim@utem.edu.my, sazilah@utem.edu.my
³Universiti Teknologi Mara, Malaysia muhammadazwan@gmail.com

ABSTRACT

Augmented Reality enhancements can apply into all senses. The ability into extraordinarily engage sight, hearing, touch, taste and smell. Augmented reality is one technologies revolution, bringing the full power of the creative and adaptive human mind to the digital-physical world. Therefore, this article explains a systematic literature review (SLR) methodology and concept to educational game design in augmented reality applications. The review studies include filtering relevant information on augmented reality and education game design from five databases to answer research questions. A total of 13 published between 2016 to 2020 randomly were used in the analysis. The literature review shows that most authors focusing only on the methodology, genre, tool, classification of augmented reality type, and the device's interface game design and limited on their development model. conclusion, we hope the conceptual of augmented reality in educational game design can be further inspiring and expanded by combining more knowledge and skills.

Keywords: Educational Game design, Augmented reality, and Systematic literature review

I INTRODUCTION

Augmented Reality has emerged as a technology that can overlay images, text, video, and audio components onto existing images or space. That's because augmented reality apps, headsets, and smart glasses hold the promise to add value to virtually every industry - from retail to industrial manufacturing. Augmented reality is already showing the key drivers of the tech economy and the potential to solve some of the biggest problems. (Ayer,S.K., et al, 2016 and Pombo,L., and Marques, M.M., 2018)

Augmented reality was a bit different from virtual reality the user will experience virtual objects that appear in the real world and do not only interact with a virtual object. (Chantzi, A.E., et al 2013) Investigating prior researcher in a field is important, as this reveals the current state of the field and offers guidance to researchers who are seeking suitable topics to explore.

Currently, there are many multimedia and online resources provided in the library, but reviews of research on augmented reality technology are less explored. The objective of this paper is to design the user motivation model by using augmented reality in educational game design. More specifically, the main research question (RQ): How to develop characteristics model to improve user motivation in augmented reality educational game design and why?

It is found that the existing model development criteria to increase motivation are only focused on characteristics, usability, effectiveness and appropriation in technology and model (Samaden, I.S et al.2020, Khan,T., et al. 2019, Tekedere,H., 2016, Li,J., et al 2017, Juan Vargas , C.G 2020) and the criteria of characteristics for model to improve user motivation in augmented reality of educational game design are limited in discussed.

II SYSTEMATIC LITERATURE REVIEW APPROACH

The approach was used Systematic Literature Review (SLR), to search, appraise, synthesize, and analyze all the studies relevant to a specific field of research. The methodology utilized is described by Kitchenham in “systematic approaches to success literature review” (Kitchenham, B., et al 2009). The planning defines the scope, searching, screening, data extraction, synthesis analyzing, and writing was seven steps utilized the SLR.

A. The planning for searching

In this phase, available online scientific databases to search for the literature. Therefore, Researchgate.net, ACM digital library, IEEE Xplore, Science Direct, and Google Scholar was five (5) relevant literature databases have been selected.

B. The scope defining

The PICO framework (Problem or Population, Intervention, Comparison or control, Outcomes - Outcomes should be measurable as the best evidence comes from rigorous studies with statistically significant findings) to define the scope in properly formulated answering research questions. For this study, P – identify the characteristic features of the
internal interface concept Augmented Reality in educational game design. I. validation by experts surveys and questioner, observe, read the document. C. characteristic features of the external interface AR educational game design and O-new model.

C. The searching
The keywords used to search and find the relevant contents in a paper’s title and content is “Augmented reality educational game design,” Augmented reality and educational game design” OR “Educational game design and Augmented reality” since the word ‘augmented reality’ and ‘mixed reality’ is interchangeable.

D. The screening
Documents are screened to narrow down the documents to a final number of documents that are relevant for answering the research questions. Articles published from 2016-2020 are taken into consideration for inclusion in the search criteria. The exclusion criteria were: studies that are not related to the augmented reality as in technological perspective; Augmented Reality, and educational game design, educational game design. (Figure. 1)

The process for selections involved skimming the title abstract and result; skimming the introduction and conclusions; skimming full text; exclude duplicates; and quality as-Quality Assessment (QA). In this review, we developed three QA criteria to assess the quality of each study as presented below:

QA1: that the topic addressed in the paper related?
QA2: that the research methodology described in the paper?
QA3: that the data collection method described in the paper?

Each publication was assessed according to the ratio scale: Yes = 1 point, No = 0 point, and Partially = 0.5 point. The total quality score for each selected study was measured between 0 (very poor) and 4 (very good). Finally, 10 selected papers were retrieved and chosen which was related to Augmented Reality and educational game design setting.

E. The Data Analysis
After reviewing the final selected papers, categorization was made to identify the type of potential educational game design in AR. (Figure 1)
C. Academic Journals
An academic is providing good quality research articles, a peer-reviewed periodical that focuses on a narrow field of study. Academic journals serve as forums for the introduction and presentation for scrutiny of new research, and the critique of existing research to give inspiration to another researcher. In this case, in addition to searching through journal writing and proceeding, researchers also obtain information through related journals, books, news, and magazines.

Augmented reality is taking digital or computer-generated information, whether it be images, audio, video, and touch or haptic sensations, and overlaying them over in a real-time environment. Augmented reality technology can be used to enhance all five senses, but its most common present-day use is visual. While, augmented reality devices can be broadly categorized into four types: head-up-display (HUD), holographic display, smart glasses optical see-through a display, and handheld/smartphone-based.

The augmented reality educational game design model has attracted users to share knowledge more engaging way, based on the previous researcher, mostly has focused on the exploration of model design to enable model production to meet target groups, such as tool, the edutainment gameplay genre, kindness, dan effectiveness

Results and discussion for this section the results reviewing and analyzing 13 published articles from 2016–2020 choose by randomly, that were related to Augmented Reality in education. In (Table 1), was a summary of the literature review.

V CONCLUSION
The conclusion for a previous review article from 2016 until 2020 explains a method review studies following a predefined procedure on educational game design in augmented reality application. Based on (Table 1), the concept of educational game design with Augmented Reality there come out with many concepts, example: simulation game technologies, virtual objects such as story animations, game-based learning and storytelling, combination with non-digital and digital elements, focusing on their interface design field, combination with diversity of fields, and combine with augmented reality with virtual reality.

Findings from this research showed us that more researches, teachers, students, and learning materials should be developed by using augmented reality and implemented in learning. To develop augmented reality first the technology and required 3D models should be prepared and the framework also should be considered accordingly and the augmented reality techniques in education, the exploration of different types of augmented reality, and the combination with the Al-Quran ayah concept still need to be explored. It to create a balance between the knowledge of the world and the knowledge of the hereafter.

ACKNOWLEDGMENT
We would like to express our gratitude to the Universiti Teknikal Malaysia Melaka (UTeM), Universiti Sultan Zainal Abidin (UniSZA), Universiti Teknologi MARA (UiTM), and Ministry of Higher Education (MOHE), for the support and scholarship sponsorship in this research.
<table>
<thead>
<tr>
<th>Reference</th>
<th>number of samples</th>
<th>methodology</th>
<th>Genre</th>
<th>Classification</th>
<th>Devices</th>
<th>Concept and tool</th>
<th>Learner Outcome(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Augmented Reality Gaming in Sustainable Design Education (Ayer, S.K et al 2016) (Paper 1)</td>
<td>34 architectural engineering students, 47 architecture students, and 27 civil engineering students were given the same design activity using augmented reality. 65 students completed a similar design activity using only blank sheets of paper, and another group of 23 students used a paper-based approximation of the computerized eco Campus.</td>
<td>simulation technologies game</td>
<td>Action-game</td>
<td>Interaction simulation game technologies</td>
<td>ecoCampus mobile computing system</td>
<td>Simulation game technologies would influence students’ design processes during the activity: eco Campus</td>
<td>Students in all disciplines who used ecoCampus were able to break the tendency toward design fixation. Students were also able to use the application to assess their designs and generate additional concepts with better overall performance across all disciplines compared with the students who used paper-based formats.</td>
</tr>
<tr>
<td>Educational magic toys developed with augmented reality technology for early childhood education. (Yilmaz, R.M. 2016) (Paper 2)</td>
<td>Mix method was used and the sample consisted of 30 teachers and 33 children aged 5 to 6 in early childhood education.</td>
<td>magic toys (EMT) Mix method</td>
<td>Idle games</td>
<td>Interaction virtual objects such as story animations, 3D objects, and flash animations appear on the toys.</td>
<td>Educational magic toys (EMT) mobile computing system</td>
<td>EMT because virtual objects such as story animations, 3D objects, and flash animations appear on the toys. EMT has included puzzles, flashcards, and match cards to teach animals, fruits, vegetables, vehicles, objects, professions, colors, numbers, and shapes for average 5 to 6 age children in Early Childhood Education</td>
<td>Shaping children’s experience, enhancing their imagination, affecting their behaviors, toys have great importance that these toys can be effectively used in early childhood education. However, collaborative and interactive learning with these toys should be provided. Moreover, this study will provide an important contribution to present a new educational AR application, and fill the gap in the educational technology field.</td>
</tr>
<tr>
<td>Science spots AR: A Platform for science learning games with Augmented Reality. (Laine, T.H. et al 2016) (Paper 3)</td>
<td>Geometry game prototype, and (3) mixed-method formative evaluation of Geometry with 61 Korean 5th-grade elementary school children.</td>
<td>Geometry game the Van Hiele model</td>
<td>Sport game</td>
<td>Interaction Game-based learning and storytelling</td>
<td>Mobile phone Science Spots AR (SSAR)</td>
<td>Game-based learning and storytelling are prominent methods Geometry game, which contains geometry problems based on the Van Hiele model. Concept and architecture of Science Spots AR, (2) design and implementation of the Geometry game prototype, and (3) mixed-method formative evaluation of Geometry elementary school children.</td>
<td>Three aspects of SSAR through Leometry: (1) features, (2) storytelling approach, and (3) impact. The formative evaluation results suggest that the Korean children appreciated the game’s features and its storytelling approach, and their answers regarding the overall impact were encouraging. The results also indicated that AR can be a powerful motivator, and other research has shown its potential in education (see Background).</td>
</tr>
<tr>
<td>A design-based approach to augmented reality location-based activities: Investigating immersion in relation to student learning. (Georgiou, Y., and. Kyza, E.A 2017)(Paper 4)</td>
<td>11th-grade students, comprised of two design iterations (n1=18, n2=10); A design-based approach to augmented reality location-based activities</td>
<td>Adventure game</td>
<td>Tracking AR Application</td>
<td>Tablet. Global Positioning System (GPS), and AR application</td>
<td>Augmented Reality (AR) location-based learning activities are argued to promote students’ immersion, and the facility at learning.</td>
<td>Augmented Reality (AR) location-based learning activities are argued to promote students’ immersion, and the facility at learning.</td>
<td>The results also indicated that AR can be a powerful motivator, and other research has shown its potential in education (see Background).</td>
</tr>
<tr>
<td>Augmented Reality Board Game for supporting learning and motivation in an indigenous community. (Pinto, D., et al 2017) (Paper 5)</td>
<td>20 students of fourth and fifth grades of elementary school, the average age of 10 years old</td>
<td>CoDesigning Game-Based learning with Augmented Reality with Teachers (Co-CreARGBL) (Training, Iterative Design and Evaluation)</td>
<td>Idle game</td>
<td>The interactive</td>
<td>tablet</td>
<td>to strengthen the educational processes of appropriation of the traditions, and values of the Nasa culture. the process of design of the ARBG, the evaluation in the classroom, and the results</td>
<td>positive results</td>
</tr>
</tbody>
</table>

|SEE ME ROAR: Self-determination Enhanced Engagement For Math Education Relying On Augmented Reality. (Jingya Li et al 2017) (Paper 6) | one primary school teacher and two primary school students, which indicate the game is fun and might be helpful for their study. primary school students. Learning subject is mathematics for students aged 7 to 8. | PLEX framework SEE ME ROAR | Adventure game | Interaction Unity 3D and Vuforia plugin for Augmented Reality features | mobile game | designed and made a prototype of SEE ME ROAR, an AR-based social learning game. The game is focused on helping primary school students engage in mathematics learning and interact with their classmates. | researcher plan to follow a practice-led approach to develop the game and instructional design, where the base prototype is modified to include these new levels. |

|An empirical study on the motivations underlying augmented reality game use: The case of Pokémon Go during and after Pokémon fever. (Zsila.Á., et al 2018) (Paper 7) | the final 37-stem, first-order, 10-factor model had appropriate factor structure and internal consistency. a sample of Pokémon Go players (N=621) | geo-located augmented reality (AR) | Action-adventure games | The tracking | smartphone | geo-located augmented reality (AR) Outdoor Activity, Nostalgia, and Boredom. Impulsivity was unrelated to Pokémon-Go motives. | to obtain a deeper understanding concerning the motivations underlying Pokémon Go use and to create a measure that assesses these motivations. |

|Augmented Reality Experience: Initial Perceptions of Higher Education Students. (Sural, L., 2018) (Paper 8) | 82 candidate teachers at Department of Computer Education and Instructional Technology in 2017-2018 fall term. male is 44 (%53,66) and female is 38 (%46,34) | marker-based mobile augmented reality application Descriptive research | Adventure-games | The tracking | marker-based mobile augmented reality application has been developed and computer hardware devices are used as teaching material | to explore the candidate teachers’ opinions about using augmented reality (AR) in classrooms. marker-based mobile augmented reality application has been developed and computer hardware devices are used as teaching material | very excited about using augmented reality. |

|Augmented reality gamification for human anatomy (A. Argo el. al 2019) (Paper 9) | medical learning. | interactive exercises like quizzes and simulations to enable users to have a fellfield learning experience on the 3D human organ model enriched with dynamic virtual content. three main modules: server, content designer, and a mobile AR interface | Action-adventure games | The interaction | mobile AR interface. "education tags" | introduction of game design elements to support university medical students in their learning activities during a human anatomy laboratory. the designed consist of three main modules: server, content designer and a mobile AR interface. "education tags" | the gamification process can substantially improve the learning experience of the students. |

|Application of the ubiquitous game with augmented reality in Primary Education | A quasi-experimental study was carried out with 91 sixth-grade primary school students; augmented reality application “WallaMe” | Adventure game | The interaction | mobile phones | to analyze the impact that the integration of ubiquitous game approaches augmented reality has on learning. | the experimental group obtained statistically significant improvements in the academic |
The experimental group: 34 girls and 35 boys; The control group had 13 girls and 9 boys. The control group was formed of 22 students in a class that studied the same unit but using a textbook and “traditional” forms of teaching.

**Augmented Piano in Augmented Reality**

(Santin, G., 2020) (Paper 12)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.

**EmoFindAR: Evaluation of a mobile multiplayer augmented reality game for primary school children**

(Lopez-Faican, L., and Jaen, J., 2020) (Paper 13)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.

**Hybrid Board Game Design Guidelines**

(Ville, K., and Janne, P., 2019) (Paper 11)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.

**EmoFindAR:** Evaluation of a mobile multiplayer augmented reality game for primary school children

(Lopez-Faican, L., and Jaen, J., 2020) (Paper 13)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.

**Hybrid Board Game Design Guidelines**

(Ville, K., and Janne, P., 2019) (Paper 11)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.

**EmoFindAR:** Evaluation of a mobile multiplayer augmented reality game for primary school children

(Lopez-Faican, L., and Jaen, J., 2020) (Paper 13)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.

**Hybrid Board Game Design Guidelines**

(Ville, K., and Janne, P., 2019) (Paper 11)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.

**EmoFindAR:** Evaluation of a mobile multiplayer augmented reality game for primary school children

(Lopez-Faican, L., and Jaen, J., 2020) (Paper 13)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.

**Hybrid Board Game Design Guidelines**

(Ville, K., and Janne, P., 2019) (Paper 11)

The survey was online two weeks in December in 2016, and it had 329 respondents. The employees of the project and project partners distributed the survey through email lists and on social media 133 respondents.

Hybrid board games combine non-digital and digital elements to introduce a new kind of game experience.
REFERENCES


Silvia,(2017), Conference: V Conferencia Internacional en Videojuegos y Educación At: Puerto de la Cruz, Tenerife, Españ.


Yilmaz,R.M.,(2016)Educational magic toys developed with augmented reality technology for early childhood education, computer human -ISSN: 1308-1470 ● www.e-iji.net 58697-7_46 Authorberg. Copyright is held by the owner/author(s).


Knowledge Management International Conference (KMICe) 2021, 1 February 2021
http://www.kmice.cms.net.my/