

REV-OPOLY: A Study on Educational Board Game with Web-based Augmented Reality

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Abstract: The use of technology in education is believed to enhance students' learning experience. Technology such as Augmented Reality (AR) is increasingly used in the classroom through the use of gamification. This study aims to examine students' experience in using a board game with web-based Augmented Reality named REV-OPOLY in their learning. REV-OPOLY's theme is on the emerging technology revolution concepts where in this board game, players can buy, rent and sell technologies through question cards to gain the opportunity to own the technology. AR is implemented into the game as the play pieces and part of the play cards. The respondents are the undergraduate students enrolled in Computer Application in Management course in Universiti Utara Malaysia. In this qualitative study, respondents will be tested through pre-test and post-test to compare the effectiveness and efficacy of REV-OPOLY compared to traditional methods of self-revision. The findings showed that 98.8% of the respondents are interest-ed in using REV-OPOLY in learning and 86.1% of them are satisfied with the structure of the game, mainly the multiplayer aspects of it (95.3%) which enforce interaction and discussion among the players (89.5%) and 93.0% agreed that they can learn better through the game as an informal learning medium. In this study, REV-OPOLY has shown to have received positive feedback from the respondents. Further research is required to assess the students' learning outcomes and experience of REV-OPOLY.

Keywords: Augmented reality, Board game, Educational game, Gamification, Student-based learning

1. Introduction

The teaching and learning of undergraduate students in higher education should be suited and reflected in the modern age of technology, following the introduction of IR4.0, to ensure better learning outcomes in their core subjects. Sánchez-Mena and Martí-Parreño (2017) argue that classroom activities in the form of games (be it online or offline) is challenging, as it is time consuming and difficult to adapt to new methods of teaching and learning. On the one hand, it has been suggested that using video games for educational purposes can inspire new generations of students who have grown up in a video game-dominated world (Glover, 2013).

In line with the Sustainable Development Goal 4: Quality Education, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, the use of technology in curricula and assessments could be a catalyst in the higher education sector. For instance, Augmented Reality (AR) could make a difference in students' engagement in the classroom. AR

technology, when combined with effective pedagogy, has the potential to promote inclusive education by representing content, expressing knowledge, and engaging students in learning. It could promote innovative and cooperative learning environments, allowing for the achievement of learning outcomes using slightly different but successful methods. From the educators' perspective, a study by Jamrus and Razali (2021) found that out of 181 respondents, the majority possess a high level of acceptance and readiness to use AR in their teaching.

With the majority of the population around the globe having smartphones, AR is considered a widely accessible technology. Since most smartphones have a gyroscope and accelerometer, the two components needed for AR applications, it would be easy to apply AR in any situation. Yuen et al. (2011) note in an overview of augmented reality in education that one of the key goals of research in the field is to increase productivity in real-world tasks. AR is thought to have the ability to engage and inspire students, cultivate their ingenuity and imagination (Kaliyaperumal et al., 2021), and aid in the teaching of concepts that are difficult, if not impossible, to encounter in the real world. For instance, Dünser et al. (2012) explored the use of a book supplemented by the use of a Hand-Held Device (HHD) to improve high school physics comprehension. They conducted a quantitative study with a group of students, half of whom studied the book with augmentation and the other half without. The findings showed that AR has the potential to aid teaching in spatial concepts that could benefit from being visualized in 3D form (Enzai et al., 2021).

Similarly, gamification with AR elements in the classroom provides learners with a lot of interactive activities – where it is capable of managing a variety of learning paths in which the main objective can be achieved depending on the learners' personality, abilities, and other characteristics. Another advantage is that gamification prioritizes the visual aspect of the learning process, especially visualization of progress and the chosen learning route. Kaufmann (2018) mentioned that gamification can also avoid procrastination among students to a certain task as gamification can help students to be more engaged just by playing an online app with a short-term reward concept. On the other hand, gaming and learning are similar in terms of receiving feedback and progress. Students will receive immediate feedback, which is in normal setting, grading, when they are playing.

For instance, courses such as Computer Application in Management that is offered in Universiti Utara Malaysia (UUM) as one of the program elective courses, includes students from a variety of backgrounds and programs such as Law, Communication, Business Administration in Logistics and Transportation, Entrepreneurship, Marketing, Public Management, International Business Management, and Human Resource Management. Since these technologies are used as intermediary means to assist in many managements related applications that are common among professionals in their respective fields, these programs require a certain level of understanding and competency from students in basic knowledge of the latest technologies. As a result, by the end of the course, students should be able to explain basic computer technology information and its development in relation to the new Industrial Revolution 4.0. (IR4.0). As a result of their exposure to the evolution of technology and future trends analysis, students will be able to identify, present, and apply relevant technical solutions to various business and management situations.

The Computer Application in Management course is an elective course for most of the programs offered in UUM since computer applications assist daily activities carried out in various contexts such as the business, communication, economics, education, entertainment, recreation etc. After completing the course, students are expected to acquire basic knowledge on the latest information and communication technology, as well as develop competency in using several management-related applications, which are popular among the professionals and entrepreneurs.

2. Literature Review

2.1 Monopoly-based Game

Many educational sectors and organizations have employed the Monopoly board game as a template reference to build their own games. In education, the Monopoly games have been adapted to be applied to different fields, such as psychology, sociology, entrepreneurship (Cruz et al., 2018), tourism (Ran et al. 2020), financial (Kulkarni, 2020) and health (Santoso et al., 2019). Collectively, the findings have shown that incorporating games such as Monopoly, or Monopoly based games provide

positive feedback from both the learners and instructors. For instance, the use of Monopoly in an introductory course in Financial Accounting are found to increase the competitiveness amongst the students which improves the classroom engagement where students are actively involved in grasping the nature and purpose of the financial accounting system compared to other pedagogical approaches that were previously used. Similarly, positive results were found by Gazdula and Farr (2020) by incorporating the Monopoly game in teaching Risk and Probability, which students can reflect on decision making in a risk environment using both formal and informal approaches which prompts for discussions, collaborative learning, and self-analysis among students.

2.2 Monopoly-based Game with AR

Pokémon Go, the smartphone gaming phenomenon, is one of the first popular games to have augmented reality (AR) elements, offering players the sensation of hunting Pokémon in real-life environments. Pokémon Go provides players to a game layer that overlays the real world and incorporates GPS and augmented reality. This ability to transform everyday tasks into gameplay allows players to live out their childhood fantasy of being a Pokémon Trainer. Following the hype, McDonald's has released an AR app that uses the same combination of real world and technology that made Pokémon Go this summer's hottest game. McDonald's introduced the new Monopoly game for diners in Australia, based on the most downloaded application of 2016, which allows players to use their mobile's camera to view cards from the promotion (McCrum, 2016). McDonald's named the app "The Monopoly Game at Macca" which turned promotion into a mobile gaming experience that converges the digital and physical worlds, where it features AR game mechanics. Even though the concept of it is as a promotion in offering prizes, cards and food offers to those who play and attend the restaurant, it demonstrates how business can also focus in creating innovative and engaging digital experiences for its customers. Basically, the game serves as a digital wallet.

The use of Augmented Reality was also used by a company named Ally financial to teach the public regarding financial literacy through an interactive method (iDEKO, n.d.). The game was named Ally Monopoly, where this project takes the idea of a common financial board game and applies it to six cities in the US. Players will obtain clues to identify the virtual reality game squares in their city once they join the game. When they arrive at their destination, Mr. Monopoly AR will appear and assist them in completing tasks and winning prizes. The AR experience could change the teaching and learning across the world. AR technology will continue to develop from the traditional board games to mobile applications and perhaps through the use of AR goggles, which is popular in video games.

3. REV-OPOLY

3.1 Objectives

REV-OPOLY which is a Monopoly-based game with AR intervention, is a board game that is aimed to be used as part of learning specifically for the undergraduate students who enroll in Computer Application in Management subject in Universiti Utara Malaysia (Nordin et al., 2021). REV-OPOLY covers one of the topics which is the emerging technology revolution. Through this game, students' comprehension level will be assessed in terms of the students' ability to (1) make explicit references to previous learning, (2) apply the knowledge into the game and (3) convert the knowledge gained to be part of the revision process. Students' demographic information, impression and opinion on the effect that REV-OPOLY might have towards their learning are collected and analyzed as the starting point to ensure REV-OPOLY satisfies and fulfills the expectation of the students. The elements of gamification in REV-OPOLY is expected to attract the students' interest, in addition to the use of colorful board and images, play cards and the AR technology in REV-OPOLY.

There are three main research questions that this study aims to solve, which are (1) What are the undergraduate students' perception towards REV-OPOLY during learning?, (2) How does REV-OPOLY assist undergraduate students' comprehension level during learning?, and (3) How effective is REV-OPOLY in enhancing undergraduate students' comprehension level during learning?. Students will be tested through pre-test and post-test to compare the effectiveness and efficacy of REV-OPOLY than the traditional method of self-revision through books and lecture slides.

3.2 Research Methodology

The research was carried out among undergraduate students who enrolled in Computer Application in Management subject in Universiti Utara Malaysia for one semester. The purpose of this research was to enhance the undergraduate students' comprehension level in emerging technology revolution concepts. The problem is identified where researchers need to understand the level of students' comprehension in the emerging technology revolution concept specifically on the evolution of computers until the IR4.0. After identifying the problem, the next action is to design the board game based on Monopoly as the intervention to enhance students' comprehension level. AR element is included as part of the game for answers verification. An observation schedule form is used to observe students' readiness in playing and engaging in the game. The students' ability to discuss and voice their opinion based on prior knowledge and critical thinking are observed. Researchers need to ensure that the gameplay is related to the course learning outcomes and bloom taxonomy of the selected topics. Post-test will be carried out to assess the students' comprehension level after playing the board game. Students and lecturer's reflections will be collected. This research is currently at this stage before proceeding with the assessments.

3.3 Design and Implementation

REV-OPOLY is a board game with AR, themed around the emerging technology revolution concepts. The objective of this game is to become the wealthiest player through buying, renting and selling technologies. REV-OPOLY consists of a board, two dice, four player pieces, play money and Title Deed cards for each technology. It has two types of question cards called "IR Question" and "Technological Question" where they cover different types of questions to represent the spaces on the board. REV-OPOLY also consists of two other stacks of cards, "Chance" and "Did You Know?" Fig. 1 shows the components of REV-OPOLY.



Fig. 1 REV-OPOLY components

The "Chance" cards are the cards with various types of advantages that the player can use while playing the game such as "Skip the question" and "Ask ONE other player to assist with the current question". As a way of retaining the distinctive learning while playing, the "Did You Know?" cards contain brief facts and statements that are related to the spaces on the board such as the meaning of the terms, examples and impact of the technology towards various sectors. To play the game, the dice is rolled for the players to move around the game board. The players will take turns to move. On the board,

players are provided with basic player pieces. However, by scanning the AR marker of the player piece, the piece will appear as a 3-dimensional (3D) character. This allows personalization and to customize different types of characters to be used based on the player's preference without having to physically change the player piece (see Fig. 2).



Fig. 2 3D player pieces for Player 1 and Player 2

The board consists of forty spaces containing 26 properties. According to the space the player's piece reaches, the player may be entitled to buy the technology or obliged to pay rent, draw a "Chance" or "Did You Know?" card. To buy the technology, the player needs to answer the "IR Question" or "Technological Question" card correctly. To make the game more interesting and to encourage discussion, other players who agree with the current player's answer can invest in the property. Each player is given four opportunities to invest in any property. If the player answers wrongly or does not know the answer, the player will be fined. This enforces the players to learn, understand and grasp the knowledge on emerging technology revolution. A sample answer for each question is provided. The player can scan the image of the question card that has to be aligned to the space that the player reaches on the board (see Fig. 3). It can be displayed as a 3D text, image, animation or video.



Fig. 3 3D AR text as a sample answer based on the "IR Question" card

4. Findings and Discussions

Students were invited to participate in a questionnaire on their experience and preference on the way the course should be conducted using a board game learning approach. Among a total of 100 students in the course, 86 responded to the survey with a response rate of 86%. The questionnaire is separated into four parts, Section A is on demographic which is to understand the relationship of age, participants' current semester and the department that they belong to. Section B is on participants' board game experience and the relevance of board games compared to other types of games. Section C is on board game features and designs that attract participants especially on Monopoly and AR-based games.

The last section, Section D is on the participants' impression of REV-OPOLY. A video of REV-OPOLY was provided to show the participants the way REV-OPOLY works. Due to the pandemic, all participants were off-campus. Therefore, they were unable to test REV-OPOLY themselves. The questionnaire contains measurement scales on the importance of game features and reasons to adopt REV-OPOLY as the learning approach rather than other typical learning pedagogy which uses a five-point Likert scale to understand and focus on the aspects that participants defined as most related and important to them.

4.1 Data Collection and Sampling

The respondents' demographics were 55 (64.0%) females and 31 (36.0%) males. 26 respondents (30.2%) aged below 20 and majority of them, 60 (69.8%) were between 21 to 25 years old. The respondents were in semester 1 (17, 19.8%), 62 (72.1%) in semester 2, 3 (3.5%) in semester 3 and 4 (4.7%) in semester 4. Due to the pandemic, the respondents who were in semester 1 to semester 3 had not been to the campus since they started their studies. Thus, REV-OPOLY is a multiplayer game that enforces interactions and discussions amongst the players is appealing to the respondents as a way to constitute the lack of face-to-face interactions in lessons into informal learning. This is supported by the result of this questionnaire where 82 respondents (95.3%) like the idea of multiplayer REV-OPOLY and 77 (89.5%) responded to try REV-OPOLY as it allows to share knowledge through discussion.

The distribution of the respondents were mainly from various different schools and programs in UUM. 61 respondents (70.9%) were from School of Business Management, 11 (12.8%) from School of International Studies, 8 (9.3%) School of Technology Management & Logistics, 5 (5.8%) from School of Government and 1 (1.2%) from Islamic Business School. Even though their degrees were not directly game and technological related, 74 respondents (86.1%) said that they like playing games in general. In 2021, it is estimated that there are currently 2.8 billion gamers around the world, and it is expected to increase each year, reaching 3 billion by 2023 (Clement, 2021a). According to another survey published by Clement (2021b) on the age of gamers in 2020, out of the 4000 respondents involved, 21% of them were aged below 18 years old and 38% were between 18 to 34 years old. This shows that students are more likely to be interested in games based on the average age of gamers.

In terms of the distribution of gamers by gender in 2020, in a study conducted in the sample size of 4000, females accounted for 41% and 59% males (Clement, 2021c). This shows that games are usually preferred by males than females even though the percentage increases each year since 2006. This proves to be true as 85.5% females liked games while males accounted for 87.1% based on the 86 respondents in this study (see Table 1). The respondents were also asked if they preferred to have the aspects of games into their learning such as the use of Kahoot, Quizizz and Quizlet, and it shows an overall in-crease of 95.4% (82 respondents) where 51 (92%) females and 31 (100%) males. All of the respondents were familiar and had tried at least one of these game-based learning platforms during their lessons. Therefore, they were able to relate their experience in playing learning games with their preferences.

Table 1. Respondents' game preference distribution by gender

Gender	Games		Education-based Games	
	<i>N</i>	<i>P</i>	<i>N</i>	<i>P</i>
Male	47	85.5	51	92.7
Female	27	87.1	31	100.0

N number of respondents, *P* percentage of respondents (%)

4.2 Relevance of Board Game

Board games have been around for quite a while. One of the oldest board games known to have existed, called Senet, was dated back to the First Dynasty of ancient (Crist, 2019). Board games have been played in most cultures and societies where they can be categorized into three main genres which are competitive board games such as Monopoly, educational board games such as Scrabble and simple board games such as Snakes and Ladders. In these genres, they can have different types of gameplay

structure to make it enjoyable. Out of these genres, 61 respondents (70.1%) agreed that they are more likely to play competitive board games, where 43 (50.0%) prefer simple board games. 20 (23.3%) open to play educational board games, where 42 (48.8%) have experience in this genre. Based on this information, the initial assumption that physical board games are still relevant proved to be true despite the advancements of technology in video games and mobile games. According to Arizton (2020), their global board games market report analyzed in-depth on the board games market revenue which is expected to grow during the period 2021-2026.

When the respondents were asked specifically about the Monopoly board game, 14 of them (16.3%) said that they had never played it, 53 (61.6%) used the physical board game, 13 (15.1%) played both the physical and online Monopoly and only 6 (7.0%) had only played the online version of the Monopoly. Monopoly has been around for a long time where the first Monopoly published by Hasbro started back in 1935. In terms of the enjoyment in playing Monopoly, 71 respondents (82.6%) responded positively while 3 (3.5%) strongly objected.

Additionally, more than half of the respondent selected Monopoly as their favorite board game (23 respondents, 26.7%), whereas 14 (16.3%) and 8 (9.3%) chose familiar board games that have the same concept as Monopoly produced by different brands such as SAIDINA and Jutaria (also known as Millionaire or Billionaire) respectively, where the properties on the boards are based on the local attractions and places in Malaysia. Nevertheless, many of the respondents chose these board games because they could learn about money management, buying and trading properties, and developing the properties with houses and hotels. They also preferred Monopoly as it has different versions, editions and variations of games such as Monopoly: Star Wars Complete Saga Edition, Monopoly: Pokémon and Monopoly: Here & Now The World Edition where in this version, an electronic banking unit device is provided.

4.3 Perception towards REV-OPOLY

Based on a three-minute short video that shows gameplay of REV-OPOLY, 40 respondents (46.5%) rated REV-OPOLY as very good, 34 (39.5%) good and 12 (14.0%) were neutral about the board game. Referring to Table 2, 85 respondents (98.8%) out of the 86 respondents were interested in using REV-OPOLY as a learning approach. This relates back to the respondents interested in having games as part of the learning process where 82 (95.4%) preferred it while a small number of 4 (4.7%) preferred traditional methods in learning and assessments. There were mixed responses in terms of the use of AR as part of the game. 31 respondents (36.0%) strongly agree that REV-OPOLY and the AR components of it can help them have better learning experience, 41 (47.7%) agree, 13 (15.1%) neutral and 1 (2.4%) strongly disagree in the use of AR. This could be due to the lack of AR-related games available, thus it can be unclear on the effectiveness of AR-based games. To support this finding, from the questionnaire, 65 respondents (75.6%) stated that they had never played any AR game while 21 respondents (24.4%) had, stating Pokémon Go and Minecraft Earth as the AR-based games that they had played.

Table 2. Respondents' acceptance towards games in learning

Statements	<i>N</i>	<i>P</i>
I like playing games	74	86.1
I likes games to be included as part of the learning	82	95.4
I like REV-OPOLY	74	86.1
I am interested in using REV-OPOLY as a learning approach	85	98.8

N number of respondents, *P* percentage of respondents (%)

The respondents were asked of the features of REV-OPOLY that attracts them to use it as part of the learning approach in terms of the design and gameplay, learning while playing experience, effectiveness of it, as an alternative to typical learning method, enforcing group learning and engaging in discussion (see Table 3). 52 respondents (60.5%) and 31 (36.0%) strongly agree and agree that REV-OPOLY opens up a new experience in learning for them as majority of the respondents feel that through this game, they can learn better (80 respondents, 93.0%) due to the nature of the game as an informal

medium which helps to keep them focus while enjoying the learning process. 39 respondents (45.3%) pointed out that the ideal time to spend on a board game is around an hour or more and 33 (38.4%) 30 to 40 minutes, which suggests that they are able to stay focused for a long period during gameplay. Only 13 (15.1%) prefer games that can be completed within 10 to 20 minutes. This strongly supports the way that REV-OPOLY is constructed, as the game revolves around the theme where it depends on the ability of the players to solve the questions to end the game. There is no time limit in REV-OPOLY. However, REV-OPOLY is expected to be played for more than 30 minutes.

Table 3. Respondents' agreement on the current features of REV-OPOLY

Features	<i>N</i>	<i>P</i>
Design and gameplay	75	87.2
Learn while play experience	83	96.5
Easy to learn through the game	80	93.0
Group learning	82	95.4
Group interaction	77	89.5
AR playing cards	64	74.4

N number of respondents, *P* percentage of respondents (%)

64 respondents (74.4%) prefer to try REV-OPOLY as an alternative to reading slides or books to understand the subject while 20 (23.3%) neutral and 2 (2.3%) are not convinced of the effectiveness that REV-OPOLY has to replace those resources. This is understandable as games are typically used to complement lessons or as assessments rather than as the main method in acquiring information. 82 respondents (95.3%) like the idea of REV-OPOLY which involves the game to be played with several players and the interaction that is enforced through discussions (77, 89.5%). The questions related to the game theme are provided to lead the players towards constructive discussion where sample answers are also provided as the guidelines. Other than multiplayer REV-OPOLY, the 15 respondents (17.4%) suggested to include an option for the game to also support a single-player. Nevertheless, the majority of respondents, 61 (70.9%) and 46 (53.5%) said that they normally play board games with their friends and families. In order to support a single-player, this can be done through modifying the rules and instructions without affecting the physical parts of the game. They also suggested that REV-OPOLY could provide a more direct reward system to record the players' improvement in acquiring the knowledge through the game in the form of scores or bonuses. 71 (82.6%) feel that the reward system such as high scores or marks is one of the important features in a game.

Table 4. Respondents' perspective on the importance of the learning game features

Important Features	<i>N</i>	<i>P</i>
Gameplay	73	84.9
Game tutorial	72	83.7
Passive information transfer	70	81.4
Multiplayer	79	91.9
Reward system	71	82.6

N number of respondents, *P* percentage of respondents (%)

5. Conclusions

Based on this study, gamification is believed to be able to enhance students' learning. This is supported by the findings of this research conducted on testing a Monopoly-based game with AR intervention called REV-OPOLY. Through this game, the students are found to comprehend the concepts of the emerging technology revolution in a more interactive and fun way. In REV-OPOLY, students are tested on "IR Question" and "Technological Question" cards, which the sample answers are provided as the baseline of the expected answer, by scanning the AR marker on the card and board. Brief information on emerging technology revolution concepts are also provided through the "Did You Know?" cards as a quick revision technique in the game. Findings from the questionnaire conducted

among the students undergoing the Computer Application in Management subject, show that the majority of the students commented that they are interested in using REV-OPOLY in their learning. However, the limitation of this research is that the students were not able to experience playing REV-OPOLY in person as they are off-campus. Further research will be done on identifying students' actual learning outcomes and experience after they are able to return to campus and play REV-OPOLY. Moreover, further research is re-quired to see whether this game can increase students' performances or grades.

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