International Journal of Evaluation and Research in Education (IJERE)
Vol. 14, No. 1, February 2025, pp. 472~481
ISSN: 2252-8822, DOI: 10.11591/ijere.v14i1.29032

Augmented reality board game in promoting financial literacy among Malaysia secondary school students

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Article Info

Article history:

Received Oct 27, 2023
Revised Jul 25, 2024
Accepted Aug 11, 2024

Keywords:

Augmented reality
Board game
Education
Financial literacy
Secondary school
Teaching and learning

ABSTRACT

About two third of working millennials have not saved and only 5% of millennials have enough saving. This study aimed the aim of the study is to promote financial literacy among secondary students using board games. Besides that, this study also focuses to enhance students' financial planning skills after using the board game. On the other hand, this study also investigates whether there is any gender difference between male and female students. The study employs the survey design. A total of 235 secondary school students aged between 15-16 years old from three different states in Malaysia was taken as samples in this study. A board game with augmented reality named FinPlan was used in this study. The study found that there was no difference between test score of financial literacy among male and female. However, there were significant between personal financial planning, practices, and interest towards financial literacy. Female students were outperformed than male students in each criteria. Conceptually, this study contributes to the development of the board game in financial literacy and give insight to the potential of mobile application with augmented reality. This learning method allows students to learn the daily situation that happen such as rewards, penalties and life event. It also brings a message to students, many daily activities that we need to spend money rather than saving the money; therefore, the students must plan the money properly.

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1. INTRODUCTION

The financial issue is always a global concern, over half of Americans are worried about not having enough money for retirement or to cover their medical bill during old age [1], [2]. Previous study [3] stated that about two-third of working millennials have not saved and only 5% of millennials have enough saving. Data from Organization for Economic Cooperation and Development (OECD) showed that financial literacy is poor globally, when the calculation using OECD/INFE 2018 toolkit to measure fundamental financial abilities, behaviors and attitudes [4]. A person who has acquired basic financial skills, behaviors and attitudes will indicate as getting the maximum score for financial literacy. The average financial literacy score across the entire sample was slightly under 12.7 (61% of the maximum) of the highest possible score, which demonstrates a foundational set of knowledge concepts and financially responsible behaviors and

attitudes [4]. However, this condition showed a little bit higher than the average for participating OECD member countries. Among all the countries, Hong Kong received the highest score of 14.8 (71% of the maximum), whereas other countries received scores between 12-14. These results indicate that financial literacy needs some enhancement in financial understanding by the public around the world [5], [6].

The outbreak of the COVID-19 pandemic has proven the significance of financial literacy again. Many workers struggled to survive for more than a week beyond unemployment [7], [8]. This phenomenon showed that many people did not have proper financial planning and sufficient saving. In addition, many young generations live beyond their means [9]. They spend beyond their means and take advantage of easy credit, resulting in a debt culture. Furthermore, many young adults begin their careers after graduation, but they have never been solely responsible for their personal finances while they were in university [10]. These conditions demonstrate that the young generation rarely practice basic financial skills, such as planning their expenses and building a regular saving plan for long-term needs, which could lead them to financial issues. Malaysian Department of Insolvency [11] reported that Malaysia has 290,619 bankruptcies. This report also pointed out that 23.96 percent of all bankruptcies were among young adults between the ages of 18 and 34. The majority of bankruptcies occur among the young generation, thus the need to raise public awareness of financial planning has prompted researchers to develop more effective teaching methods in university or high school courses. OECD [12] stressed the importance of financial literacy to young children and adults for their personal and social well-being; therefore, financial literacy should be taught in school. Many countries have adopted financial literacy into their education system [13]. Malaysia is not left behind; financial literacy has been instilled as a cross-curricular subject since 2017. However, not many teachers have been trained to teach these essential skills. Concerning the importance of this skill, educators should develop some learning materials with gamification and digital element that can attract students' attention because most of the students are tech-savvy.

The education system in many developed countries has changed profoundly, moving away from traditional education toward more technological advancements system. The Malaysia Education Blue Print 2015 to 2025 has prepared our education system to undergo a big transformation in order to prepare our students to face the challenges of the 21st century. However, research showed that many school teachers were still unprepared and the spoon-feeding system was still adopted instead of emphasizing 21st century learning skills and promoting relevant life skills such as financial literacy to the students [14]. The transformation has been implemented for about 8 years but there are some initial gaps that need to be focused on. Evidence showed that game-based learning affects a person's motivations, skills, and behavioral triggers to bring about behavioral changes [2]. The existence of game features stimulates intrinsic impulses to engage in activities and evokes experiences [15]. These motives may increase user engagement [16], learning effectiveness and efficiency [17], and actual behavioral changes [18]. Financial games with augmented reality element have been shown to help students gain knowledge, experience and confident [19]. However, research about game-based learning and financial literacy is still a new area and is yet to be filled [2] even though financial literacy among young adults has been considered important by researchers [19].

A study [20] showed that female outperformance than male in game-based learning; in contrast, another study at the same year [21] indicated the opposite result. However, the recent study indicated that there was no difference between male and female students [22]. It seems that studies have different points of view about gender in game-based learning, it has an interesting point to look into it.

This study makes several contributions to the literature reviews. Extensive research on board game with augmented reality (AR) to enhance financial literacy. Previous research only explored on gamification toward financial literacy but without the AR element. In addition, this paper investigated the impact on students' behaviors and financial planning skills after using the board game. The second contribution is related to the development of the board game. This game was developed based on the secondary school economics and mathematics curriculum. It is also designed based on Malaysian culture and local daily live. However, this element hardly gets in the recent literature review. This is the research gap that is yet to fill.

2. GAME-BASED LEARNING IN FINANCIAL LITERACY

Game-based learning is defined as the implementation of a game in the education context [23]. It begins to get attention and gain popularity recently in education. However, it is a new aspect of financial literacy that needs attention in the game elements that influence financial decision-making and changing of behavior [2]. Basically, the game included board games and digital games. These two kinds of games bring benefits to students' learning.

The banking system provides a mobile application for customers, all the banking applications focus on functional features but lack elements that increase engagement, enjoyment, and motivation [24]. The banking services applications were designed for transactional but not for fun, yet consumers have higher intentions to use banking apps if elements of increasing enjoyment and fun were emphasized [25].

In addition, some financial digital games and debt management can foster learning and enhance personal financial planning because the games have been tailored to reward consumers for ongoing real-world saving actions, entertaining interface, and using an animated cartoon that dances for saving activity [26]. As a result, there was an increment of 25% saving for the users as compared with others. There is a chance for the convergence of banking with classic gamification principles, and there is significant potential for gamification elements to enhance financial behavior, as many people are not new to using their cell phones to obtain financial information. Board game with some digital elements could be used to track learning progress. For this study, a board game with augmented reality will be designed to promote financial literacy.

Prior research has focused on the affordances of motivation and engagement, not much research mentioned behavioral intention in financial literacy. Wang and Sanders [27] argued that a combination of gamification and financial incentives leads to the largest volume of reviews. However, there was no significant relationship between gamification and financial incentives. In contrast, several studies also revealed that game-based learning is an effective medium of financial education [28]. In this study, the usage of badges, leaderboards and other configurations can further enhance the effectiveness of the game [28]. The same research also pointed out that to enable the effectiveness of the financial serious game on young adults, an immersive, persuasive, personalized and voluntary approach should be implemented. Young adults are comfortable with the digital environment nowadays, therefore introducing financial education concepts can be realized through immersive games. In addition, effective persuasion can be instrumental in redirecting technology for young adults' financial well-being. The effect of immersion and persuasion can be leveraged through personalization in the game and user. By integrating the idea into different loops of learning, the evolutionary component makes use of persuasion, immersion, and personalization. Game-based learning can help students gain financial knowledge through learning by doing [19].

The effect of gamification has been found can enhance students in engagement during financial education learning activities [27]. Widyastuti and Suhud [29] reported that financial literacy learning opportunity was significant influence on game preference, usefulness and playing intention. Another study also shown the significant result of gamification on personalized financial decisions [30]. Financial literacy can be learned through games because games are able to close the engagement gap that makes financial literacy growing up [28].

2.1. Gender difference in game based-learning

Gender difference in game-based learning is important because researchers showed that male students are more enjoyable than female students [31]. However, this study also pointed out that women were outperformance than men after game-based learning. Hsu [32] also showed the similar results that males were more willingness to use computer game to learn but they did not show significant on the performance. In other words, male students showed the willingness to use game-based learning than female students but there is not statistical difference in analysis gender difference. Bernik *et al.* [33] showed that the tendency of female students using game-based learning more often but the statistical different only found in male students. Denden *et al.* [34] mentioned that gender and perception can affect students' perception of game elements. Female students were more likely to find feedback useful and more likely to answer self-explanation question than male students. Male students low in extraversion are more likely to perceive badges useful than those high in extraversion. Similarly, another study [35] also showed that female students were more likely in answering self-explanation question. In contrast, the recent study showed that there is no significant result between gender in game-based learning [36].

3. METHOD

The study employs the survey design. The survey explores more about the board game with AR in promoting financial literacy. Therefore, the focus of the study is whether the students can learn better financial literacy with the absence of game.

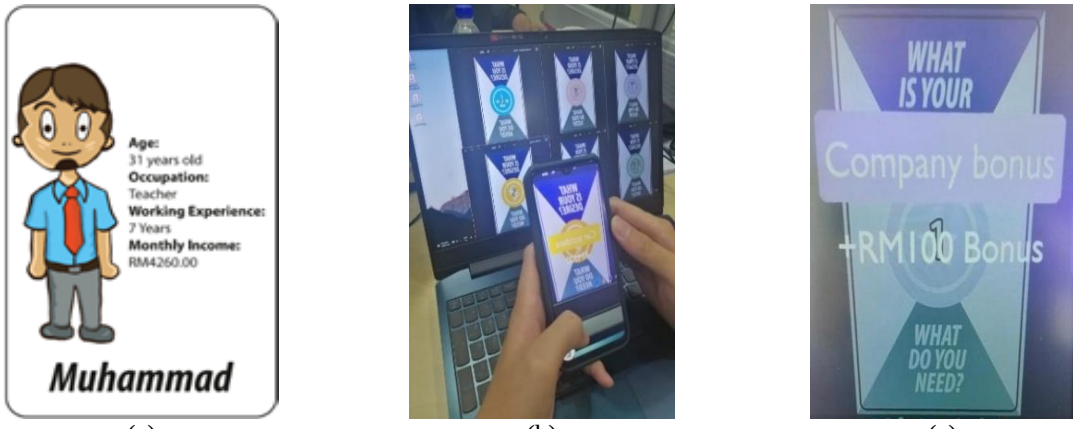
3.1. Samples

The study employed Form 3 and Form 4 secondary school students (aged between 15-16 years old) from three different states in Malaysia (Penang, Perak, and Selangor). A total of 235 students were selected from three schools in the different states. Form 3 and Form 4 students are selected because financial literacy is a subject integrated into Form 3 Mathematics and Form 4 Economics. The sample for quantitative respondents was selected randomly from three schools among 15-16 years old students; whereas, the qualitative subjects were selected by using purposive sampling. The samples consisted of 140 female and 95 male only.

3.2. Educational board game

FinPlan is an educational board game with financial literacy element. This game is geared towards personal financial management. Researchers developed the game based on the theory of planned behavior. The game, as shown in Figure 1, has been tested and verified by an expert in gamification. In the game, a total of 2-6 students are allowed to become players. They can play the role of a teacher, cashier, farmer, pharmacist, or lawyer with different monthly salaries followed by the characteristic card they draw, as shown in Figure 1(a). For example, a teacher has a monthly salary of RM4260 and a farmer has a salary of RM1800. Another player can become the manager to deal with the card and cash flow the players spend throughout the game. Basic financial literacy and simple Mathematics are the skills that are required in the game.

All the players played this game in a designated physical environment using handphones to assess the information. Students worked in teams of 6, they required to throw the dice and draw the card according to 6 different circumstances they will be faced either reward, penalties, life events, basic needs, accidents and liabilities. The gamers need to record their rewards or expenses on designed sheet using i-Pad or handphone while playing. Instructors allow students to play the board game with AR element after the lesson that is related with financial literacy, as shown in Figure 1(b) and (c). A financial planning sheet will be distributed to the students while playing the game. The financial literacy elements of Form 3 Mathematics and Form 4 Economics are selected to be developed in the game. The Malaysia culture and living style will be taken as the background of the board game development.



(a) (b) (c)

Figure 1. Board game card (a) game character, (b) card with AR element, and (c) AR showed wording

This game took around 30-45 minutes to finish, the winner is selected according to the ratio of money they have in hand with the formula, money in hand divided by income multiply 100. The highest ratio is the winner. The learning goal of the game is to teach the students how to manage their own money wisely. Financial knowledge that students can learn from game is savings, investment, mortgage, consumption, and caring to parents and society. It has a donation element to the poor in the game, furthermore it also has an element of the summary of the characteristic of the game has been illustrated in Table 1.

Table 1. Characteristics of the FinPlan

Game	Role play	Gamified online learning environment
Learning environment	Physical play 2–6 players financial literacy game	Online with AR element
Typical hours used	30 minutes – 1 hour	- Discussion - Personal financial management - Knowledge and behavioral change

3.3. Instruments

A set of 25 items FinPlan questionnaires was used as an instrument of the study. A 5-point Likert scale was applied in the instruments. The instrument was constructed by the researchers based on the Theory Planned Behavior. The questionnaire contained of three components, demographic of respondents, financial planning and financial literacy. Basically, the questionnaire consisted of three main criteria: i) personal financial planning; ii) practices; and iii) interest towards financial literacy.

A pilot test was carried out to examine the reliability of the instrument before being used in the actual research. Content validity of the questionnaire and assessment was established by a team of experts including lecturers in economics education and expert from the Malaysian Financial Planning Council. The reliability of the questionnaire is measured by Cronbach alpha with the value of .843.

3.4. Data collection and data analysis procedure

Data were collected from April-May 2023. The form of consent was collected before employed the survey. The result after the implementation of an educational board game named FinPlan was analyzed. The analyses carried out through various statistical techniques. Mean score was calculated and univariate analysis of variance (ANOVA) was applied in this study.

4. RESULTS

The demographics results showed that 235 respondents who participated in the survey, the majority of them were females (59.6%) whereas only 40.4% were males. Most of them neither have foundation of financial literacy nor game-based learning. In addition, a total of 68.9% of the respondents were Malay, 11.5% were Chinese, 12.8% were India, and 6.8% were other races.

This study aimed to measure the effect after using the board game with augmented reality. The further investigation was measured between gender. The descriptive statistics showed the different statistics for financial literacy level of males and females separately. The average for male students were 72.44 and 74.16 for female, overall, female students slightly outperformed than male in financial literacy.

The stem and leaf plot for each gender separately showed the frequency distribution of students' financial literacy scores. This plot usually gives a visual impression of the distribution and each student score on financial literacy. The stem is the first digit of score and the leaf is the second digit. Figure 2 indicates that 29 persons had steams of 6 and leaves of 0 through 9, it means that the score is between 60 and 69. On the other hand, Figure 3 shows the stem and leaf plots for female students showed that there are 22 female score 75 to 79, whereas, there is only a female scored 42 marks. The plot also showed that four females score the highest score, there is 96. The boxplots of performance between male and female students were illustrated in Figure 4.

```
Frequency    Stem &  Leaf

     2.00 Extremes    (=<40)
     3.00        4 .  666
     7.00        5 .  5566668
    29.00        6 .  00004444455688888888888889999
    24.00        7 .  000000000024466666788888
    23.00        8 .  00022234445666666778889
     7.00        9 .  0022246

 Stem width:     10.00
 Each leaf:        1 case(s)
```

Figure 2. Financial literacy stem-and-leaf plot for gender=1.00

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Frequency    Stem &  Leaf

     4.00 Extremes    (=<38)
     1.00        4 .  2
     2.00        4 .  67
     3.00        5 .  044
     5.00        5 .  66666
    11.00        6 .  00000444444
    20.00        6 .  55556677778888888889
    20.00        7 .  00000022222244444444
    22.00        7 .  5566667788888888889999
    21.00        8 .  000001222222334444444
    19.00        8 .  5666666666678888888
     8.00        9 .  00002444
     4.00        9 .  6688

 Stem width:     10.00
 Each leaf:        1 case(s)
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Figure 3. Financial literacy stem-and-leaf plot for gender female

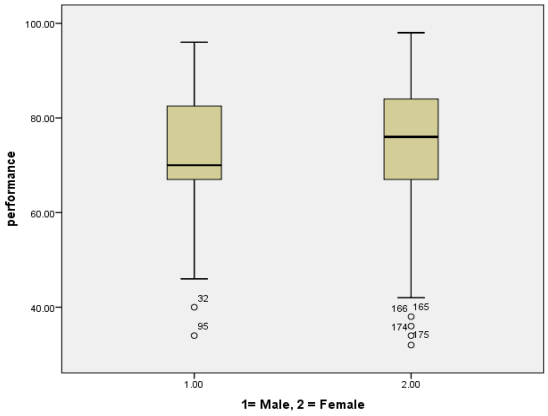

Figure 4. Boxplots of performance between male and female students

The further investigation is on students' score for financial literacy after using the board game. Table 2 shows the findings of the statistical test of the difference between the male and female mean scores. The findings of ANOVA test for F=1.014 (Sig.=.351>.05) showed that the test score of the financial literacy between male and female was not significant. It indicated there was no difference in the mean score of the test between the male and the female. The female was outperformed than male with 1.571 in the mean score.

Table 3 indicated the result of statistic analyzing to compare the financial literacy of males and females after using the board game with AR. Females were outperformance than males in each criteria. After using FinPlan for 4 weeks, the financial planning showed significant improved. In addition, the students also showed interest towards financial literacy.

A further investigation on ANOVA test for three criteria (personal financial planning, practices and interest towards financial literacy) to check whether there is any significant difference between male and female. The findings in Table 4 indicated there are significant difference between three criteria, in other words, there are different between males and female in personal financial planning, practices and interest towards financial literacy. Female students are outperformed than male students in every criteria.

Table 2. A summary of the ANOVA on financial literacy test score

Group	n	M	SD	ANOVA test for equality of variances	
				F	Sig. (at <.05)
Male	95	72.442	12.499	1.014	.315
Female	140	74.013	14.583		

Table 3. Mean score between male and female

Criteria/Item	Males		Females	
	M	SD	M	SD
1 (B1-B7)	3.696	.921	3.9224	.56714
2 (B8-B15)	3.557	.954	3.8196	.56626
3 (C1-C10)	3.784	.872	4.1571	.54774

Table 4. Statistical ANOVA test for three criteria

Criteria/Item	Between groups	
	F	Sig. (at <.05)
1	8.288*	.004
2	11.800*	.001
3	26.904*	.000

5. DISCUSSION

The novel finding in this study is the effectiveness of board game with AR on promoting financial literacy and personal financial planning skills among secondary school students in Malaysia. The finding is relevant and in line with the current education trend where many educational institutions are turning into online learning mode especially after pandemic. In addition, this study also has found a significant difference between male and female after using the board game with AR element in personal financial planning, practices and

interest towards financial literacy. However, the findings showed no difference between male and female in financial literacy test score. It means that the financial knowledge of male and female did not show any significant different. In contrast, the result of a study [37] showed there was significant difference between male and female in financial literacy. Prior study showed that female was lower in financial literacy due to social economic and local environment. Financial literacy was associated with mathematic skills [37]. However, researchers found that financial literacy's test score also reflects students' financial knowledge and the use of board game with AR element can help students to enhance their financial literacy and plan their personal budget. This finding is consistent with prior research game based learning theory that shown significant of promote students' financial literacy and helping them to plan their personal budgets [2].

By engaging in FinPlan, it combines with learning and technology, it can make the lesson more interesting and changing the way of learning. It also allows learning to happen anywhere and anytime, students can play after FinPlan during or after class. If the game has been designed according to curriculum or learning outcome, it can boost students learning ability easily. FinPlan can enhance students' decision making ability in financial planning, social interaction, communication skills and problem-solving abilities. The players must work together to achieve the common goal. These games also help in reinforcing academic concept in a fun and engaging way. This finding consistent with theory of Zone of Proximal Development (ZPD) which indicated that students can achieve the learning outcome in higher level with the assistance of learning tool or peers. In FinPlan, students can achieve higher level of ZPD when they communicate during game playing and with the design of the game the learning outcome can achieve easily.

On the other hand, this study also improves the teaching method by adopting augmented reality which is the current technology to increase the attention and fun in learning. When using the technology of augmented reality, teacher can redesign the rewards and penalties in order to increase the students' learning interest. By authoring the challenging task, students may have different learning experiences and they can practice doing budgets in different scenario. It is a known fact that game based learning is one of method of conducting active learning. Similarly, prior researches also indicated learning tool with the element of ICT significantly benefits learners [38], especially in financial literacy [39]. Both studies also mentioned visual tools can enhance financial literacy with the assistance of fingertip technology, students can learn anywhere and anytime [40], [41]. Overall, the implications of FinPlan have positive impact on various aspects of players cognitive, behavior and social development.

Educators in Malaysia have transformed the teaching method from teacher-centered to students' center many years ago. However, financial literacy is not a stand-alone subject in Malaysia, it only applied cross curriculum since 2019 [42]. Due to it is an important life skill, Malaysian government has taken responsibility to emphasis its role in school and public.

Nevertheless, there were several limitations in this study that should be looked into. One of these limitations was the ration between male and female students. This study employed more female than male students due to the real scenario of the students in the selected school, it may generalize the findings of this study. Additionally, this study did not consider about the students' prior knowledge of financial literacy that they learned from family. Furthermore, the existing knowledge for teachers about financial literacy should be considered. Future research could replicate this study with more equal ratio and students' background of prior financial literacy will take into consideration. In addition, teachers' financial knowledge will be checked.

6. CONCLUSION

In sum, this study focused on promoting financial literacy among secondary school students using game-based learning with AR. This learning method allows students to learn the daily situation that happen such as rewards, penalties and life event. It also brings a message to students, we have a lot of events that we need to spend money rather than saving the money, therefore, the students must plan the money properly. The knowledge that students gain while playing game is fast and effective. They must grasp the main concept and plan their budget with the salary that they draw the card. Additionally, positive financial behavior should begin at a young age. The most effective way to encourage students to have a positive financial behavior is parents influence and develop the saving habit when they are young. Nevertheless, educators also play an important role to educate and training students for positive financial behavior.

Future research directions for educational board games with augmented reality could focus on exploring the effectiveness of incorporating immersive AR experiences to enhance student engagement and learning outcomes. Researchers could investigate the impact of AR features, such as interactive 3D models, simulations, and real-time feedback on student motivation, retention of information, and overall academic performance. Additionally, studying the potential benefits of collaborative AR experiences in educational board games, where students can work together in a shared virtual environment, could provide valuable insights into the social and cognitive benefits of this technology. Furthermore, researchers could explore the

design principles and best practices for integrating AR seamlessly into educational board games to create a more interactive and personalized learning experience. Overall, future research in this area could continue to push the boundaries of educational technology and enhance the effectiveness of AR enhanced board games as innovative learning tools.

ACKNOWLEDGEMENTS

This research has been carried out under the Grant GPUBP (2022-0159-107-01) provided by Universiti Pendidikan Sultan Idris (UPSI). The authors would like to extend their gratitude to UPSI that provide the grant.

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