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The Effectiveness of Object-Oriented-QR Monopoly in Enhancing Ice-Breaking and Education UX: A Preliminary Study

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Abstract. With increasing COVID cases, many are studying or working from home. We aim to address two problems. First, since many companies are into reskilling and upskilling in groups, the human touch and community are important. One aspect of human touch and community development, is ice-breaking. Second, we need to enable easy customization to reuse the objects or assets for different scenarios, contexts and needs. We are interested in games. Hence, a third problem we want to address is to improve problem-solving competencies through games. Our scope of work is to investigate the effectiveness of an object-oriented QR Monopoly game, to enhance ice-breaking in online training, and for education. Preliminary user testing indicates positive findings, with regards to the inclusion of chance, theme/rules/process/asset switching/modification, adding on to computer playfulness via object-orientation of the QR-Monopoly game and entity-process modeling.

Keywords: object-oriented QR-Monopoly game, enhance ice-breaking, education, user experience, computer playfulness

1. Introduction

Educational games are on the rise with the development of technology. There are terms such as “games science” or “serious games.” These have the potential to help us to understand and model, learn behaviors in game environments. Interestingly, Freitas (2018) points out that these games can not only help people to learn, but also to learn design through the game’s design. Pilon (2015) for example, cites Monopoly as a means to explain Henry George’s single-tax theory.

1.1 Problem Statement

With the current pandemic, and the increase in the number of covid cases, most people are required to stay at home. We aim to address two problems. First, companies or trainers, who host online training/ online webinars/online community sessions, face the problem of breaking the ice among trainees digitally. If the ice-breaking session requires physical items, it would make the session troublesome and even confusing, if trainees do not own the required item. Hence, creating an app, where game pieces are integrated would be necessary. The second problem to be addressed, is the need to reduce development, and to encourage reuse of assets for diverse contexts. This can be done by using object-oriented programming, as it encourages reuse of codes/random retrieval of assets to create surprises.

1.2 Objective

The objectives of this study are:
a) to create a mobile game, where players can play the game without being troubled by environmental factors, such as wind or accidental water spills;
b) to create a customizable game, where players can change the theme/assets of the game.

Our scope of work is a mobile Monopoly application. Created by Lizzie Magie to explain Henry George’s single-tax theory in 1903, Monopoly is sometimes known as the Landlord’s game.

Subsequently, in 1991, Hasbro published many different spin-offs. Our Monopoly game is simpler. Our Monopoly game can be used for ice breaking or educational events, where questions (e.g., Mathematics or English questions) can be developed easily, to suit different contexts, needs and abilities.

We also allow users to freely customize using the 'chance' mechanic of the game, to enhance Monopoly's user experience (UX). Players can freely develop their own rules and custom deck of questions for any situation that they desire. With QR codes, board game cafes can use QR codes with discounts at certain places, to surprise customers who pay attention to details. The prototype will be for a single player.

The outline of this paper follows the evolutionary/incremental Software Development Lifecycle (SDLC): Section 2 covers related work, Section 3, the design and development, Section 4, unit, functional and systems testing and user evaluation and in Section 5, the conclusion.

2. Literature Review

2.1 Educational Games

Games can be developed for different situations. Educational games are already in the market, to assist parents and teachers to educate kids. They are widely accepted. Some of the benefits of playing educational games, are the development of computational thinking skills. Framing and reframing (Lee & Wong, 2014) in order to encourage transfer has resulted in positive outcomes (micro- macro- causal structures, and evidences of near and far transfer).

Oei and Patterson (2014) find that a variety of higher-order executive function skills significantly improve with 20 hours of training playing *Cut the Rope*, a physics-based puzzle game, compared to *Modern Combat* (an action video game), *Starfront Collision* (a real-time strategy game), and *Fruit Ninja* (a fast-paced arcade game). They conjecture that in contrast to popular belief that greater complexity will hinder problem-solving, the executive improvements exhibited, imply generalized transfer. This stems from constantly refining strategies, planning and reframing in a variety of complex puzzle games.

Video games, however, are usually negatively perceived, as violence is one of games' main attractions. Blumberg, Altschuler, Almonte, and Mileaf (2013) and Elson and Ferguson (2014) opine that this perception is inconclusive. They find that the major drive for the "serious games movement", which tends to be more educational, is the distinction between entertainment games and non-entertainment games. To Özçelik, Cagiltay, and Ozcelik (2015), from a game study perspective, it teaches people about competition as a design component, and how developers should balance entertainment and education in a game. Hence, there are differences in views towards games.

Shute, Lubin, Greiff, Zhao and Moore's (2016) competency model simplifies the issues, by suggesting four aspects in improving problem-solving skills, i.e., "analyzing givens and constraints," "planning a solution pathway," "using tools and resources effectively and efficiently" and "monitoring and evaluating progress." This competency model makes design and development easier to measure.

2.2 Monopoly

Monopoly is created by Lizzie Magie to explain Henry George's single-tax theory in 1903. It is patented in 1904 and in 1923 (Pilon, 2015). After acquiring Monopoly in 1991 (Seay, 2017), Hasbro publishes many different spin-offs. An example is the Monopoly: Ultimate Banking Edition where the 'Ultimate Banking Unit' replaces cash. Hasbro also collaborates with Star Wars, and thus the release of the Monopoly Star Wars Mandalorian edition.

2.3 Ice-Breaking Games

Due to the pandemic, many creative and innovative ice-breaking games have been featured through Google searches. Figures 1a, and b illustrate four examples from *Conceptboard's* collaborative online whiteboard. Some others turn to Zoom. Examples are those by TrixTV (Figures 1c) on YouTube and Howell (Figures 1d).

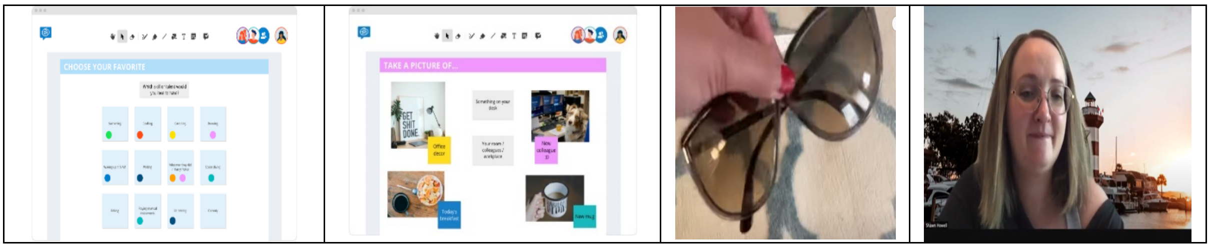

Figure 1a. Choose your favorite *Figure 1b.* Take a picture *Figure 1c.* This thing is me! *Figure 1d.* Where are you?

The non-Zoom games in *Conceptboard* are richer in terms of interactions, because the games are supported by a database with template libraries, board history, role management, file import and an extensible workspace. Interactions are captured and analytics can be carried out.

2.4 Gamification

Gamification in the context of learning and education are activities and processes that aim to solve problems and learn by using different game mechanics (Brathwaite & Schreiber, 2009). Some gamification studies such as by Kim, Song, Lockee, & Burton (2018) are designed bsed on "positive failure", i.e., problem-solving via through multiple attempts and failures. However, similar to Lee and Wong's (2018) study on gamification for the Smart Cities, we prefer rewards and no penalties, as the games in the series are casual games, i.e., for enjoyment, relaxation, recovery and rest.

2.5 Learning Using Board Games

Board games have been utilized throughout the years. Abramson, Burke-Bergmann, Nolf, and Swift (2009) and Mostowfi and Mamaghani (2016) agree that playing is an important factor in educational development. A child's development can be enhanced through "play." It is also claimed that using board games, children can relate better with the context that is being taught. Both also highlight the advantages of using board games as teaching tools, and Hunsucker (2016), platforms for collaborative learning.

2.6 QR Codes in Marketing and Education

The square-shaped QR code is a two-dimension code, which can store all kinds of contents such as image, URL, and text. These provide designers more options. Since they can be designed with any shape and color, and are free and easily accessible to users, QR codes are often used for marketing.

They can also be used for learning. In Chang and Law's (2008) study, teachers can generate a QR code, which brings students to the respective websites to complete their work. Papadakis, Kalogiannakis, and Zaranis' (2018) study also finds that children are motivated while learning Mathematics through a QR-code-based game.

Based on the above review, we identify two points, to be included into the QR-Monopoly application, to achieve ease of use, and increase the expressiveness of the system:

a) the *chance* mechanic is useful. Depending on chance, players are either given a bonus, such as money, or are allowed to move to a certain square. Conversely, chance can pull players back, by penalizing their money, or sending them to jail.
b) the *contents* of the cards can be freely customized, with different instructions or wording, as long as they help the game state to progress.

3. Methodology

This project is developed using a total of 26 weeks and the incremental waterfall model is utilized as the Software Developmental Life Cycle Model. The application's functional and non-functional requirements are both determined mostly through literature review. During this stage, solutions for the problems discussed in the introduction are identified using literature review. By gathering information about prior work using literature review, we can understand different solution factors from the existing solutions, and thus identify feasible and higher priority solutions, to be included in the prototype.

The ‘chance’ mechanic in Monopoly, comes into the picture when players land on a square. Subsequently, they have to pick up a random card from the deck, and follow the instructions on the card. XML and the Java language is used to develop the prototype, the ZXing library is used for the QR code scanner.

System testing is then carried out, followed by usability and user testing. The user testing is carried out on 30 users via Google Form and the link to the online application. The questionnaire is designed based on Davis’ (1989), Davis, Bagozzi, & Warshaw’s (1989) and Venkatesh & Bala’s (2008) Technology Acceptance Models, 1, 2 and 3.

4. Design, Development and Test Case

From a designer/developer’s perspective, this mobile application enables users to create their own themed questions or instructions, based on different events, topics, drama series related, for educational purposes. Players should also be able to develop new rules for the game. Two examples of the plan-based scenarios are presented in Table 1 below.

Table 1. *Plan-Based Scenario*

Rolling the dice		**Buy or rent**	
Actor	Player	Actor	Player
Trigger Event	Player clicks on the dice	Trigger Event	The player lands on a property square
Preconditions	Application is installed on the device and Application is running and The Player still has money	Preconditions	The game board is generated and Dice is clicked, and The Player still has money
Postcondition	The system moves the Player, based on the outcome of the dice click.	Postcondition	Increment the Player’s purchase info., and decrement the Player’s funds.

From a player’s perspective, the Player will enter the main page of the application. There will be options to exit, or to look at more information at the official Monopoly website (not our site). When the user clicks Start, the system will create the game board and ask the Player to enter his/her name. The Player will then click the dice. It will decide randomly, which square the Player will land on. There are two kinds of landing squares. For the property squares, there are two kinds of property squares, which are owned and unowned. When Player lands on an owned property square, rent will automatically be deducted from the cash-in-hand by the application. But if the Player lands on an unowned property square, the Player will have to make a choice between buying or renting the property. Buying the property by clicking buy will make the Player the owner of the property. This enables them to receive rent from other players who land on the said square and stop the opponent from purchasing the said property. Clicking Rent will result in an empty turn. No changes are made to the property’s ownership and the Player’s cash-in-hand will still remain the same.

For the chance squares, the Player can draw a random card from the stack, scan the QR code on the card, and carry out the instructions. Then the Player needs to pick the Pass or Fail option based on whether the Player has successfully or unsuccessfully met the requirements in the card. The score and the Player’s cash-in-hand are then adjusted based on the option chosen. If Pass is picked, the Player will gain an extra amount of cash. Otherwise, a fixed amount will be reduced from the player’s cash at hand. The game loops until the Player runs out of funds.

The game’s user interfaces (*using XML Preview in Android Studio)* are presented in Figures 2a, and b. Two sample QR codes are shown in Figures 2c and d.

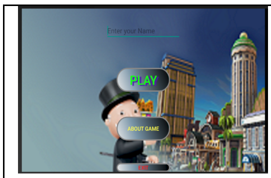

Figure 2a. Main menu

Figure 2b. The board game

Text: Mimic a Disney character

What genre of music do you enjoy

Figures 2c, d. Sample QR code examples for Dares

The functions are presented in Table 2 below.

Table 2. *Functions and Description*

Functions	Description
update ( )	Updates the cash on hand of both players
onDraw ( )	Creates the Game board
Play ( )	Plays music and sound effects
checkMovement ( )	Makes sure that drawable is at the location which they are supposed to be in.
gameOver ( )	Triggered when the player's cash-in-hand drops below zero, which then shows the player the game-over dialog and brings them back to the main menu.
computerTurn ( )	In charge of managing the computer's turn and progress.
check_RentIncrement( )	Check how much the rent increased on the property with the number of times Rent was clicked.

5. User Testing

5.1 Perceived Usefulness

After the application is developed, it is analyzed based on its perceived usefulness and ease of use. From the findings, the user feedback is positive. Users like the concept of using the game for ice-breaking and the use of chance, ranking these first and second respectively (Table 3). They also agree with the object-oriented themed questions, and the likelihood of capturing the attention of other players. Because of time constraints, aesthetics, theme changes and the score systems are basic and can be improved in the future.

Table 3. *Perceived Usefulness Ranking*

Perceived usefulness	Likert scale					Rank
Questions	**2**	**3**	**4**	**5**	**Sum (4 & 5) %**	
Game2icebreaking	0.0%	3.3%	43.3%	53.3%	96.7%	1
Chance	0.0%	6.7%	60.0%	33.3%	93.3%	2
Themed questions	0.0%	10.0%	33.3%	56.7%	90.0%	3
Teach (capture attention)	0.0%	10.0%	36.7%	53.3%	90.0%	4
Theme changes	0.0%	20.0%	40.0%	40.0%	80.0%	5
Aesthetics	6.7%	20.0%	36.7%	33.3%	70.0%	6

The corresponding histograms are presented in Figures 3a-f below.

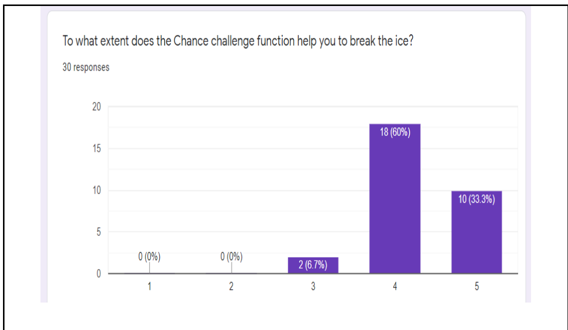

Figure 3a. Usefulness of chance to ice-breaking

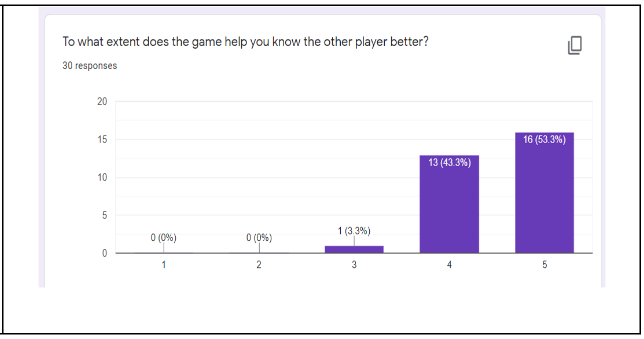

Figure 3b. Usefulness of the game to ice-breaking

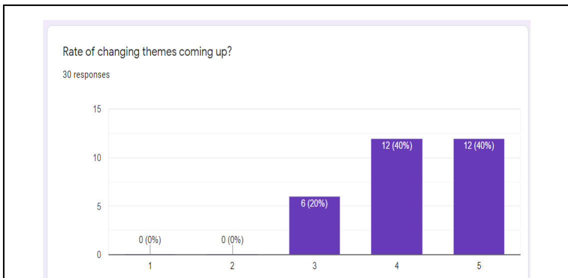

Figure 3c. Usefulness of rate changes in themes

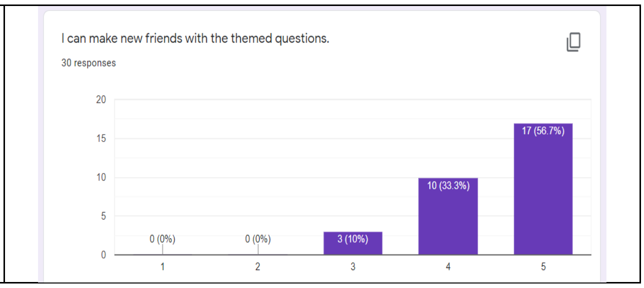

Figure 3d. Usefulness of themed questions

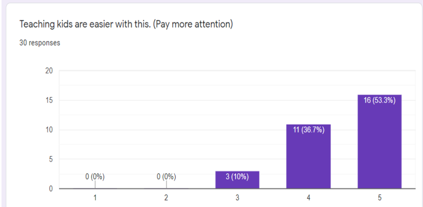

Figure 3e. Usefulness in capturing attention

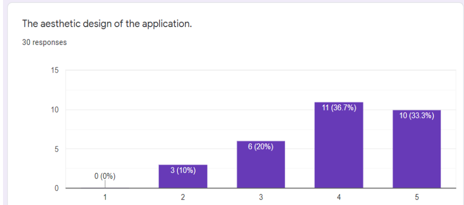

Figure 3f. Pleasantness of design aesthetics

5.2 Perceived Ease of Use/Result Demonstrability, Self-Efficacy and Computer Playfulness

Most of the feedback are positive. In terms of ranking, theme switching, board layout, customizing questions, QR function, and turn progress are ranked highest (Table 4), with a summation of score 4 and score 5 percentages accounting for 96.7% each. The difference thus lies in the percentage of users/players who score 5 for each question. These highlight again, the users/players like the novelty of dynamic and easy changes, via the object-oriented nature of functions in the system. These contribute to system playfulness, a key attribute in Technology Acceptance Model 3.

Table 4. *Ranking for Perceived Ease of Use*

Perceived ease of use							
Questions	**Likert scale score**				**Sum (4 & 5%)**	**Rank**	**TAM 3 attributes**
	2	**3**	**4**	**5**			
Theme switching	0.0%	3.3%	33.3%	63.3%	96.7%	1	Playfulness
Board layout	0.0%	3.3%	36.7%	60.0%	96.7%	2-3	Playfulness
Customizing questions	0.0%	3.3%	36.7%	60.0%	96.7%	2-3	Playfulness
QR function	0.0%	3.3%	43.3%	53.3%	96.7%	4	Result demonstrability
Turn progress	0.0%	3.3%	50.0%	46.7%	96.7%	5	Result demonstrability
At ease	0.0%	6.7%	20.0%	73.3%	93.3%	6	Self-efficacy
Confidence	0.0%	6.7%	26.7%	66.7%	93.3%	7	Self-efficacy
Score tracking	3.3%	6.7%	40.0%	50.0%	90.0%	8	Result demonstrability

Result demonstrability/ease of use and confidence (self-efficacy) (another two attributes in Technology Acceptance Model 3), are scored highly as well, indicating that although the design is simple, it is positive. Some users/players enjoy the part where they design the cards to look more aesthetic, e.g., designing the card's back with different cartoons and in the future, printing the QR code and card design input from the users on an actual card. In a later version, the game is extended to an AR-enhanced food ordering app, for Instagrammable shots (Figures 4a, b, c, d, e) at a cafe.

Figure 4a (food ordering app), *b* (start AR)*, c* (Halloween AR), *d, e* (Other AR examples)

6. Conclusion

We have set out to design and develop an object-oriented QR Monopoly game, in order to enhance Monopoly's customizability, asset and game development/management and user experience (UX). Users/players like the flexibility and easy customization of the application, as it can suit educational as well as non-educational needs and contexts. Examples of use cases are ice-breaking sessions, even for corporate training. User testing indicates very positive results, prioritizing surprise, flexibility, playfulness, above mechanics. The most important success factor is Monopoly's inherent game design.

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