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# UMSG: An Extended Model to Investigate the Use of Mobile Social Games

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**ABSTRACT** Mobile Social Games (MSGs) are becoming increasingly popular worldwide, and the factors leading to the diffusion and use of such games need to be further investigated. This study proposes an extended model that aims to explore the Use of Mobile Social Games (UMSG). The UMSG model was inspired by two of the most recognized theories: the Theory of Reasoned Action (TRA) and the Diffusion of Innovations (DOI) theory, in addition to newly introduced factors drawn from the unique characteristics of MSGs. This paper describes the model construction and then validates it using two case studies. The investigation adopts a sequential mixed-method design that gathers qualitative and quantitative data. The first phase of the investigation includes a focus group of 11 MSG players. The results of the focus group inspired improvements to the proposed model. The second phase included two large-scale quantitative studies that gathered data from 890 participants through an online questionnaire. The results demonstrated that the UMSG model was a good fit with the case study datasets and was able to explain the discrepancy between the different MSGs. Most of the diffusion attributes were found to be significant, in addition to a newly introduced factor that represents communication.

**INDEX TERMS** DOI, Mobile game diffusion, Mobile Social Games, Technology Acceptance, TRA

## I. INTRODUCTION

In recent years, the popularity of games has increased, especially on online social networking websites and mobile devices as compared to PC and console devices. According to the Global Games Market Report by Newzoo,[1] the number of online mobile game users constitutes 42% of the gaming market, and the mobile gaming market share in 2020 is expected to represent more than half of the total games market. With Asia Pacific being the largest region, the fastest-growing region in upcoming years will be the rest of Asia (excluding China, Japan, and Korea), with total game revenues growing to $10.5 billion in 2020[1]. These data indicate that mobile games have great potential in attracting new users and will surpass PC and console games.

With the rise of Social Networking Sites (SNS), social mobile games have changed the game industry. Mobile social games are defined as "'casual games that are created to play on portable devices and are integrated in social networking platforms to facilitate the user's interactions" [1]. The characteristics of mobile social games are that they are "easy to play, less time consuming, facilitate social interaction, and focus on entertaining and casualness" [1]. Similarly, in [2], it was stated that the topmost significant attractive elements of social games are "easy and convenient," "friendly and lively," and "social interaction". In addition, more elements distinguish social games from others, such as "social platform based," "real identity," "casual gaming," and "multiplayer" [3]. These characteristics are visible in a number of popular mobile social games such as Candy Crush,[2] Hay Day,[3] and Ludo Star.[4]

Researchers have tried to explain the reasons behind the spread of innovations or ideas. One well-known model is Rogers' Diffusion of Innovation theory (DOI), which postulates that the diffusion of an innovation can be defined

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[1]https://newzoo.com/insights/articles/the-global-games-market-will-reach-108-9-billion-in-2017-with-mobile-taking-42/[Date accessed 9 Feb. 2018]

[2]https://king.com/game/candycrush [Date accessed Feb. 24, 2018]
[3]http://supercell.com/en/games/hayday/ [Date accessed Feb. 24, 2018]
[4]http://gameberrylabs.com/ [Date accessed Feb. 24, 2018]

as ''the process by which an innovation is communicated through certain channels over time among the members of a social system'' [4]. This theory lays out five determinants that contribute to how and why new ideas and technology spread: Relative advantage, Compatibility, Complexity, Observability, and Trialability.

One approach to understanding why people use a certain technology is through technology acceptance models and theories. These theories model human decision-making in terms of behavioral intention to use a certain technology. One widely used model in technology acceptance is the Theory of Reasoned Action (TRA), which defines the relationships between beliefs, attitude, subjective norms, intentions, and behavior. The attitude toward behavior indicates the degree to which a person has favorable or unfavorable views of the behavior in question. Subjective norm refers to the perceived social pressure to perform, or not to perform, the behavior [5].

In a recent study, Hamari and Keronen conducted a meta-analysis of 48 studies on the reasons for using games [6]. They compared results across games that are designed for either entertainment or instrumental use. Their analysis showed that enjoyment and usefulness are equally significant factors for using online games. The researchers argued that although games were the focus of a substantial number of research studies in the past decade, ''there is still a lack of a clear and reliable understanding of why games are being used, and how they are placed in the established utilitarian-hedonic continuum of information systems.'' Therefore, our study proposes a new extended model that combines both DOI and TRA theories along with newly introduced factors to investigate the Use of Mobile Social Games (UMSG).

The remainder of this paper is organized as follows: Section 2 reviews theories and related work used in this study. Section 3 demonstrates the developed research model. Section 4 presents the research methodology, which includes both data collection and measurements. Section 5 presents the analysis and results, followed by section 6, which discusses the results. Finally, section 7 concludes the paper with contributions to research and practice, and suggestions for future research.

## II. RELATED WORK

### A. TECHNOLOGY ADOPTION MODELS AND THEORIES

Advances in technology during recent decades led to the development of a number of theories to explain users' acceptance and use of such technologies. One approach to understand why people use a certain technology is through technology acceptance models and theories. These theories model human decision-making in terms of the behavioral intention to use a certain technology.

One well-known theory is the TRA [5], which describes the connection between beliefs, attitude, subjective norms, intentions, and behavior. In this model, the attitude toward behavior indicates the degree to which a person has favorable or unfavorable views of the behavior in question.

The Theory of Planned Behavior (TPB) [7] argues that a person's intention to perform a certain behavior can be predicted from attitudes toward that behavior, subjective norms, and perceived behavioral control. The first two factors are derived from TRA, while the third factor indicates the perceived control of a user that may limit his/her behavior.

The DOI theory [4] highlights ''the process by which an innovation is communicated through certain channels over time among the members of a social system'' [4]. This model proposes four main factors that influence the spread of a new technology: the innovation itself, communication channels, time, and a social system. A theoretical model of DOI was applied in the field of technology acceptance and was used to predict usage behavior with different technologies and information systems.

Another popular model is the Technology Acceptance Model (TAM) [8]. The model explains the factors of technology acceptance that lead to explaining user behavior. The basic version of TAM looks at two specific beliefs: Perceived Usefulness, that is, a potential user's belief that the use of a certain system will improve his/her action; and Perceived Ease of Use, that is, the degree to which a potential user expects the target system to be easy to use.

The Unified Theory of Acceptance and Use of Technology (UTAUT) [9] is also used in several studies. The model aims to explain user intentions to use a certain technology and subsequent usage behavior through four key factors: performance expectancy, effort expectancy, social influence, and facilitating conditions.

These models were verified and evaluated by many researchers over the past years with regard to various new technologies. As reported in [10], the TRA, TAM, TPB, and DOI were all used to develop a conceptual model for the IT innovation adoption process in organizations. While, in [11], the adoption of the University Campus Card applications was investigated using the UTAUT. Moreover, teachers' acceptance of information and communication technology integration in the classroom was also investigated using the UTAUT [12]. Another example is the investigation of mobile banking, which was carried out using the DOI model [13]. In addition, the use of blogs and microblogging were investigated using the TRA and the UTAUT [14], [15].

Many argue that identifying the reasons for accepting or rejecting new technologies has become one of the most significant research areas in the information technology field, and that it has a great impact on technology utilization and realization [16].

### B. MOBILE SOCIAL GAMES (MSGs)

MSGs are types of games that use social networking platforms and encompass social interaction features. These are game applications embedded within social network platforms such as Facebook or MySpace, etc., or have a social feature where players can compete with other players around the world via the Internet [17]. Social games provide an attractive

venue for socialization in an enjoyable environment. This feature distinguishes them from other games [1], [18].

Many factors have been examined through various research studies. These factors include:

- Attitude, which refers to a user's opinion on how positive or negative playing a game is [5].
- Behavioral Intention (or Playing Intention), which can be defined as the degree to which a user intends to play online games in the future [5].
- Perceived Enjoyment, which refers to the degree to which a user believes that playing online games is enjoyable, entertaining, and fun [19].
- Perceived Ease of Use, that is the extent to which a user considers that playing a game would be free of physical and mental effort [8].
- Perceived Usefulness indicates the degree to which a user considers that playing a game would enhance a certain aspect of his or her life [8].
- Subjective Norms (or Social Influence) refers to the perception of whether other people approve of the behavior (use of games) [20].
- Flow Experience indicates the degree to which a user feels fully immersed and deeply engaged while playing a game [21].

### C. MSGs RESEARCH

To investigate the various factors associated with online games and their impact on the adoption and use of online gaming applications, several theoretical models were used in many studies. Most of these models were derived from TAM [8], TPB [7], TRA [20], UTAUT [9], the Uses and Gratifications Theory UGT) [22], DOI [4], or combinations of some of these models [23], [24]. A summary of recent studies of mobile social games is shown in Table 1.

Lee examined whether flow experience, perceived enjoyment, and interaction have an impact on people's behavioral intention to play online games, and investigated the effects of gender, age, and prior experience on online game acceptance [23]. The findings showed that flow experience is a more important factor than perceived enjoyment in influencing users' acceptance of online games. Huang and Hsieh looked at the factors affecting user loyalty toward online games. These researchers focused on massively popular multiplayer online role-playing games based on the UGT and the Flow Theory [25]. Analyses revealed that the users' sense of control, perceived entertainment, and challenge affect their loyalty toward an online game, while sociality and interactivity have an insignificant impact on loyalty. Attitudes toward online games were investigated by Yoon et al., whose results showed that perceived usefulness, enjoyment, and economic value have a positive impact, whereas perceived ease of use was not a significant factor [26].

Many argue that games serve both hedonic and utilitarian needs [6], [27]. Davis et al. provided a conceptual model for the relationship between hedonic and utilitarian consumption and game usage [27]. Their survey results showed that hedonic, rather than utilitarian, use positively affects online game purchase and usage. Psychological elements that may contribute to players' behavior regarding mobile social games were examined. The results showed that perceived enjoyment and usefulness together with perceived mobility, perceived control, and skill are all determinant variables affecting the intention to play social games [28].

Other models were used to study other factors. For example, in [29], the researchers developed a model of expanding the UGT to explore six factors: perceived entertainment, social interaction, pass time, game popularity, usability, and trust. The results showed that four of these factors (i.e., perceived entertainment, game popularity, usability, and trust) have a strong impact on the intention to play MSGs.

On the other hand, Chen et al. investigated both the social and gaming factors of social games and their roles

**TABLE 1. Summary of the research on mobile social games.**

| Study | Factors | Model used | Sample size |
|---|---|---|---|
| [23] | flow experience, perceived enjoyment, and interaction | Theory of Planned Behavior (TPB) | 458 |
| [25] | control, perceived entertainment, challenge, sociality, and interactivity | Uses and Gratifications Theory (UGT) and the Flow Theory | 320 |
| [26] | perceived usefulness, enjoyment, and economic value | TAM | 244 |
| [27] | hedonic and utilitarian consumption | TAM | 493 |
| [38] | perceived ease of use, connection quality, and content quality | TAM, Flow | 231 |
| [39] | incentives and enjoyment | TAM | 536 |
| [29] | perceived enjoyment and usefulness together with perceived mobility, perceived control, and skill | TAM | 1409 |
| [29] | perceived entertainment, social interaction, pass time, game popularity, usability, and trust | Expanding the Uses and Gratifications Theory | 387 |
| [2] | social and gaming factors | Theory of Reasoned Action (TRA) | 169 |
| [30] | social interaction | TAM | 200 |
| [31] | perceived enjoyment, flow experience, level of perceived behavioral control, subjective norms, attitude, perceived enjoyment, and flow experience | Theory of Planned Behavior | 1584 |
| [32] | challenge, variety, novelty, and design aesthetics, and playability attributes of ease of use, and interactivity | Cognitive dissonance theory | 207 |
| [33] | hedonic, emotional, and social benefits and social norms | Uses and Gratifications Theory | 642 |
| [40] | Satisfying the need for competence | Uses and Gratification Theory, Intrinsic Motivation and Self Determination Theory | 293 |

in enhancing perceived enjoyment [2]. The researchers also looked at the interaction between perceived enjoyment, subject norm, perceived critical mass, intention to play, and actual behavior. Their findings suggest that perceived enjoyment is significantly affected by social identification, social interaction, and diversion, which in turn influence the intention to play. Chen et al. also investigated a popular mobile social network game in China called WeChat. Their results revealed that social interaction has a great impact on perceived enjoyment and has a strong influence on the use context, which increases the positive attitude to play the game [30].

Perceived enjoyment and flow experience were examined as important drivers of the actual use of online games. The results revealed that perceived enjoyment has the strongest influence on actual use. Other variables such as the level of perceived behavioral control, subjective norms, attitude, perceived enjoyment, and flow experience also have a strong impact on actual use [31]. The role of enjoyment as a motive for continual mobile game use was also examined in [32]. Their results highlighted "enjoyment" as the key factor in determining continued mobile play, and that it is deeply affected by the game's ease of use, novelty, design aesthetic, and challenge. In a recent study, Pokémon Go, one of the first mobile augmented reality (AR) games, was investigated using a framework based on the UGT, technology risk research, and flow theory. The results showed that hedonic, emotional, and social benefits and social norms drive consumer reactions [33].

In summary, the literature review revealed that behavior intention, attitudes, enjoyment, perceived ease of use, and perceived usefulness are the variables frequently investigated and proven to have a significant impact. The TAM, or an extended version of it, is commonly used in these studies with a sample size ranging from 200 to 1500 participants. Although TAM has a simple structure and acceptable explanatory power of 40% in behavioral intention [34], many argue that the model fails to explain the remaining 60% [35]. In addition, many believe that the model ignores social influence (see [36] and [37]) and lacks generalizability and reliability across cultures [35].

Therefore, to overcome such limitations, our study proposes a model that takes into account the TRA and the DOI theory, in addition to newly introduced factors. The rationale behind choosing these two theories is explained next.

## III. UMSG MODEL

The previous survey of studies revealed that MSGs were not addressed as an innovation or a new medium since, as many argue, it fails to explain the variance in behavioral intention [35], ignores the social influence (see [36] and [37]), and lacks generalizability and reliability across cultures [35]. Therefore, this paper proposes an extended model that combines Rogers' innovation attributes with the TRA in order to investigate the factors leading to the diffusion and use of MSGs.

The DOI lists five determinants that contribute to the diffusion of new ideas and technology. They are defined as follows:

- Relative advantage: The degree to which an innovation is perceived as better than the idea it supersedes.
- Compatibility: The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.
- Complexity: The degree to which an innovation is perceived as relatively difficult to understand and use.
- Observability: The degree to which the results of an innovation are visible to others.
- Trialability: The degree to which an innovation may be experimented with one on a limited basis.

In this study, we aim to understand the factors leading to the diffusion of MSGs and how these factors affect the users' attitudes toward a game. Rogers' DOI theory postulates that rapid adoption of an innovation leads to its success; hence, the innovation determinants suggested by the DOI (as explained earlier) can be important. Therefore, the present research looks at MSG use from the perspective of the DOI theory. Moreover, since the current study aims to understand the use of technology, it proposes a model that combines TRA with DOI. This allows us to investigate whether these widely studied attributes of innovations impact attitudes toward the use of MSGs.

This study suggests that the innovation attributes (Relative advantage, Compatibility, Complexity, Observability, and Trialability) influence user beliefs regarding the outcome of playing MSGs, and lead to a positive attitude toward these games. Therefore, we hypothesize the following:

H1: Relative advantage has a positive effect on attitudes toward playing MSG.
H2: Compatibility has a positive effect on attitudes toward playing MSG.
H3: Complexity has a positive effect on attitudes toward playing MSG.
H4: Observability has a positive effect on attitudes toward playing MSG.
H5: Trialability has a positive effect on attitudes toward playing MSG.

In addition to the DOI attributes, we also consider two other game-related factors affecting the attitude toward playing MSGs, namely, the *Chatting* factor and the *Communication* factor. They represent the *Social Interaction* within the game. Previous studies on online games suggested that social interaction significantly affects enjoyment and increases the positive attitude toward playing games [30]. Therefore, we hypothesize the following:

H6: Chatting with friends/family has a positive effect on attitudes toward playing MSG.
H7: Communication with friends/family has a positive effect on attitudes toward playing MSG.

The TRA proposes that attitude toward a certain behavior and the subjective norms determine the behavioral intention of an individual, and consequently the actual behavior [5].

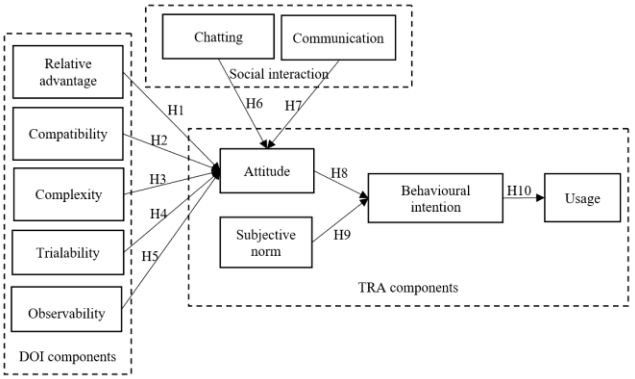



**FIGURE 1.** UMSG model.

Several studies confirmed the direct relationship between TRA constructs: the attitude, subjective norm, behavioural intention, and the actual usage [8], [41], [14]. Therefore, we also hypothesize that a person's attitude toward MSGs and the subjective norm will affect the behavioral intention to play the game, which in turn will have an effect on the actual usage:

H8: Attitude has a positive effect on the behavioral intention to continue playing MSG.

H9: Subjective Norm has a positive effect on the behavioral intention to continue playing MSG.

H10: The behavioral intention to continue playing MSG has a positive effect on the actual usage.

The proposed model is shown in Fig. 1. The analysis of the hypotheses is presented in section IV where Table 6 summarizes all the results.

## IV. RESEARCH METHODOLOGY

### A. DATA COLLECTION

The data was collected in several phases, that is, through a focus group session and two case studies on two popular MSGs, as discussed next.

*Focus group* In the first phase, a focus group session was conducted as an exploratory step to gain a deeper understanding of the factors affecting MSGs and to inform the survey design.

We sent invitations to a group of MSG players and received responses from 11 players. A set of hypothesis-driven questions that reflected the factors in the proposed model were discussed with the participants. This was an open discussion where the participants were encouraged to express various aspects related to the game.

Based on the data gathered from the focus group session, Relative advantage was linked to entertainment and passing time. Moreover, Observability was defined as token collection. During the discussion, we also found that Social Interaction items were salient; these were expressed in terms of the Communication factor and Chatting factor, which support H6 and H7.

Analyzing the data gathered from the focus group interviews helped in identifying the most significant factors affecting MSGs and the items to be included in the survey.

### B. MEASUREMENT

A survey was designed based on the data gathered from the focus group, which went through several phases of revisions and validation. First, the survey was reviewed and evaluated by a psychology expert, and a few modifications were made according to the feedback received. Next, the authors conducted a think-aloud session to review the items' wording and to ensure its clarity and readability. Finally, a pilot survey was administered to a sample of 100 participants. From this pilot, we conducted an exploratory factor analysis and found that the Compatibility factor was cross loading with other factors in the proposed model.

Therefore, to achieve a clear discrimination between the factors, the Compatibility factor was discarded from the proposed model. In addition, this pilot enhanced the reliability of the remaining measurements.

The final validated version of the survey included nine factors. The items were based on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The adopted measurement items were mainly derived from previous literature on online social games and the DOI theory. Measures of users' intentions to play social games were adapted from previous studies using TAM, mainly from [8]. Relative advantage and Complexity were measured by items derived from [42] and [43]. Observability and Trialability were measured by adapting items in [42] and [43]. Subject norm was adapted from [7]. The detailed items for each of the factors along with the sources of measurements are presented in Appendix A. Survey Monkey[5] was used to design the survey and a hyperlink was generated and distributed through mailing lists and social networks (WhatsApp, Snapchat, Instagram, and Twitter). Incentives were provided to attract participants and encourage participation.

#### 1) CASE STUDY 1

Ludo Star was chosen as a case study to validate the UMSG model. It is one of the most popular MSGs launched as a mobile application by Gameberry Labs Pvt. Ltd.[6] in the second quarter of 2017. Ludo Star became a phenomenon because not only did it attract 5–10 million installs on mobile devices,[7] it was also listed as the top download in both the Apple Store and Google play (as of summer 2017).

The survey link was sent to participants via mailing lists and social network platforms where a total number of 591 responses were received.

#### 2) CASE STUDY 2

In order to find out if the proposed model can be applied on another MSG, a second case study was conducted. PUBG

(PlayerUnknown's Battlegrounds) was selected for this case study. This is an online multiplayer battle game designed and developed by PUBG Corporation, a South Korean video

[5]https://www.surveymonkey.com/ [Date accessed 9 Feb. 2018]

[6]http://gameberrylabs.com/ [Date accessed 9 Feb. 2018]

[7]https://www.techsandooq.com/2017/07/ludo-star-addictive-game-viral/ [Date accessed 9 Feb. 2018]

**TABLE 2.** Demographic data.

| Category | Item | Case study 2 | | Case study 1 | |
|---|---|---|---|---|---|
| | | Frequency | % | Frequency | % |
| Gender | Men | 100 | 17% | 50 | 16.7% |
| | Women | 491 | 83% | 249 | 83.3% |
| Age | 9 years or less | 3 | 0.5 % | 2 | 0.7% |
| | 10–17 | 38 | 6.4% | 53 | 17.7% |
| | 18–24 | 309 | 52.3% | 171 | 57.2% |
| | 25–30 | 153 | 26% | 57 | 19.1% |
| | 31–39 | 65 | 11% | 12 | 4.0% |
| | 40–49 | 18 | 3% | 3 | 1.0% |
| | 50 years or more | 5 | 0.8% | 1 | 0.3% |
| How did you get to know of the game? | Advertisement | 24 | 4% | 9 | 3% |
| | Friends or family | 491 | 83% | 252 | 84.3% |
| | Twitter | 94 | 16% | 43 | 14.4% |
| | Snapchat | 68 | 11.5% | 19 | 6.4% |
| | Instagram | 36 | 6% | 21 | 7% |
| | WhatsApp | 35 | 5.9% | 7 | 2.3% |
| | Other | 24 | 4% | 21 | 7% |
| When did you start playing the game? | One week | 6 | 1% | 14 | 4.7% |
| | Less than a month | 17 | 2.9% | 12 | 4.0% |
| | One month | 39 | 6.6% | 28 | 9.4% |
| | Two months | 95 | 16% | 48 | 16.1% |
| | More than two months | 434 | 73.5% | 197 | 65.9% |
| Which identity do you use when you play? | Using my own identity on Facebook | 291 | 49.3% | 135 | 45.2% |
| | Anonymous Facebook account | 103 | 17.4% | 50 | 16.7% |
| | Guest account | 197 | 33.3% | 114 | 38.1% |
| How many times do you play? | Hardly ever | 73 | 12.3% | 21 | 7.0% |
| | Occasionally | 197 | 33.3% | 55 | 18.4% |
| | Few times a week | 56 | 9.5% | 32 | 10.7% |
| | One time a day | 76 | 12.9% | 42 | 14.0% |
| | Few times a day | 189 | 32% | 149 | 49.8% |
| How much time do you spend playing the game? | Less than 10 min | 58 | 9.8% | 12 | 4.0% |
| | 10 min to 30 min | 254 | 42.9% | 38 | 12.7% |
| | 30 min to 1 h | 177 | 29.9% | 97 | 32.4% |
| | 1 h to 2 h | 71 | 12% | 65 | 21.7% |
| | More than 2 h | 31 | 5.4% | 87 | 29.1% |

game company. The free-to-play mobile game was first released on September 2018 gaining huge popularity among gamers. It was the second most-downloaded MSG in 2018, with nearly 300 million downloads worldwide.[8]

The survey link was sent to participants through mailing lists and social network platforms where a total number of 299 responses were received.

The demographics of both studies are listed in Table 2.

## V. ANALYSIS AND RESULTS

This study applies the Structural Equation Modeling (SEM) approach to test the hypotheses in the proposed model. SEM is highly recommended for complex theoretical models that include multiple constructs. It is widely used in behavioral science studies for the modeling of complex, multivariate data sets. It is especially popular in information technology and information systems research [44]. There are two main steps in SEM. First, the measurement model identifies how measured variables work together to represent latent factors. Second, the structural model evaluates how constructs are related to each other in the model [45].

### A. MEASUREMENT LEVEL ANALYSIS

The measurement model aims to establish interrelationships between each latent variable and its measured items. This is done through a series of validity and reliability tests [46]. Appendix A shows the latent variables used in this study and their measured items (statements), which were adopted from the literature. The measurement level of SEM aims to confirm the robustness of the instrument and its reliability and validity. In order to achieve this, Composite Reliability (CR) and construct validity need to be tested. A reliability score is considered acceptable if it lies between 0.6 and 0.7, and good if the score is higher than 0.7 [46].

[8] "Q4 and Full Year 2018: Store Intelligence Data Digest" (PDF). Sensor Tower. 16 January 2019. Retrieved 19 January 2019.

**TABLE 3.** Composite reliability, AVE, and Cronbach's Alpha.

| | Case study 1 | | | Case study 2 | | |
|---|---|---|---|---|---|---|
| | CR | AVE | Cronbach's alpha | CR | AVE | Cronbach's alpha |
| BI | 0.953 | 0.872 | 0.953 | 0.951 | 0.867 | 0,951 |
| CH | 0.929 | 0.813 | 0.928 | 0.819 | 0.605 | 0,809 |
| COMM | 0.908 | 0.768 | 0.905 | 0.894 | 0.739 | 0,892 |
| ADV | 0.795 | 0.579 | 0.773 | 0.786 | 0.564 | 0,762 |
| COX | 0.776 | 0.639 | 0.755 | 0.738 | 0.585 | 0,737 |
| TRI | 0.858 | 0.669 | 0.855 | 0.847 | 0.648 | 0,846 |
| SN | 0.925 | 0.806 | 0.923 | 0.931 | 0.818 | 0,927 |
| AT | 0.874 | 0.702 | 0.865 | 0.851 | 0.657 | 0,847 |
| OBS | 0.842 | 0.641 | 0.837 | 0.862 | 0.678 | 0,847 |

Notes: ADV: Relative advantage, COMM: Communication, COX: Complexity, OBS: Observability, TRI: Trialability, AT: Attitude, SN: Subjective Norm, BI: Behavioral Intention.

**TABLE 4.** Square root of AVE vs. correlation (bold numbers in diagonal row are square roots of AVE) – case study 1.

| | BI | CH | COMM | ADV | COX | TRI | SN | AT | OBS |
|---|---|---|---|---|---|---|---|---|---|
| **BI** | **0.934** | | | | | | | | |
| **CH** | 0.121 | **0.902** | | | | | | | |
| **COMM** | 0.376 | 0.298 | **0.877** | | | | | | |
| **ADV** | 0.459 | 0.110 | 0.273 | **0.761** | | | | | |
| **COX** | 0.151 | 0.026 | 0.116 | 0.228 | **0.800** | | | | |
| **TRI** | -0.056 | 0.051 | -0.015 | -0.008 | 0.192 | **0.818** | | | |
| **SN** | 0.298 | 0.224 | 0.497 | 0.190 | 0.173 | 0.117 | **0.898** | | |
| **AT** | 0.646 | 0.156 | 0.339 | 0.483 | 0.206 | 0.003 | 0.335 | **0.838** | |
| **OBS** | 0.339 | 0.225 | 0.349 | 0.370 | 0.194 | 0.062 | 0.314 | 0.369 | **0.800** |

The construct reliability scores of all constructs are presented in Table 3. This shows that all reliability scores exceeded the minimum threshold, and therefore the constructs are considered reliable for the remaining analysis. It is also suggested that convergent validity can be estimated using the Average Variance Extracted (AVE), and the recommended value of AVE is 0.5 or higher [46]. Table 3 shows that all variables have good AVEs, which are greater than 0.5. Internal consistency reliability was also assessed using Cronbach's alpha measure, which should be greater than 0.7 [47]. All variables exceeded the recommended threshold.

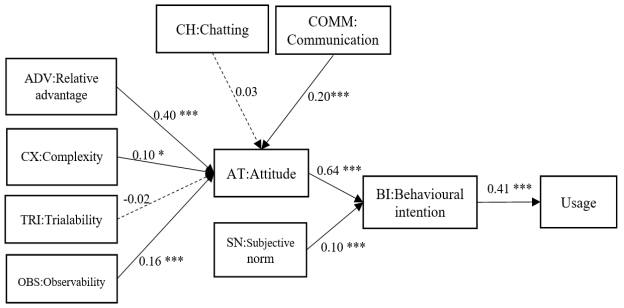
Discriminant validity is measured by comparing the square root of the AVE of each construct with the correlation estimates of all other constructs. To establish the discriminant validity test, the value of the AVE for each construct should be higher than the correlation estimate between constructs [46]. As shown in Tables 4 and 5, the results suggest that good discriminant validity of the constructs in both studies is achieved.

### *B. STRUCTURAL LEVEL ANALYSIS*

The structural model includes path analysis in which all hypothesized paths between constructs are assessed. There are nine hypothesized relationships in the model, which are illustrated in Fig. 2 and 3. Each hypothesis is assessed by examining the following variables: p-value, standardized path coefficient $\beta$ (regression coefficients), and Critical Ratio

**TABLE 5.** Square root of AVE vs. correlation (bold numbers in diagonal row are square roots of AVE) – case study 2.

| | AT | ADV | CH | COMM | COX | TRI | OBS | SN | BI |
|---|---|---|---|---|---|---|---|---|---|
| **AT** | **0.811** | | | | | | | | |
| **ADV** | 0.447 | **0.751** | | | | | | | |
| **CH** | 0.306 | 0.162 | **0.778** | | | | | | |
| **COMM** | 0.208 | 0.160 | 0.321 | **0.860** | | | | | |
| **COX** | 0.299 | 0.274 | 0.211 | 0.244 | **0.765** | | | | |
| **TRI** | 0.084 | 0.132 | 0.099 | 0.221 | 0.327 | **0.805** | | | |
| **OBS** | 0.369 | 0.341 | 0.207 | 0.154 | 0.267 | 0.167 | **0.824** | | |
| **SN** | 0.327 | 0.201 | 0.122 | 0.491 | 0.306 | 0.134 | 0.205 | **0.904** | |
| **BI** | 0.690 | 0.393 | 0.301 | 0.167 | 0.249 | 0.086 | 0.338 | 0.293 | **0.931** |




Note: * p < 0.05; ***p < 0.001.

**FIGURE 2.** Path diagram of the model (Case study 1).

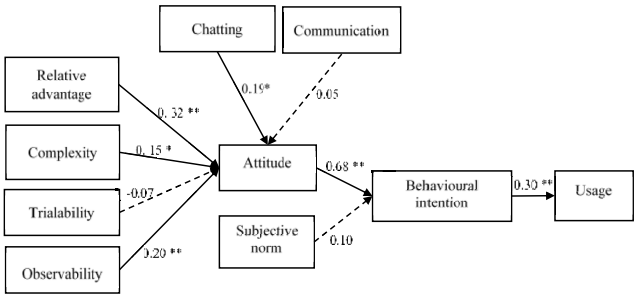



**FIGURE 3.** Path diagram of the model (Case study 2).

(C.R.) [46]. Table 6 shows the results of the analysis for all hypotheses and more discussion will be provided in the next section.

The analysis revealed that the model was a good fit with the data as indicated by the goodness of fit index in both datasets: case study 1: (RMSEA = 0.046, CFI = 0.97, Standardized RMR = 0.057), and case study 2: (RMSEA = 0.042, CFI = 0.97, Standardized RMR = 0.058). The chi-square index is also significant in both studies (study 1: X2 = 661.166, X2/df = 2.2; study 2: X2 = 450.235, X2/df = 1.52). H2 was discarded from the model, as explained earlier in the methodology section, as the Compatibility factor did not achieve good discrimination and was cross loading with other factors. Most hypotheses were found to be statistically significant in the two studies. H4, which represents the effect between Trialability on the attitude factor, was found to be insignificant. There are other hypotheses that were not supported, including H6 in case study 1, and H7 and H9 in case study 2. This variation can be explained by the nature of the games in each study, which we will explain in the discussion section.

**TABLE 6. Hypothesis assessment.**

| | Path | Case study 1 | | | | Case study 2 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | β | C.R. | P | Result | β | C.R. | P | Result |
| H1 | ADV → AT | 0.365 | 8.966 | <0.001 | ✓ | 0.323 | 4.815 | <0.001 | ✓ |
| H3 | COX → AT | 0.079 | 235 | 0.025 | ✓ | 0.145 | 1.970 | 0.040 | ✓ |
| H4 | TRI → AT | -0.024 | -0.428 | 0.669 | × | -0.069 | -1.087 | 0.277 | × |
| H5 | OBS → AT | 0.164 | 3.486 | <0.001 | ✓ | 0.202 | 3.133 | <0.001 | ✓ |
| H6 | CH → AT | 0.025 | 1.109 | 0.268 | × | 0.188 | 2.886 | 0.004 | ✓ |
| H7 | COMM → AT | 0.184 | 5.140 | <0.001 | ✓ | 0.051 | .822 | 0.411 | × |
| H8 | AT → BI | 0.635 | 15.818 | <0.001 | ✓ | 0.683 | 10.774 | <0.001 | ✓ |
| H9 | SN → BI | 0.101 | 2.914 | 0.004 | ✓ | 0.087 | 1.825 | 0.068 | × |
| H10 | BI → Usage | 0.404 | 10.273 | <0.001 | ✓ | 0.267 | 4.662 | <0.001 | ✓ |

✓: Supported; ×: Not supported
Case study 1: X2 = 661.166, X2/df = 2.2, RMSEA = 0.046, CFI = 0.97, Standardized RMR = 0.057.
Case study 2: X2 = 450.235, X2/df = 1.52, RMSEA = 0.042, CFI = 0.97, Standardized RMR = 0.058.

## VI. DISCUSSION

This study aims at bridging the gap in the literature on MSGs by proposing a new model to explain attitudes toward their use.

The proposed model considers the factors leading to their diffusion, including Roger's DOI attributes and the Social Interaction factors related to MSGs. The results show that Relative advantage, Complexity, and Observability have statistically significant effect on attitudes toward playing MSG. Trialability, on the other hand, was not significant. This can possibly be justified by the users' high experience with MSGs. Relative advantage was defined under the entertainment context of passing time, and it had the strongest effect among the other factors in both case studies ($\beta = 0.40$ and 0.32, respectively). This indicates that participants enjoyed passing time playing the game. This is consistent with the results in [48], as they found that game adopters have stronger personal needs for passing time and a higher perception of Relative advantage in playing online games, whereas they perceive the risks in terms of time spent in playing online games as less significant. Other studies also showed that entertainment, enjoyment, and perceived usefulness have strong impacts on game adoption [2], [26], [28], [29], [31]–[33].

Complexity was also significant but had a relatively smaller effect as compared to Relative advantage in both case studies ($\beta = 0.10$ and 0.15, respectively). This implies that the ease of use positively affects players' attitudes toward the game. This finding aligns with a recent study which found that some players chose the game owing to its perceived simplicity and ease of use [32], [40].

Observability was defined as the observed outcomes of playing the game. These include the number of tokens won in the game (game money or survival). Most participants in the focus group explained that they like to brag among their peers about the amount of money they earned in the game or how they survived where no one else could. As expected, the Observability factor was significant, and it had a strong positive effect on the attitude toward the game in both case studies ($\beta = 0.16$ and 0.20, respectively).

The Social Interaction factors related to the game include Chatting and Communication. These were added to the model as an integral part of MSG characteristics.

There is an interesting discrepancy in the results related to the Social Interaction factors of the two case studies. The obtained results demonstrate the model's potential in explaining the influential factors affecting the use of MSGs. Despite participants often expressing how chatting was a key feature in the game, the Chatting factor was found to be insignificant in case study 1. This can be justified by the fact that chatting with other players is a preference and not everyone might enjoy it. In addition, the games in the first case study provide text-based chatting unlike the second game in case study 2, which allows players to chat through the mike as they play along. This also explains why the factor was found to be significant in the second case study.

Communication, on the other hand, had a significant positive effect on the attitude in case study 1 ($\beta = 0.20$). This is consistent with the results obtained from the question "How did you get to know of the game?", wherein 83% of the participants reported that they were introduced to the game through friends and family.

Subjective norm also had a significant positive effect on the Behavioral Intention to continue playing the game in case study 1 ($\beta = 0.20$). The findings regarding social interaction and subjective norm are consistent with the findings in previous studies [2], [31], [33]. In addition, it was found that social interaction significantly affects enjoyment, which in turn increases the positive attitude toward playing the game [30].

However, both Communication and Subjective Norm were found to be insignificant in case study 2. This can possibly be linked to the violent nature of the game, which suggests that parents, relatives, or caregivers might not support playing the game. However, in case study 1, the game is considered a non-violent and appropriate family board game and therefore it is likely to be approved by others. In the next section, the study implications and suggestions are presented.

## VII. IMPLICATIONS

The results discussed in the previous section indicate several important implications. The UMSG model proposed in this study was able to successfully identify the most influential factors on mobile games' diffusion and use. This could lead to a better understanding of such a popular and fast-growing market. Results can assist game developers in providing users with the best gaming experience by focusing on the most significant factors affecting players' attitudes toward MSGs. Researches especially in the Games User Research (GUR) field, which is an important aspect of game development, can gain a deeper understanding of players' attitudes and

intentions. The model managed to highlight different aspects of the use of mobile social games, and it certainly illustrated that the relative advantage of the games (passing time, enjoyment) are key factors affecting users positive attitude towards the game. In addition, the observability of the game results (collecting points, money, or surviving a battle) was hugely influential. This should encourage game developers to focus their attention on the observable results or player's gains in their game design. Another key issue can be drawn from results related to the social interaction factors, where Communication was significant in case study 1 but not significant in case study 2, and the opposite with the Chatting factor. Given the games nature and the chatting style (text vs. speech), the model was able to highlight which one matters the most which could assist decision making when designing a game aiming at providing the best game experience. Finally, results suggested that the Subjective Norm was insignificant in case study 2 compared to case study 1: (violent game vs. board game). Such findings raise a concern regarding the ethical responsibility in the game-development industry as is suggests that the perceived social pressure to play, or not to play a game is less significant when it comes to games involving violent acts. In other words, the approval of others (parents, caregivers, etc.,) to play a violent game is less likely to influence the player's decision to play that game.

## VIII. CONCLUSION

This study investigated the factors leading to the diffusion of MSGs. A proposed model combining the TRA with the DOI was used to test ten hypotheses related to Relative advantage, Compatibility, Complexity, Observability, Trialability, Chatting, and Communication.

The study followed a sequential mixed-methods design that gathered qualitative and quantitative data. Data collection was carried out in two stages: first, a focus group session was conducted to enhance the understanding of the factors associated with the MSGs and to inform the survey design. Second, two case studies were conducted through an online survey via several platforms. A total of 890 responses were received and analyzed. The study employed SEM to analyze the data, where Measurement and Structural Level Analyses were conducted.

The results indicated that the proposed model was a good fit with the data. Relative advantage, Complexity, Observability, Chatting, and Communication with friends and family had a positive effect on players' attitudes toward playing MSGs. On the other hand, Trialability had no effect. In addition, attitude toward the game had a strong positive effect on the behavioral intention to play the game.

Applying the model on two different MSGs helped reveal some interesting insights on how factors affect differently attitudes toward different games and how it can be linked to the characteristics of each game and the way it is played. The study findings and implications are hoped to contribute to a better understanding of such a popular and fast-growing market.

## APPENDIX

| | |
|---|---|
| Observability [42], [43]. | |
| OBS1 | I like earning money/tokens in the game. |
| OBS2 | Collecting more money/tokens in the game is fun. |
| OBS3 | I like bragging about the amount of money/tokens I earned in the game. |
| Chatting | |
| CH1 | Chatting with other players is a great feature of the game. |
| CH2 | Chatting with other players in the game is fun. |
| CH3 | I like the chat feature in the game. |
| Relative advantage [42], [43]. | |
| ADV1 | Playing the game is a way to pass free time for me. |
| ADV2 | I will consider playing the game when I am bored. |
| ADV3 | I will consider playing the game when I have free time. |
| ADV4 | Playing the game enables me to have fun. |
| ADV5 | Playing the game enhances my entertainment. |
| Complexity [42], [43]. | |
| COX1 | Overall, I think the game is easy to play. |
| COX2 | Learning to play the game was easy for me. |
| Trialability [42], [43]. | |
| TRI1 | I have had the opportunity to play the game using a guest account before using my Facebook account. |
| TRI2 | Before deciding on whether or not to play the game, I would be able to properly try it out. |
| TRI3 | I was permitted to play the game using a guest account long enough to see what it can do. |
| Attitude [42]. | |
| | How would you describe your feelings toward playing the game?<br>Endpoints: |
| AT1 | unpleasant-pleasant |
| AT2 | bad-good |
| AT3 | unfavorable-favorable |
| Subjective Norm [7], [49], [50] | |
| SN1 | People who are important to me, like my friends, accept that I play the game. |
| SN2 | People whose opinion is important to me, like my friends, think it is okay to play the game. |
| SN3 | People who have influence on me, like my friends, believe it is okay to play the game. |
| Behavioral Intention [8] | |
| BI1 | I intend to continue playing the game in the future. |
| BI2 | I predict I will continue playing the game in the future. |
| BI3 | I plan to continue playing the game in the future. |
| Communication | |
| COM1 | Communication with my relatives and friends is one of the benefits of playing the game. |
| COM2 | Playing the game enhances communication with my relatives and friends. |
| COM3 | The game created a communication channel with my relatives and friends. |

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