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AN INTERACTIVE GAMES EXPERIENCE MODEL (GXM) FOR THE DESIGN AND EVALUATION OF THE UX OF GAMIFIED APPS OVER TIME

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Abstract
This paper utilized a literature survey method to review prior literature and to provide support for the modeling of a theoretical interactive games experience model (GXM) for the design and evaluation of the games experience of gamified apps players over time. The outcome of the survey indicates that though there are several games experience models, the accessed models are deficient as they lack comprehensive dimensions and criteria required for a holistic design and evaluation of games experience over time. To solve this problem, this paper conceptualized and proposed a more holistic games experience model for a comprehensive design and evaluation of games experience. The model has eight (8) dimensions. These eight dimensions cover a wider spectrum of games design and evaluation qualities. Each dimension has associated criteria. The model supports the temporality and dynamics of games experience.

Keywords--Design, evaluation, games experience, gamified apps, interaction, UX model, user experience

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INTRODUCTION

Understanding the interactive experience of using digital gamified technologies is actually a complex process. Traditional methods of assessing interactive games technologies stem from usability, which concentrated on ease of use, ease of learning and performance. User experience (UX) and games experience emerged from the recognition that usability only, does not account for the more subjective emotional responses experienced when interacting with any gamified apps. Though the terms UX and games experience are largely recognized in the human-computer interaction (HCI) circles, their definitions are vague, thus, making it challenging forthe evaluation and design of games experience.Several theories have been suggested to help in the understanding of UX and games experience; however, there is yet no consensual theory or model that has emerged. The importance of games experience qualities in influencing and contributing to decisions about games product quality has gained much attention in UX studies, but with conflicting results. This sparked a rise in studies to understand the complexities of user quality judgment. Prior UX studies concentrated on the multi-dimensional constructs of pragmatics, affects, hedonics and aesthetics, and how these may impact user perception and judgment (Hart, 2014). These constructs can vary depending on the context, task and user background. Conversely, small attention has been directed to the effect of interactive design/product features on games experience of games application. Hart (2014) found from her research that interactivity, affectivity, hedonics and engage ability are vital component in UX in both short and long-term usage.

Further, Hart (2014) expanded the existing process model of user quality judgment, through a series of studies to show the significance of interactivity and how initial perception and judgment of a products quality has the possibility of changing over time. Her studies ascertained the significance of interactivity in positively impacting on UX. The studies indicated that affective and hedonic ratings improved as a result of interaction, signifying the powerful influence of interaction, and indicating clear variations for products that contained enriched interactive features and qualities, regardless of the presence of usability issues. Further exploration by the same researcher using cluster analysis showed three sub-groups that classified users not only by their interactive style preferences, but also by their predispositions towards technology (Hart, 2014). A number of UX studies have concentrated on short-term evaluations, based on the first impressions that users have in their pre and post-interactions, however, few of these studies captured long-term usage of interactive products (Hart, 2014). In addition, Hart (2014) reported on an ecological longitudinal inquiry into how UX changes over time and in long-term product use.An important quality in games experience is user engagement. The quality relates tothe quality of an interactive experience rather than a whole life span experience of a product (Sutcliffe, 2009). It refers to examining why games technologies attract people to use them and continue to use them within a session. On the other hand, however, games experience is set aside for the broader assessment that include what makes people adopt and continue to use gamified technology in a long-term multi-session use. The comprehension of what attracts people to use, and continue to use such interactive digital products incorporates a combination of broader effects that embodyqualities such as aesthetics, interactivity, affect, presence and flow among others.

Interactivity is part and parcel of games experience. In the domains of advertising, marketing, communication, education and computer science, the landscape of interactivity has been extensively deliberated, however, even with all this, the definition and explanation of the concept seems vague and unclear (Domagk, Schwartz, & Plass, 2010).The subject of interactivity has been given limited attention within the human-computer interaction (HCI) literature despite the fact that it is an important topic. Majority of studies on interactivity originated from business and marketing, or computer science (Hart, 2014). There is also an increasing collection of studies examining the use of interactivity in museum and cultural spaces to assist learning and improve engagement via multi-media exhibits and mobile technologies (Haywood & Cairns, 2006; Othman, Petrie, & Power, 2011). In addition, the effect of interactive design

features utilized in games to improve user engagement has been reported in a number of studies (Jennett et al., 2008; Schild, LaViolaJr, & Masuch, 2012). It is acknowledged that the interactivity of a digital artifact is a vital factor in the attraction and engagement of users and can lead to improved satisfaction and sense of efficacy (Bargas-Avila & Hornbæk, 2011; Venkatesh et al., 2003). Prior studies propose that product interactivity can enhance usability and user satisfaction, boost playfulness (Chen & Yen, 2004), and improve emotional pleasure (Fiore, Jin, & Kim, 2005) and engagement (Mollen & Wilson, 2010; Szuprowicz, 1995). On the other hand, it was found that interactivity in advertising interrupts the process of persuasion, and thus was ineffective (Bezjian-avery, Calder, &Iacobucci, 1998). This discrepancy can be as a result of other confounding variables, such as the level of interactivity, type of interactive features, user characteristic and context of use (Teo et al., 2003). Lee and Koubek (2010) discovered that the influence of perceived aesthetics and usability was higher for pre than for post interaction, and that aesthetics had effect on user preference. In addition, Teo et al. (2003) in their study, employed three levels of interactive communications, and revealed that high levels (online social feedback) had positive influence on users perceived satisfaction, effectiveness, efficiency (Hussain et al., 2016a; 2016b; Hussein et al., 2019a; 2019b; Mkpojiogu et al., 2016, 2018) and general attitude towards the products. However, Porat and Tractinsky (2012) discovered that the aesthetics of e-stores impacted consumers' emotion (pleasure), affective (arousal) states, and attitudes towards the web stores; moreover, the effects of interactive features were not explored fully.

Furthermore, Cyr, Head and Ivanov (2009) examined the perceived interactivity (user control, connectedness and responsiveness) of e-commerce at several degrees of dynamic visualization, and found that improved interactivity in visual information had positive effect on users perceived effectiveness, efficiency, enjoyment and trust, which led to a higher interactive product loyalty. In a survey of e-shopping websites carried out by O'Brien (2010) which indirectly examined interactivity with several engagement constructs (focused attention, novelty, felt involvement etc.), found that they were impacted positively by social interaction facilities, as user attitudes (hedonic motivation) to the e-shopping experience (idea, adventure) may have been improved through the interactive features utilized to improve product presentation and exploration. On the other hand, Yi, Jiang and Benbasat (2011) utilized two levels of activated interaction (where the user is triggered to interact) and discovered that the interaction level that was constrained was more effective than the one that was unconstrained or a full video presentation, that led to product seductiveness is stronger and that also led to a more positive attitudes towards the interactive digital products. Likewise, Jiang and Benbasat (2007) made a comparison of static presentations of products with interactive versions and discovered that interactivity and vividness boosted users intention to purchase, where vividness relates to the "richness of a mediated environment as defined by its formal features; that is, the way in which an environment presents information to the senses" (Steuer, 1992). Furthermore, Chen and Yen, (2004) revealed that playfulness; connectedness and reciprocal communication are vital variables that explains the quality and preference of interactive digital artifacts. Equally, De Angeli, Sutcliffe and Hartmann (2006) revealed that UX (in terms of, expressive aesthetics, and pleasure) and overall preference were improved by interaction style.In sum, while interactivity has been investigated (across several domains, but mainly websites), majority of the studies in flow and presence were found to be in the virtual reality and games field (Cyr, Head, & Ivanov, 2009; Cyr, Head, Larios, et al., 2009; O'Brien & Toms, 2013; O'Brien, 2010; Teo et al., 2003). The positive effect of interactivity on efficiency, effectiveness and satisfaction has been demonstrated, as shown in the TAM measures (Venkatesh et al., 2003), nevertheless the impact of the subjective measures of UX (for instance, aesthetics, emotion and affect) on interaction has gotten limited attention. Furthermore, the approach to interactivity has been hinged on Lee (2005), and Hoffman and Novak's (1996), models, that focused on user control, responsiveness and connectedness, other than deliberating on specific design features that may impact UX constructs. Hence, the impact of design features that may boost interactive experience and a sense of flow or presence have not been adequately explored and investigated with respect to UX.

Similarly, McMillan and Hwang (2002) carried out a broad review of the interactivity literature and acknowledged three different forms of interactivity: process orientated (interchange or 2-way communication), user control (interactive features) and time perception (responsiveness). However, all three dimensions frequently overlap and inter-correlate. On the other hand, Rafaeli (1988) proposed a process-orientated definition, that relates to the extent of responsiveness (reciprocal communication), which Hoffman and Novak (1996) anchored their feedback model utilized in the computer-mediated environment. Also, Wu (2006) description for perceived interactivity of websites interlinked three components, namely: perceived control, perceived responsiveness and perceived personalization. Likewise, Lee (2005) framework suggests that perceived interactivity have effect on trust within mobile commerce environment. This model of user control, user connectedness and responsiveness to the user was likewise employed by Cyr, Head and Ivanov (2009), and Cyr, Head, Larios and Pan (2009). Furthermore, Kristof and Satran (1995) proposed that interactivity is motivated when stimulated by self-directed control, where low and high levels of interactivity can impact engagement and cognitive processing. They created a seven-level scale hinged on the differing levels of interactivity and user control, employed by Teo et al. (2003), and Wang, Vaughn and Liu (2011). In addition, Johnson, Bruner and Kumar (2006) studied the perceived interactivity of a website in association with non-verbal information, speed of response, responsiveness and reciprocity, contending that interactivity entails a reciprocal communication process that is contingent on the level of responsiveness of the system to the user. Despite the number of works done (Hoffman & Novak, 1996; Kristof & Satran, 1995; Lee, 2005; Wu, 2006), the notion of interactivity is to some extent still elusive and vague. There appears to be no common consensual agreement on its definition in literature (Johnson et al., 2006; Sohn & Lee, 2005).

As Hart (2014) posits, few studies has concentrated on summative evaluations of interactive products (for example, digital games). She also pointed out that in these studies; less attention is given to the interactive features in such product. Furthermore, akin to UX, interactivity is a commonly used term; however the concept is rather unclear. Even though there are several different models of interactivity and user engagement (Hoffman & Novak, 1996; Kristof & Satran, 1995; Lee, 2005; Wu, 2006), nonetheless the benefits that are gained from the various interactive features, and the way they may impact on UX is still vague. Research in HCI has principally concentrated on the use of interactive features to improve UX in the field of games and entertainment, with stress placed on immersion (Jennett et al., 2008; Korhonen, Montola, & Arrasvuori, 2009; Sanders & Cairns, 2010; Takatalo, et al., 2007), flow and presence (Qiu & Benbasat, 2005; Trevino & Webster, 1992), and playfulness (Korhonen et al., 2009). Furthermore, there is also an emergent and rising field of research in the use of interactive multi-media technology within cultural spaces and museums for the improvement of user engagement (Haywood & Cairns, 2006; Othman, Petrie, & Power, 2011), with an mounting interest in serious games and gamification, that connects playful design principles with

interactive digital technology (Clark, 1987; Deterding, Dixon, Khaled, & Nacke, 2011). A few experimental studies on the impacts of interactivity in e-commerce websites have revealed that it can positively affect user satisfaction, enjoyment and motivation (Cyr, Head, & Ivanov, 2009; O'Brien, 2010; Teo, Oh, Liu, & Wei, 2003). Nonetheless, these studies only explored a limited collection of constructs, therefore the impact of UX constructs like those of aesthetics, emotion and usability with regard to specific interactive features is still indistinct and not fully supported (Hart, 2014).

User Interaction has to be designed for as it does not take place by accident. It is needful that designers know the best way to use interactive features, and how they can be utilized to impact on games experience. Nielsen, (1999) maintained that different multimedia technologies offer numerous design options, which required controlled use in order to avoid confusion. In spite of the existence of formal guidelines meant to avoid these issues (ISO 14915, 2002) they offered little advice when designing for UX and aesthetics in the games domain (Sutcliffe, Kurniawan, & Shin, 2006). A few studies have looked into how different design features may impact user judgment of their experience. Kim, Lee and Choi, (2003) pointed out components of aesthetic design features within a website (for example, hue, brightness, shape, texture etc.) and linked them to 13 generic dimensions of emotion, even though these are more similar to aesthetic perceptions (for example , strong and powerful, calm and balanced, classical and conventional), rather than emotional responses. Besides, some formal design guidelines can be found in the design community (Galitz, 2007; Kristof & Satran, 1995), this notwithstanding, they concentrate primarily on general layout, style and color suggestions, which constitute just a little aspect of the understanding of the impact of interactive design attributes (Lidwell, Holden, & Butler, 2010). The frameworks of multimedia design are made available (Heller, Martin, Haneef, & Gievska-Krliu, 2001), together with methods to support the suitable choice of interactive media to point attention to and improve user engagement and experience (Sutcliffe et al., 2006), this notwithstanding, a very limited attention is however given to the impact of interactive design features on UX (Hart, 2014)

Immersion (flow/involvement/absorption) and presence and their roles have been well explored in prior research (Berlyne, 1960; Csikszentmihalyi, 1975, 1988); however, the way these constructs impact on games experience is poorly comprehended. According to Csíkszentmihályi (1990), flow is an 'optimal experience', that explains "the state in which people are so involved in an activity"to the extent that"nothing else seems to matter" to them. The maintenance of flow demands optimal arousal, where curiosity is sustained via complexity and variety (Berlyne, 1960), and by a mixture of perceived challenge (difficulty) and user ability (skill). The emphasis is in keeping and sustaining the specified user in the flow zone, which has been a considerably employed concept within game design (Sweetser & Wyeth, 2005). The Trevino and Webster (1992) adapted the concept in the computer mediated communication (CMC) context and described four dimensions of flow, inter alia: sense of control, attention focus, curiosity and intrinsic interest (the last two dimensions are also explored as constructs of cognitive enjoyment). Furthermore, in CMC, Hoffman and Novak (1996) abstracted flow in their process model, which linked interactivity, telepresence and flow (skill, control, challenge and attention). In addition, Agarwal and Venkatesh (2002) delivered a multi-dimensional model of cognitive absorption, which is an extension of flow that comprises enjoyment, curiosity, control and focused immersion. Though flow demonstrates some similarities with immersion, it is taken or seen as more fleeting or transitory (Sanders & Cairns, 2010), whereas immersion is considered as more long lasting, as explained by Jennett et al. (2008), who assessed immersion as a graded three-step process that starts with engagement, then involvement and then total immersion, with flow experienced at the extreme or terminal end of immersion.

Furthermore, the roots of presence originated from virtual reality where the user is characterized as an avatar (that is a virtual character). Presence refers to the subjective experience of feeling situated in one place, and it is concisely described as 'the sense of being there' (Lombard & Ditton, 1997). Moreover, occasionally presence is taken to be two correlated elements, viz: telepresence (the sense of feeling present in the mediated environment), and social presence (the sense of being there with another). However, presence relates to the natural perception of the environment (Biocca, Harms, & Gregg, 2001; Steuer, 1992). As Witmer and Singer, Michael, (1998) puts it, while presence is a multifaceted construct, control and involvement on the other hand, are important constituent parts, this notwithstanding, other variables (such as, attention, naturalness, sensory experiences) are also essential, and like immersion are experienced in varying extents. As a result of the nature of presence, prior research found mostly in virtual reality or gaming has limited studies examining the influence of presence in other areas other than virtual reality or games. Qiu and Benbasat (2005) in their work examined presence utilizing a with or without avatar as live-help assistance for an online shopping site, and discovered that 3D avatar enhanced the users sense of telepresence, but not their social presence. Also, Yoon, Laffey and Oh (2008) compared 2D and 3D graphical representations of an online furniture store, and discovered that users felt a higher sense of presence as they are interacting with the 3D store, and this improved their sense of usefulness and usability (Hassenzahl & Tractinsky, 2006). Interactivity has been viewed as a vital variable in attracting and engaging users in games and entertainment (Jennett et al., 2008), cultural spaces (Haywood & Cairns, 2006) and e-commerce websites (O'Brien, 2010). Even though flow and presence is viewed as valuable measures for immersion and engagement in the field of games (Jennett et al., 2008), they have not been adequately employed to examine the impact of games experience. Notably, to sustain engaging experience during interaction, users need to retain high arousal and positive affect via interesting, stimulating and exciting interfaces. Positive affect has been presented to improve problem solving and decision-making (Isen, 2001), and impacts users' intention to use IT applications (Zhang & Li, 2004).

There are a number of interactive games experience models, however, the dimensions and criteria explaining the model are limited. In addition the context of time is absent in these models. This limitation is a gap in such models. There is the need in the research community and among practitioners for a more comprehensive games experience model for the design and evaluation of the games experience of gamified apps and which caters for the component of time in games experience. It is with respect to this that this study is geared at conceptualizing and proposing a theoretical interactive games experience model with time component for the comprehensive design and holistic evaluation of players' games experience.

METHODOLOGY

This study employed literature survey methodology to elicit and conceptualize an interactive games experience (GXM) with time component for holistic design and comprehensive evaluation of players' games experience over time. In the course of the survey, relevant articles and literatures were accessed and analyzed. Then the needed information was extracted for the purpose of formulating and developing the theoretical model. Essentially, the protocol followed in the study is as follows: i) download relevant papers relating to the modeling of games experience

over time; ii) synthesize and analyze the downloaded papers; iii) extract suitable information from the synthesized papers; iv) conceptualize the games experience model; v) propose the theoretical model for the design and evaluation of games experience over time. Figure 1 depicts the protocol used in this study.

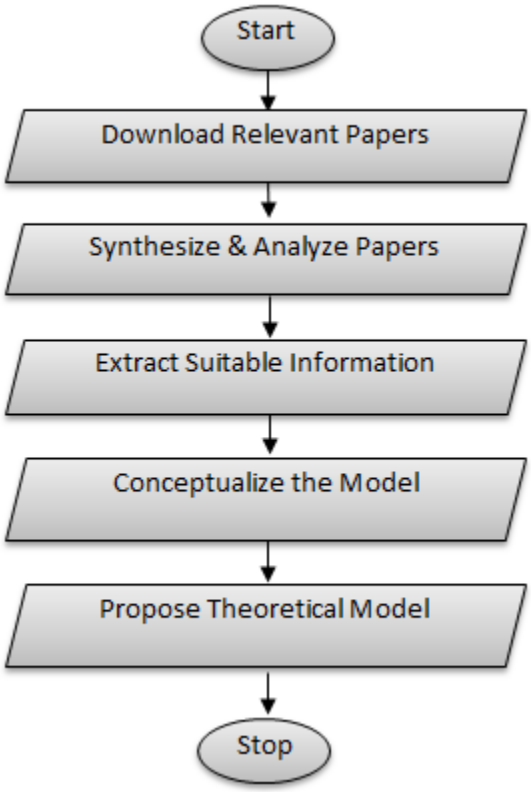

Figure 1. Research Steps

RESULTS

The findings of this study show that though there are several games experience models, such models were deficient in that they were not comprehensive for a holistic design and evaluation of games experience over time. Also, prior models did not represent the evolution of games experience as they did not have the time component.

However, this study incorporated time into the model. The outcome of the conceptualization of the games model indicates a model with eight (8) dimensions and each dimensions has their respective criteria (see Figure 2). The dimensions include: i) ubiquity, ii) engageability, iii) interactivity, iv) affectivity, v) aesthetics, vi) trust, vii) usability, and viii) ludicity.

The ubiquity dimension is the ability of a games application to offer its players an anywhere, anytime availability experience. The dimension has three criteria: i) immediacy: this is the ability of a games application to be available at the time the player(s) wants to play it; ii) continuity: this is the ability of a games applications to be available always for the player(s) to play; iii) locality: this is the ability of a games application to be available at the place the player(s) wants to play it.

The engage ability dimension is the ability of a games application to enables players to be actively involved and immersed in the play activities. Its criteria are: i) presence: this is the ability of a games application to makes players to have the feeling of the sense of being in the application. The dimension consists of telepresence, that is, the sense of feeling present in the games application while playing it, and social presence/ co-presence, that is, the sense of being inside the games application with another person(s) playing the game together. Presence relates to the natural perception of the games environment; ii) flow: this is the state of being immersed, engrossed, absorbed and totally involved in the game playing activities. The players' state of flow is stimulated by the following qualities: sustained interest, focused attention, felt involvement, challenge, emotional attachment, identification, tension, players' skills, curiosity, and players' control, etc.; iii) Adventure: this the ability of a games application to trigger an adventurous drive in games players. This criteria is stimulated by papers' intrinsic desire to do new things (novelty), discover new things (discovery), explore (exploration and do exploits; iv) fun: the is ability of a games application to give its players fun in their immersive involvement in the play.

The interactivity dimension is the capability of a games application to support interaction. The criteria for this dimension are inter alia: i) controllability: this is the ability of a games application to enables its players have control over the play interaction with the app; ii) responsiveness: this is ability of a games application to support a two way interaction between the player and the app as well as fast response in the interaction; iii) connectedness: this is the ability of the games application to enable the player feel connected to others, that is, connected to any other player(s) playing the games with him/her; iv) personalization: this is the ability of the games application to be tailored to the interactive capability of the player.

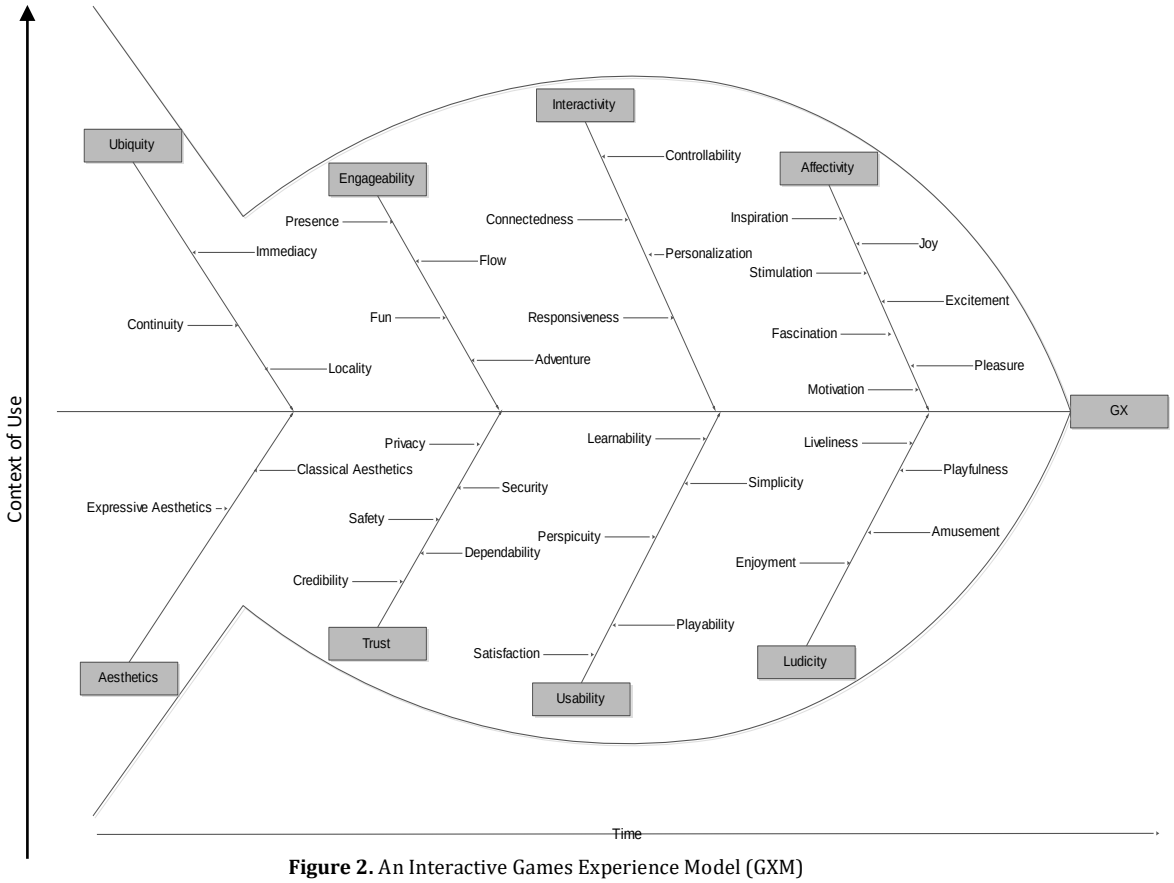

Figure 2. An Interactive Games Experience Model (GXM)

The affectivity dimension is the emotional aspect of games experience. It is feelings that accompany the playing of games. The criteria for this dimension consist of: i) inspiration: this is ability of the games application to inspire its player(s); ii) stimulation: this is the ability of the games application to stimulate and arouse desirables feelings in the player(s); iii) fascination: this is the ability of the games application to fascinate those who play it; iv) motivation: this is the ability of the games application to intrinsically motivate the apps players positively; v) joy: this is the ability of the games application to gives its player(s) transcendental joy, happiness and bliss; vi) excitement: this is the ability of the games application to excite positively player(s) who play it; and vii) pleasure: this is the ability of the games application to give pleasure (pleasurable feeling) to those who play it.

The aesthetic dimension is the attractiveness and visual appealing aspect of the games experience. It deals with the concept or qualities of beauty, styling, color, form, captivation, harmony, balance, creativity, neatness, originality, calm, hue, brightness, shape, texture, conventional, innovation, perceived layout, visual appealingness and attractiveness, cleanness, and fascinating, clear, symmetrical, and well organized design, etc. This dimension deals with users' sense and perception of games that is beautiful and the qualities that constitute this beauty. The dimension has two criteria, namely: classical and expressive aesthetics. Classical aesthetics is the aspects that deal with the organization, arrangement; styling, form and color of the games interface interacted with and how tidy, balanced, orderly, and harmonious the game is. Expressive Aesthetics on the other hand deals with the interface of the games app that is visually beautiful, interesting, appealing and attractive to players.

Trust dimension comprises of games experience qualities that stimulate trustful perceptions in players before, during and after interaction with the games app. These qualities include: credibility, privacy, dependability and security. Privacy: This is the ability of games to support and keep the privacy and confidentiality of players and their information. Security: This is the ability of the games to provide a safe environment that is free from all harm and where the interests of players are protected while playing the game. Credibility: This is the ability of the games app to ensure its integrity and reliability. Dependability: This is the ability of the games app to be dependable, unfailing and consistent. Transparency: This is the ability of the games app to be transparent and open to players.

The usability dimension is the capacity of the games app to be easily learned and played with ease without too much mental/cognitive efforts. The criteria for this dimension include: learnability, perspicuity, simplicity, playability and satisfaction. Learnability: this quality describes the ease with which the game can be learned and easily played. Perspicuity: this is the ease of understanding the game. Simplicity: this quality explains how simple the game is to play. Playability: this describes how playable the game is. Satisfaction: this describes the level of satisfaction the games gives to players as they successfully play the game.

Ludicity dimension is the aspect that describes the interactive engagement and fun of the games. The ludicity criteria include: liveliness, playfulness, amusement, and enjoyment. Liveliness: this is how lively the games app is to players. Playfulness: this is the level of playfulness of the games app. Amusement: this is the level of amusement that the game gives to its players. Enjoyment:

this is the level of enjoyment the players derive from the playing of the game.

The model also has a horizontal timeline to represent the dynamics or the evolution in games experiences. It is a reflection of the changing episodes of experiential encounter in the context of games experience. The criteria (design factors) influence the dimensions (players' organism) which in turn affect the players' reaction or response (Games experience) in terms of players' delight or disgust, pleasure or pain, acceptance or avoidance; or favor or frustration.This study proposes the adoption of this model for the design and evaluation of games experience.

CONCLUSION

In this study, a literature survey was carried out to support the modeling of a theoretical interactive games experience model for the design and evaluation of players' games experience over time. The results of the review reveal that though there are a number of games experience models, the available models lack comprehensive dimensions and criteria needed for a holistic design and evaluation of games experience over time. To fill this gap, this study proposed a more comprehensive games experience model with eight (8) dimensions and each dimension having accompanying criteria. The model also captures the temporality and evolution of games experience.

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