THE EFFECTS OF AVATAR REALISM LEVELS ON STUDENTS' EMOTION AND MOTIVATION IN A DIGITAL GAME-BASED LEARNING

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UNIVERSITI PENDIDIKAN SULTAN IDRIS

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ABSTRACT

This study aimed to investigate the effects of realism levels of 3D avatar on students' emotions, specifically arousal and valence, and its mediating effects on their motivation in digital game-based learning (DGBL) environment. A game prototype with five different realism levels of 3D male avatar were designed and developed. The realism levels are ranked from low realism to high realism based on the enlargement and reduction of eye size and, thickness and eyebrow shape. Quasi experimental design was used to answer the research questions formulated and the data obtained was analysed using ANOVA, post hoc and bootstrap mediation statistical analysis. A number of 200 Diploma in Computer Graphic Design students from five different Cosmopoint College branches were selected using multistage sampling as research sample. Each college consists of one class of 40 students who underwent DGBL prototype with different realism levels of 3D avatar respectively. The ANOVA test show that there were significant differences on arousal ($F_{(4,195)} = 12.15$, $p<0.05$, $\eta_p^2 = 0.20$), valence ($F_{(4,195)} = 21.03$, $p<0.05$, $\eta_p^2 = 0.30$) and motivation ($F_{(4,195)} = 7.29$, $p<0.05$, $\eta_p^2 = 0.13$) caused by different realism levels of 3D avatar. The result revealed that all of the five realism levels of avatar promoted positive arousal and valence. Meanwhile, as for the motivation aspect of DGBL, it was found that all the groups were highly motivated with DGBL environment. Nevertheless, this study recommends avatar which has the increased eye size of 125%, non-droopy eyes and thick straight eyebrow as the most appropriate design as this avatar obtained better arousal, valence and motivation mean score and it was statistically significant in comparison with other avatars. On the other hand, as in the mediation analysis, only valence showed significant mediating effects on the relation between different realism levels of 3D avatar and motivation ($ß = 0.105$, CI $= 0.039$ to 0.186). In sum, this study concludes that avatar design do effects students' emotions. However, the effects do not lead to any serious negative consequences on motivation in DGBL environment. To conclude, the findings of this study can be a useful guideline for character designers in determining the ideal 3D avatar appearance, especially in increasing motivation in DGBL environment.

KESAN TAHAP REALISTIK AVATAR YANG BERBEZA TERHADAP EMOSI DAN MOTIVASI PELAJAR DI DALAM PEMBELAJARAN BERASASKAN PERMAINAN DIGITAL

ABSTRAK

Penyelidikan ini bertujuan untuk mengkaji kesan avatar 3D dengan pelbagai tahap realistik terhadap emosi pelajar, khususnya rangsangan dan valensi, serta kesannya sebagai pengantara terhadap motivasi pelajar dalam persekitaran pembelajaran berasaskan permainan digital (DGBL). Satu prototaip permainan dengan avatar 3D lelaki yang terdiri daripada lima tahap realistik yang berbeza telah direka bentuk dan dibangunkan. Tahap realistik ditetapkan dari realistik rendah ke realistik tinggi berdasarkan pembesaran dan pengecilan saiz mata serta ketebalan dan bentuk kening. Reka bentuk eksperimen kuasi digunakan untuk menjawab persoalan-persoalan kajian yang dibina dan data yang diperolehi telah dianalisis dengan menggunakan analisis statistik ANOVA, *post hoc* dan *bootstrap mediation*. Sejumlah 200 pelajar Diploma Seni Reka Grafik Berkomputer dari lima cawangan Kolej Cosmopoint yang berbeza telah dipilih dengan kaedah persampelan pelbagai tahap sebagai sampel kajian. Setiap kolej melibatkan satu kelas yang terdiri dari 40 pelajar, di mana, masing-masing menerokai prototaip DGBL dengan avatar 3D yang berbeza tahap realistiknya. Ujian ANOVA menunjukkan terdapat perbezaan yang signifikan terhadap rangsangan (F $(4,195)$ $=12.15$, $p<0.05$, $\eta_p^2= 0.20$), valensi (F $(4,195)$ $=21.03$, $p<0.05$, $\eta_p^2=0.30$) dan motivasi (F $(4,195)$ $=7.29$, $p<0.05$, $\eta_p^2=0.13$) disebabkan oleh tahap realistik avatar 3D yang berbeza. Hasil kajian mendapati bahawa kesemua lima tahap realistik menjurus kepada rangsangan dan valensi positif. Sementara itu, dari aspek motivasi dalam DGBL, didapati bahawa kesemua kumpulan bermotivasi tinggi dengan persekitaran DGBL. Walau bagaimanapun, kajian ini mencadangkan avatar yang mempunyai saiz mata yang dibesarkan sebanyak 125%, mata bukan kuyu dan kening yang lurus dan tebal sebagai reka bentuk yang paling sesuai. Ini adalah kerana, avatar dengan pendekatan reka bentuk ini memperolehi min skor yang lebih baik untuk rangsangan, valensi dan motivasi serta ia adalah signifikan secara statistik berbanding dengan reka bentuk avatar-avatar yang lain. Manakala, dari sudut analisis pengantaraan pula, hanya valensi yang menunjukkan kesan pengantaraan yang signifikan terhadap hubungan antara avatar 3D dengan tahap realistik yang berbeza dan motivasi (ß $= 0.105$, CI $=0.039$ to 0.186). Secara keseluruhannya, kajian ini menyimpulkan bahawa reka bentuk avatar ada memberi kesan terhadap emosi pelajar. Walau bagaimanapun, kesannya tidak membawa kepada sebarang akibat negatif yang serius terhadap motivasi dalam persekitaran DGBL. Kesimpulannya, dapatan kajian ini boleh menjadi garis panduan berguna bagi pereka bentuk karekter dalam menentukan penampilan avatar 3D yang ideal terutamanya untuk meningkatkan motivasi dalam persekitaran DGBL.

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MSLQ   Motivated Strategies for Learning Questionnaire

PSSUQ   Post-Study System Usability Questionnaire

SAM   Self-Assessment Manikin

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Virtual environments and digital games are being increasingly used as educational tools in current education settings. It was also widely acknowledged that digital games are an ideal tool to encourage learners to actively participate in learning activities (Baid & Lambert, 2010; Huizenga, Akkerman, Admiraal & Dam, 2009; Kirikkaya, İŞERİ & Vurkaya, 2010; Wichadee & Pattanapichet, 2018). Therefore, for the past few decades there were tremendous amount of studies involving digital game based learning (DGBL) in many subject matters to identify best design approach to increase its effectiveness.

In general, using games in learning is beneficial, as they are interesting, enjoyable, fun-filled, effective, engaging, interactive and motivating (Huyen & Nga,

2003; Tinedi, Yohandri & Djamas, 2018; Uberman 1998). However, over the years' studies in DGBL have been expanded in several ways by referring to digital entertainment games such as in using avatar which would assist the students to revise and learn on their own. Usage of avatars as an educator in the virtual learning environment such as game is increasing as it is interactive, engaging, communicative and motivating whereby these are important design requirements in a virtual learning environment (Adham, Parslow, Dimitriadi and Lundqvist, 2018; Ratan & Hasler, 2011).

Nevertheless, question arises as what type of avatar whould be preferred by the learners in DGBL. In previous literature, it was stated that participants in online interaction would prefer a more anthropomorphic avatar as their companion or to represent them in a virtual enviroment (Nowak & Rauh, 2006; Straßmann, & Krämer, 2018). An anthropomorhic avatar can be defined as a virtual character which appears human like (Nowak & Rauh, 2006). Meanwhile, studies also have been conducted on the level of realism prefered by user of an anthropomophic character in a live or virtual interaction. Schwind, Wolf and Henze (2018) and Hanson (2005) stated that characters which are designed in the right aesthetic way, any level of realism or notion can be appealing. However, there were dearth studies conducted on how the realism level of an avatar in DGBL would influence the emotions of a learner since researchers stated that emotions experienced during a learning process provide clues not only to the effectiveness of a learning activity but also to the process of learning (Novak & Johnson, 2012).

On the other hand, avatar in DGBL also proven to motivate and engage learners (Inal & Cagiltay, 2006; Turner, Johnston, Kebritchi, Evans & Heflic, 2018). As stated by Sincero (2012), theorists such as Thayer, Newman and McClain (1994) mentioned that emotion is interrelated to motivation in which human beings have a tendency to perform things that they hope would lead to happiness, satisfaction and any other positive emotion at some extent. However, there are dearth research being conducted on relationship between level of realism with different elements of emotions (valence and arousal) and different theories of motivation. Under those circumstances, this research is principally aimed to identify how different level of realism of a game avatar would influence different elements of emotions (valence and arousal) and its mediating effects on motivation in learning among tertiary level students.

1.2 Research Background

Educational digital games have become a huge research opportunity nowadays which has opened up plenty of research area for researchers to expand their ideas. Fame of digital games and the rigorous advancement in technology and computer science, establish a trial for researchers to explore further by combining both these approaches effectively and efficiently (Terzidou, Tsiatsos, Dae, Samaras & Chasanidou, 2012). It has also enabled players to immerse themselves into virtual world and acquire knowledge while having fun. Over the past decade, implementation of DGBL has impelled significant attention in exploring how and why digital games might be

powerful tools in the classroom (Groff, Howells & Cranmer, 2010; Moral Pérez, Guzmán Duque & Fernández García, 2018).

There are also growing bodies of DGBL research in Malaysia to enhance both tertiary and also the secondary level students' knowledge acquisition. To name a few of these studies; research conducted to investigate the International Islamic University College students' perception on gamifying formal educational content along with their habits of online game usage (Khalid, Ab Rahman, Kasbun & Yunus, 2017), research conducted to study the relationship among Digital Game-Based Learning (DGBL) features on University Malaysia Sabah students' perceived motivational support and cognitive investment (Kumar, Soundirapandian, Jaraime, Krishnan, Juno & Samsudin, 2017), research conducted to investigate the effect of Malaysian Kimia (Chemistry) Digital Games (MyKimDG) module on secondary school students" achievement and motivation in chemistry as well as 21st century skills (Lay & Osman, 2018), research conducted to examine the needs of digital mobile games in the development of Arabic language learning application students enrolled in elementary Arabic language courses in three universities, Universiti Pendidikan Sultan Idris, Universiti Malaysia Kelantan, and International Islamic University Malaysia (Ghani, Ramli, Hamzah & Daud, 2019).

Nevertheless, in a virtual learning environment such as game-based learning, learners tend to complain that online learning feels cold and impersonal since they miss the presence of an instructor or buddy to support them through the instruction process (Jaggar, 2014; Rourke, Anderson, Garrison & Archer, 2007). One way to overcome this problem is by using virtual characters or avatars to personalize the

experience (Grivokostopoulou, Kovas & Perikos, 2019; Ratan & Hasler, 2011). However, implementation of DGBL particularly assisted by an avatar seems lacking in teaching and learning in Malaysia.

Avatars have been defined by Peterson (2005) as 'online manifestations of self in a virtual world, and are designed to enhance interaction in a virtual space' (p. 30). Meanwhile, in a study conducted by Inal and Cagiltay (2006) stated that, when virtual space is implemented to represent classroom in game-based learning, educators prefer an avatar to represent them to increase students' motivation. By the same token, human-like avatars that have many characteristics are ideal to serve as tutors, coaches, or guides in game-based learning environments to provide knowledge-based facilities to the learners (Adham, et. al., 2018; Johnson, Rickel & Lester 2000). Avatar or virtual character has gone through several developments to suit the players need in a digital game environment. Advances in technology have enabled animators and game designers to create highly realistic virtual characters (Tinwell, 2015). It was believed that, increased in realism would allow the viewer to engage and enjoy the game that they play (Doerr, 2007; Hoggins, 2010; Ravaja, Turpeinen, Saari, Puttonen, & Keltikangas-Järvinen, 2008). Notably, users tend to feel creepy when a virtual character looks too human like or too realistic (MacDorman, Green, Ho, & Koch, 2009; Zibrek, Kokkinara & McDonnell, 2018). This has been explained through a graph produced by a Japanese roboticist, Masahiro Mori in 1970 namely the Uncanny Valley (Mori, 1970).

The "valley" refers to that supposedly inevitably disturbing region in the middle. Mori (1970) claimed that the valley existed for static as well as dynamic humanlike figures and one should avoid making robots that might land in the valley as such creation would be rejected by people. Meanwhile Hanson, Olney, Prilliman, Mathews, Zielke, Hammons, Fernandez and Stephanou (2005) stated in their studies that there is almost utterly unexplored territory of intermediate designs between realistic and cartoonish character. Hence, Hanson et al. (2005) conducted a research to identify the acceptance level versus the realism level of virtual character among participants. This is shown in Figure 1.1. Hanson et al. (2005) identified that virtual characters that designed with appropriate level of continuous change from cartoonish to realistic are positively acceptable. They also suggested that "any level of realism or can be socially engaging if one designs the aesthetic well" (Hanson et al., 2005). As such, this can be one of the considerations in designing a virtual character.
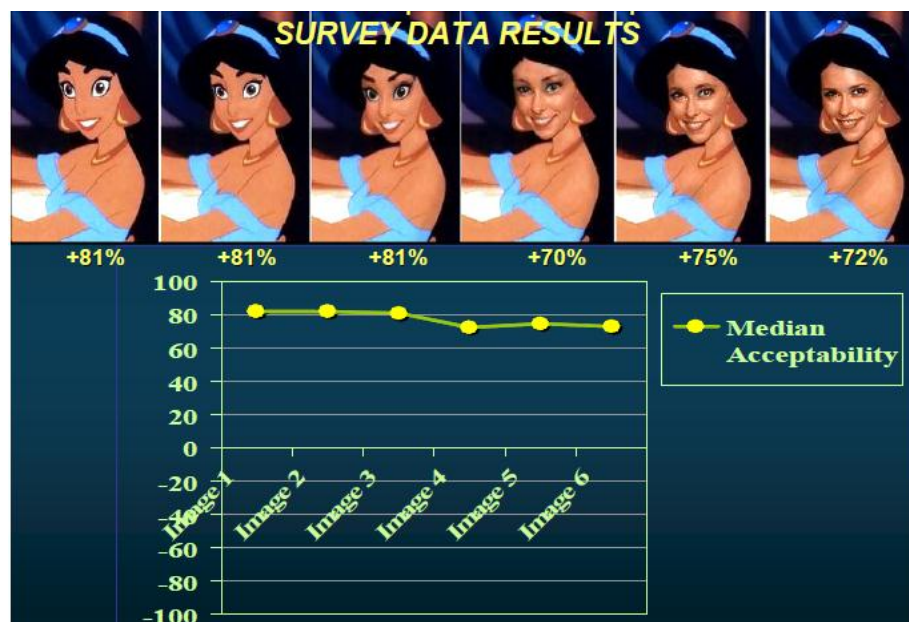
Figure 1.1. Percentage of respondent acceptance level base on the realistic level of 2D animated character and real human character (Hanson et al., 2005)

On the other hand, Schindler, Zell, Botsch and Kissler (2017) have reviewed human brain responses to six professionally stylized faces as shown in Figure 1.2 that express happy, neutral and angry emotions varying from abstract to realistic by using an electroencephalogram or EEG measuring device. The data from the EEG reading found that 3D characters with happy emotions showed higher readings on the level of acceptance and comfort experienced by the respondents. However, the most realistic 3D characters in reading are almost identical to smiling and neutral face expression. It is also found that human emotion was less disturbed by a character that resembled a real human who portrayed a happy emotion like smiling.
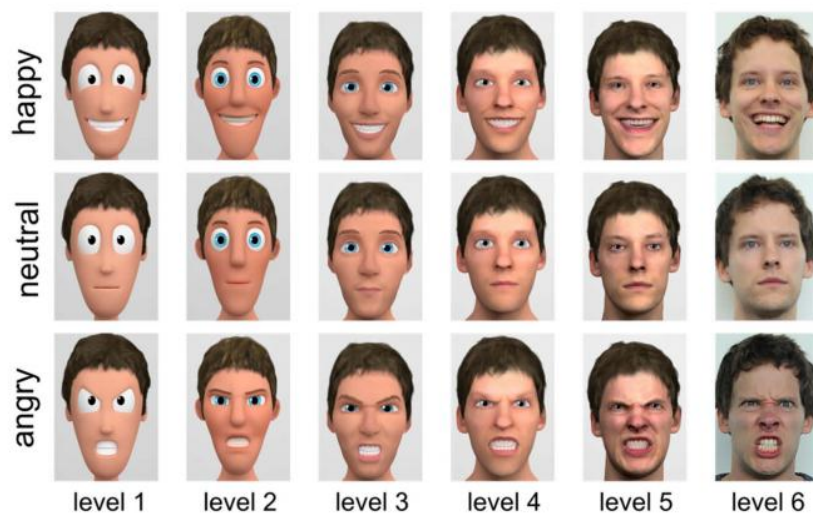
Figure 1.2. Emotional and neutral expressions for six realism levels. (Schindler et al., 2017)

However, these studies did not explore different dimensions of emotion involved among participants during the experiment. There are two main dimensions in emotion which can vary from positive to negative (valence) and from calm and arousing (arousal) simultaneously (Russell, 2003). Numerous studies have been conducted to identify whether emotions influences players' motivation in a game. Hence, in a study conducted by Bailey, Wise and Bolls (2014), stated that, making a

game more physiologically arousing will keep players coming back to play and play longer. By the same token, students' performance and motivation are influenced by their emotions (Muñoz, Lunney, Kevitt, Noguez, & Neri, 2013). Previous studies found that positive emotions enhance motivation to learn, learning strategies, and learning outcomes (Goetz, Pekrun, Hall, & Haag, 2006; Mohammadipour, et al., 2018; Pekrun, 2006; Pekrun, Goetz, Tiltz, & Perry, 2002). Alternatively, studies also found that arousal can improve memory and learning (Falk & Gillespie, 2009; Tyng et al., 2017). As a matter of fact, media psychology studies have found that valence and arousal in various levels differently influence the amount of cognitive resources allocated in processing information (Lang, 2006; Tyng et al., 2017). Nevertheless, there were fewer studies conducted in considering interaction effects between valence and arousal on level of motivation.

Motivation plays a significant role in the success of the learning process and of the game for educational purpose. Besides that, motivation is a driving force behind both participation and progression in gaming environments (Konetes, 2010). As to date, numerous studies have been conducted either separately or combined to identify intrinsic and extrinsic motivational factor in DGBL. As pointed out earlier, usage of avatar in DGBL proven to motivate students (Birk et al., 2016; Falloon, 2010; Inal & Cagiltay, 2006). In line with this, studies have been conducted in features and metamorphosis of an anthropomorphic avatar that would motivate and engage learners in a virtual environment (Adham, et. at., 2018; Nowak & Rauh, 2006). The term motivation and engagement has been a norm in DGBL world. In consequence, engaged students experience aroused pleasure that is synonymous with intrinsic motivation (Kang & Tan, 2014). Whereas, Lacovides, Aczel, Scanlon, Taylor

and Woods (2011) stated that, there is a necessitate to revise existing theories of motivation and engagement in order to take recent game-related developments into account. Besides that, understanding the links between why people play games, what keeps them engaged in this process, and what they learn as a result could have a significant impact on how people value and use games for learning (Lacovides et al., 2011).

Considering all these views together, this research aims to investigate how different levels of realism of a game avatar would influence different elements of emotions (valence and arousal) and its effects on motivation in learning among tertiary level students in DGBL settings.

1.3 Problem Statement

One of the challenges in designing a DGBL is getting the tertiary level students engaged with the content and stay in the game. In order to get the students engaged, a motivational factor needs to be implemented in the DGBL environment. In this case, implementation of an avatar in DGBL environment would motivate and engage the students as avatar would represent a coach or a buddy in the virtual world. However, question arises as what level of realism would be appropriate in order to make the students motivated and engaged. This situation evolves as there are theories such as Mori's Uncanny Valley, Russell's Circumplex Model of Affect and study conducted

by Schindler et. al., (2017) and Hanson et. al., (2005) have stated that different realism level would create different emotions among viewers.

As stated earlier, there are two scopes in emotion which is from positive to negative (valence) and from calm to arousing (arousal). A DGBL which is physiologically arousing will encourage the learner to sustain in the game and play longer. As such, emotions influence the students' performance and motivation to sustain in the game (Muñoz, Lunney, Kevitt, Noguez, & Neri, 2013).

Motivation characterizes the learner's intrinsic and extrinsic reasons for participating in and becoming engaged with the content of an educational game (Konetes, 2010). Higher levels of accomplishment in educational game are measured by the intrinsic motivational factors created in the game. Extrinsic motivational factors differ in terms of draw and appeal as the learner becomes motivated by their yearning to attain a reward for their participation or to avoid the effect for non-participation (Konetes, 2010). Nevertheless, maintaining the factors may require having relation between realism, emotion and motivation.

However, there is a dearth of research conducted in investigating how different level of realism of a game avatar would influence different elements of emotions (valence and arousal) and its effects on motivation among Malaysian tertiary level students in DGBL. Although much research has been conducted towards game based learning for school and pre-school students, there is less research specifically on tertiary education and even less in highly interactive virtual

environments (Terzidou, Tsiatsos, Dae, Samaras & Chasanidou, 2012). Thus this study is expected to fill this gap.

1.4 Theoretical Framework

The conceptual framework of this study is grounded on Russell's Circumplex Model of Affect (1980), motivational theories which are expectancy-value theory, self-efficacy theory, goals and goal orientations theory. Russell's Circumplex Model of Affect is a theory proposing that emotions are distributed in a two-dimensional circular space, containing arousal and valence dimensions (Russell, 1980). Arousal represents the vertical axis and valence represents the horizontal axis (Figure 1.3), while the centre of the circle represents a neutral valence and a medium level of arousal (Rubin & Talerico, 2009). In this model, emotional states can be represented at any level of valence and arousal, or at a neutral level of one or both of these factors. Each emotion can be described as a linear combination of these two dimensions, or as changeable degrees of both valence and arousal (Posner, Russell & Peterson, 2005) Joy, for example, is an emotional condition that is the result associated with positive valence or pleasure together with moderate activation with arousal (Posner, Russell & Peterson, 2005). Affective states other than joy similarly arise from the same two neurophysiological systems but differ in the degree or extent of activation. Specific emotions therefore arise out of patterns of activation within these two neurophysiological systems, together with cognitive interpretations and labelling of these core physiological experiences (Posner, Russell & Peterson, 2005). Circumplex

models have been used most commonly to test stimuli of emotion words, emotional

facial expressions, and affective states (Rubin & Talerico, 2009).
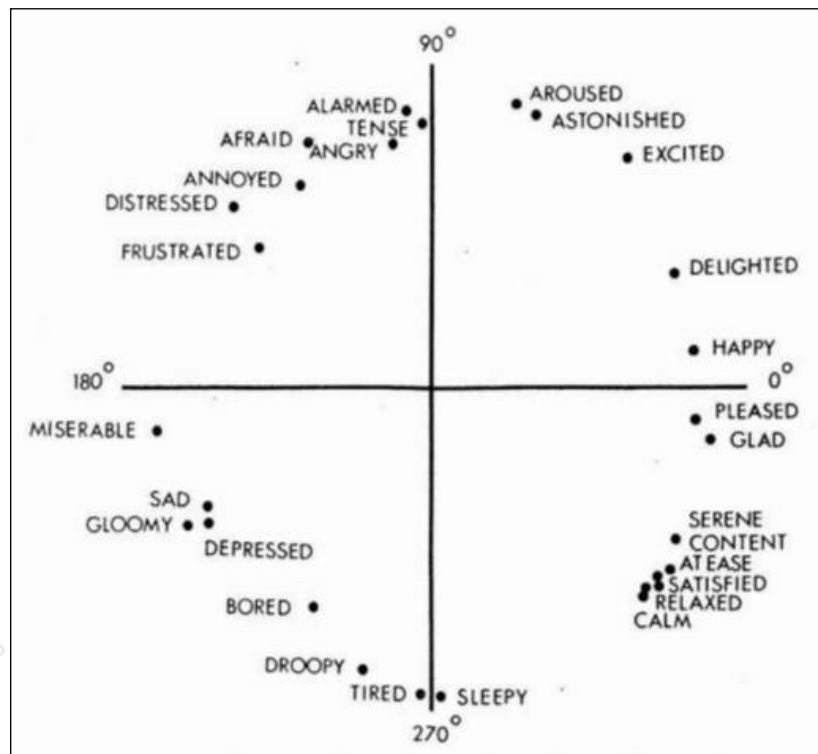
Figure 1.3. Russell's Circumplex Model of Affect (Russell, 1980)

Meanwhile, effects that arise from incorporating different realism level of

avatar can be seen in Uncanny Valley phenomenon which will be the second theory

this research has been grounded. Uncanny valley is a phenomenon that describes the

relationship between different levels of realism of a character and towards the comfort

and human emotions (Mori, 1970; MacDorman, 2006). This has been illustrated

through the Uncanny Valley graph produced by a Japanese roboticist, Masahiro Mori

in 1970.
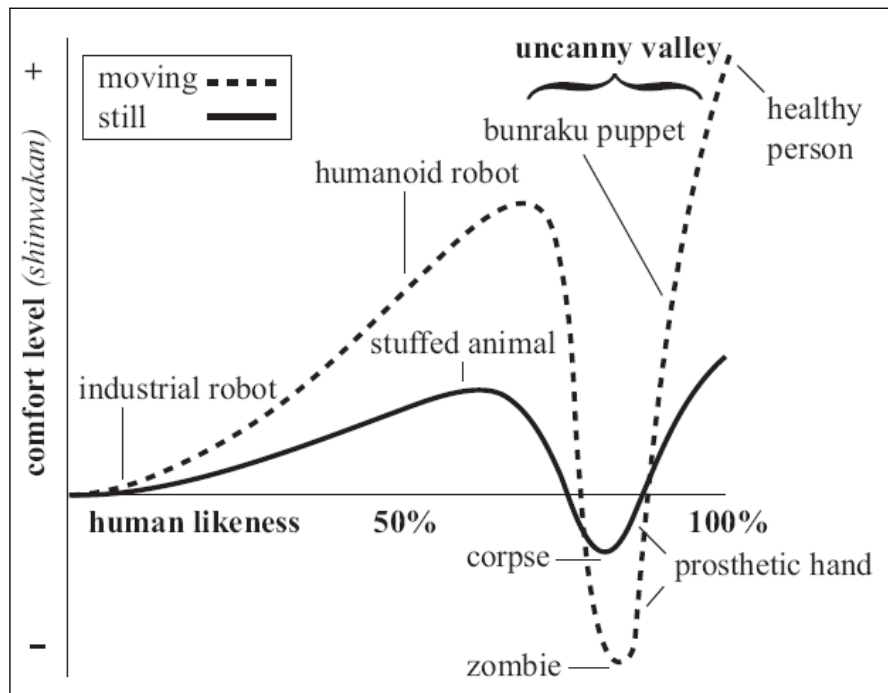
Figure 1.4. Masahari Mori's Graph of The Uncanny Valley (MacDorman, Green, Ho, & Koch, 2009)

Figure 1.4 shows Masahiro Mori proposed relation between human likeness and the comfort level in which it explains when a character look too human, even the slightest flaws will make it look creepy (MacDorman, Green, Ho, & Koch, 2009). Mori also added that, this situation deepened when there are movements added to the character (MacDorman, Green, Ho, & Koch, 2009). Nevertheless, the human emotion graph increased to positive level when the character is a real human (Mori, 1970; MacDorman, 2006). The phenomenon mentioned here is for robots, however it might also have applied for animated characters.

Some of the major social-cognitive theories of motivation will be the third theory this research is grounded on. Motivation is a state of being stimulated to do something, which is considered as an effort to drive a person's behaviour (Park,

2017). Without motivation, students are not inspired to learn new skills or engage in any learning activities (Park, 2017). Hence, expectancy-value theory, self-efficacy theory, goals and goal orientations theory are the three motivational theories this research is grounded on. Expectancy-value theory proposes that the two most important predictors of achievement are expectancies for success and task value beliefs (Wigfield & Eccles, 2000). Expectancies for success refer to students' beliefs of whether they will do well on an upcoming task (Wigfield & Eccles, 1992). The more students expect to succeed at a task, the more motivated they are to engage with it. Task value answers the question, "Why should I do this task?" Tasks are perceived important when they reflect the important aspects of one's self.

On the other hand, self-efficacy theory is defined as people's beliefs in their ability to perform a course of action required to achieve a specific task (Bandura, 1977). Self-efficacy is one of the strongest factors that drive one's motivation. When students believe that they are competent to successfully accomplish a task, they are more motivated to engage in and complete the task. Where else, Goal setting is a key motivational process (Latham & Locke, 1979). Goals are the outcome that a person is trying to accomplish. People engage in activities that are believed to lead to goal attainment. As learners pursue multiple goals such as academic goals and social goals, goal choice and the level at which learners commit to attaining the goals influence their motivation to learn (Locke & Latham, 2006; Wentzel, 2000).

As for this research purpose, an educational game has been developed to fulfil the study. Hence, in an educational game setting, the players usually will learn to

solve complex problems along the way (Khalid, Ab Rahman, Kasbun & Yunus, 2017). The problems usually will start off with easy level and then become complex as players regain skills as they progress. During this process, players experience joy, fun and engagement which relates to the flow theory. The flow theory conditions that activities which are in the balance between difficulty and skills could create a state of flow that is motivational (Csikszentmihalyi, 1990) which in recent years has been applied to the behaviour in gaming activities by some research such as researches conducted by Herzig, Strahringer and Amelin (2012) and Shi, Cristea, Hadzidedic and Dervishalidovic (2014). Flow designates a state of complete absorption or engagement in an activity (Khalid, Ab Rahman, Kasbun & Yunus, 2017). A "flow activity" is one in which the mind becomes focused and engaged on an activity, rather than being distracted (Khalid, Ab Rahman, Kasbun & Yunus, 2017).

Flow theory in a game known as a state of full immersion and engagement triggered when a subject's skills can overcome challenges, creating a positive experience and positive affect. The flow state is an optimal state of intrinsic motivation (Sanjamsai & Phukao, 2018). When players are in this flow state, highly focused and enjoying the game, they tend to retain in the game and also retain the learned content. Hence, flow theory is the fourth theory this research is grounded on.

As mentioned earlier, main challenges in designing a DGBL is getting the players engaged with the content and stay in the game. As such designing an engaging game is obviously important in order to achieve the objectives of this study.

Therefore, apart from all these four theories, mechanics, dynamics and aesthetics are main elements to consider when it comes to design a game (Hunicke, LeBlanc & Zubek, 2004). "The mechanics of the game are the actions, behaviors, and controls that are used to 'gamify' an activity and to stimulate specific emotions on the player, whereas game dynamics are the result of desires and motivations reflecting those emotions", (Hunicke, LeBlanc & Zubek, 2004). Table 1.1 summarize the game mechanics, dynamics and aesthetics

Table 1.1

Game Mechanics, Dynamics and Aesthetics (Bunchball, 2010; Hunicke, LeBlanc & Zubek, 2004)

Game Mechanics	Game Dynamics	Game Aesthetics
Points	Reward	Curiosity
Levels	Status	Satisfaction
Challenges	Achievement	Surprise
Virtual goods and spaces	Self-expression	Trust
Leaderboards	Competition	Envy
Gifts and charity	Altruism	Fun

In sum, by adapting to these theories, principles and the literature overview, a conceptual framework has been proposed as depicted in Figure 1.5.
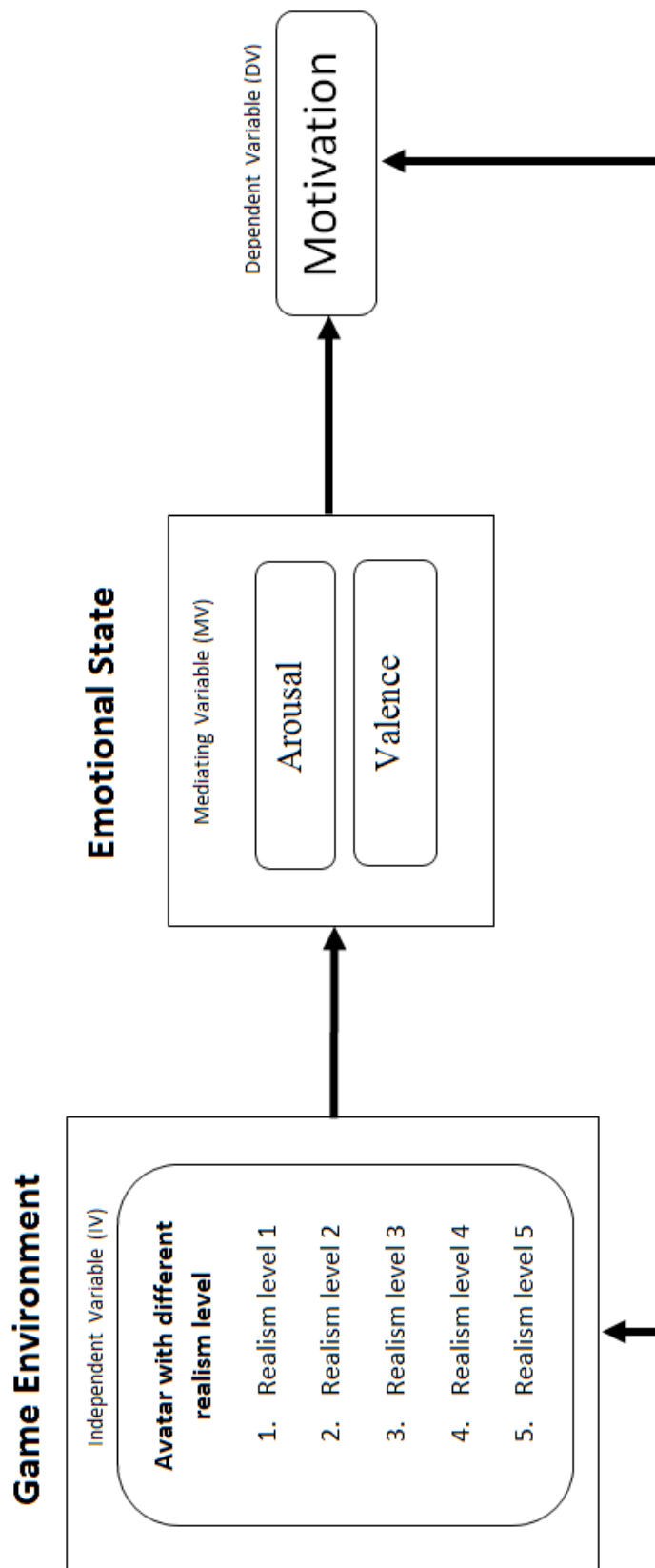
Figure 1.5. Conceptual Framework

When the students play the game, they will be exposed with an avatar with certain degrees of realism. Based on Mori's (1970) uncanny valley graph, students might go through either a comfort level which indicates the likeness towards the avatar or students might feel creepy towards the avatar realism level added with movements. Concurrently, the students will experience the flow throughout the game via going through the game mechanics and dynamics. Besides that, the students will go through different emotional state depending on the realism level that they perceived in relation with Mori's (1970) uncanny valley graph and Russell's Circumplex Model of Affect (Russell, 1980). The students' emotional state will fall into any of the two-dimensional circular space, containing arousal and valence dimensions whereby, emotional states of the students can be represented at any level of valence and arousal, or at a neutral level of one or both of these factors.

Following that, the students both will be motivated to be engaged with the game and continue to play or will leave the game. Nevertheless, there might be a situation where the emotional state of the students will not influence their motivation to continue to play the game. Thus, this study will identify whether emotion will be a significant mediator in determining the motivation of students who undergo different realism level of avatar in the game.

1.5 Research Objectives

The objectives of this research are:

Development:

1. To develop a DGBL prototype entitled *Colour Travel* with five different avatar realism levels.

2. To conduct usability (UX) and user satisfaction study of the DGBL prototype developed.

Research:

1. To examine if there is any significant difference in arousal and valence of students who undergo different realism levels of avatar.

2. To examine if there is any significant difference in motivation level of students who played DGBL with different realism levels of avatar

3. To examine if arousal and valence appeared to be significant mediators in determining the motivation of students who played DGBL with different levels of avatar.

1.6 Research Questions

1. Is there any significant difference in arousal of students who undergo different realism levels of avatar?

2. Is there any significant difference in valence of students who undergo different realism levels of avatar?

3. Is there any significant difference in motivation level of students who played DGBL with different levels of avatar?

4. Are arousal and valence significant mediators in determining the motivation of students in DGBL with different realism levels of avatar?

1.7 Hypotheses

The research hypotheses derived based on pass studies related literature and conceptual framework grounded are as follows:

H1.   There is a significant difference in arousal of students who undergo different realism levels of avatar.

H2.   There is a significant difference in valence of students who undergo different realism levels of avatar.

H3.   There is a significant difference in motivation level of students who played DGBL with different levels of avatar.

H4.   Arousal and valence are significant mediators in determining the motivation of students in DGBL with different realism levels of avatar.

1.8 Significance of the Study

This research per se contributes to create a better and comfortable virtual DBGL environment for students to acquire knowledge with the existence of avatar as a virtual teacher. It will not only contribute in producing good environment generally but also identify the appropriate approach of an avatar in DGBL. Hence, it can create better engagement when students are in appropriate emotional state (arousal and valence) to acquire knowledge using DGBL.

Apart from that, this research also will give an opportunity to tertiary education to identify new approach to enhance learning process rather than usual presentation of an avatar in a DGBL. This results in creating an interesting way of learning since it engaged with an environment which preferred by most of the youngsters nowadays. Moreover, it will give the luxury of learning on their own pace and time with a virtual teacher which eventually makes the learning as a lifelong learning process.

1.9 Limitations

This research is limited on few areas mainly the content used to conduct the study, the respondent and the device used.

1.9.1 The respondent

This research is focused on the Malaysian tertiary level students. According to Ding, Guan and Yu (2017), studies have showed that games have a great potential in motivating and engaging learners and may enhance the level of concentration of intellectual activities in tertiary education. It is also only focused among Malaysian tertiary level students who are pursuing studies at private colleges generally without considering any ethnic group.

1.9.2 The content

The content of DGBL is only focused to colour theory subject which will be offered to diploma in Computer Graphic Design students in semester 4. Colour knowledge is a fundamental tool in the Graphic design process and will help when incorporating it into design with confidence base on tested concepts and methods. This is crucial for semester 3 students in this course as students will have deep knowledge on colour theory and uses its psychological edge to their advantage in artwork, advertising,

retail packaging, clothing trends, interior decorating, and design colour schemes. Moreover, this knowledge can be applied to a majority of art course.

Besides that, the avatar developed for the game is limited in terms of the gender which is focused only on male character. This is because as claimed by Liew, Su-Mae, and Jayothisa (2013), learners working with male characters were more satisfied with their performance and reported that characters better facilitated self-regulation. They concluded that, male virtual characters may be more advantageous for both female and male learners in a virtual learning environment.

The appearances were limited to 3 dimensional (3D) with only five level of realism to match the needs for testing all hypotheses. On the other hand, motivation aspect that is being identified in this research is not focusing only on extrinsic or intrinsic motivation, but it is focused as an overall aspect. Likewise, the emotion tested in this research is only based on two dimensions which are valence and arousal. Therefore, the instrument used to test the emotion which is SAM (Self-Assessment Manikin) of the students is only limited to two dimensions which are valence and arousal. Meanwhile, the overall research is focused to visceral level of emotional design for the game whereby, only the appearance of the avatar is being focused.

1.9.3 The Device Used

The device used in the quasi-experimental study would be limited to desktop computers as it is easily available in the computer labs at the research locations.

1.9.4 The System and Game Used

The operating system of the device used will be limited to only Windows 10 system because the game was designed and developed specifically for this platform. In terms of game contents, the game levels were limited to five to match the needs for testing all hypotheses.

1.10 Operational Definitions

1. Avatar

   A virtual tutor like character integrated in the game developed for this research purpose

2. DGBL

   DGBL (Digital Game Based Learning) refers to learning via a digital game environment. In this research a digital game for learning colour study was developed.

3. Tertiary level

   Tertiary level also referred to the sample of students' education level which was chosen for this research purpose. It is considered as third stage, third level, and post-secondary education, is the educational level following the completion of a school providing a secondary education, such as a high school, secondary school, university-preparatory school.

4. SAM

   Self-Assessment Manikin is a non-verbal pictorial assessment instrument which measures the valence, arousal and dominance experienced by the students.

5. MSLQ

   Motivated Strategies for Learning Questionnaire is a self-report instrument designed to assess the students' motivation via student self-efficacy, extrinsic value, and self-regulation from playing the digital game integrated with different realism levels of avatar.

6. Emotion

   Feelings and mood perceived by the students' upon playing the digital game integrated with different realism levels of avatar

7. Arousal

   One of the emotion components which explain the alertness and tension perceived by students upon watching the different realism levels of avatar.

8. Valence

   The intrinsic attractiveness (positive valence) or evasiveness (negative valence) perceived by the students upon watching the different realism levels of avatar.

9. Motivation

   The reason for students' actions, engagement and willingness to complete or retain in the game.

10. Avatar realism level 1

   Avatar with eye size increased to 150% from normal human eye size, non-droopy eyes, and unattractive, thin and curvy eyebrow.

11. Avatar realism level 2

   Avatar with eye size increased to 130% from normal human eye size, non-droopy eyes, thick and curvy eyebrow.

12. Avatar realism level 3

   Avatar with eye size increased to 125% from normal human eye size, non-droopy eyes, thick and straight eyebrow resembling calm emotion.

13. Avatar realism level 4

   Avatar with eye size increased to 120% from normal human eye size, non-droopy eyes and realistic eyebrow.

14. Avatar realism level 5

Avatar with correct proportion of eye size of normal human eye size, non-droopy eyes and realistic eyebrow.

1.11 Conclusion

During the past few years there has been a significant amount of work carried out into the use of DGBL technologies and concepts to enhance teaching and learning, both for education and training purposes. DGBL is being a trend in the world of academia as it is known for motivating and engaging students to acquire knowledge.

Hence, in order to fulfil learners' expectation to have a virtual teacher, avatar been introduced to represent an educator. However, there have been many studies conducted in order to represent an avatar that would accommodate the need of all kind of learners. As such, studies also have been conducted in order to identify the level of realism prefered by user of an anthropomophic character in a virtual interaction. By the same token, there were dearth research conducted in order to identify the emotional aspect of user when they are interacting with avatar that was developed with different level of realism and the motivation theory involved while learning using avatar with different realism level.

Highlighting to that, this research is important in order to identify how different levels of realism of a game avatar would influence different elements of

emotions (valence and arousal) and aspects of motivation among Malaysian tertiary

level students in DGBL settings.