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ABSTRACT

This research was aimed to analyse students' emotions caused by the character's realism design in the dimension of valence and arousal and its' mediating effects on emotions in learning. 2D female virtual agents with four different realism appearances namely realistic, semi-realistic, stylized and cartoon-like were designed and developed. Quasi-experimental design was used to answer the research questions derived and the data obtained was analysed using ANOVA, post hoc and bootstrap mediation analysis. The experiment was carried out with 600 Electrical Engineering students from seven polytechnics in Malaysia. Students were divided into four different groups using multistage sampling methods, where each group consisted of 150 students who underwent four different realism designs of the virtual agents respectively. The ANOVA test show that there are significant differences on valence ($F(3, 596) = 15.48$, $p=0.00$, $\eta_p^2= 0.07$), arousal ($F(3, 596) = 15.79$, $p=0.00$, $\eta_p^2= 0.07$) and emotion in learning ($F(3, 596) = 2.89$, $p=0.35$, $\eta_p^2= 0.01$) caused by different realism designs of virtual agents. The results revealed that cartoon-like design scored the lowest mean score for both valence and arousal followed by stylized, realistic and semi-realistic design. It has been found that all the different realism designs of virtual agents fell at high affective state and consequently escaped from the uncanny valley effect. Interestingly, cartoon-like design scored the highest mean score for emotions in learning followed by semi-realistic, realistic and stylized designs. In summary, cartoon-like agent is the best agent among others in inducing positive emotions in learning. In addition, the mediation analysis showed that only arousal has mediating effects on the relation between different realism designs and emotions in learning (ß=-0.311, CI = -0.564 to -0.114). Therefore, this study recommends cartoon-like agent as the best suitable design for 2D virtual agent followed by semi-realistic, realistic and stylized designs. Finally, the findings of this study can be a useful guideline for character designers in determining the ideal 2D virtual agent appearance to elicit maximum impact of it in promoting positive emotions in multimedia learning environment.

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KESAN TERHADAP KESERONOKAN, RANGSANGAN DAN EMOSI DALAM PEMBELAJARAN DISEBABKAN REKA BENTUK EJEN MAYA 2D DENGAN TAHAP REALISTIK YANG BERBEZA

ABSTRAK

Kajian ini bertujuan untuk menganalisis emosi pelajar dari dimensi keseronokan dan rangsangan yang diakibatkan oleh reka bentuk tahap realistik ejen maya dan kesannya sebagai perantara terhadap emosi dalam pembelajaran. Ejen maya 2D wanita dengan empat penampilan tahap realistik berbeza, iaitu realistik, separa realistik, *stylized* dan rupa kartun telah direka bentuk dan dibangun. Reka bentuk eksperimen kuasi telah digunakan bagi menjawab persoalan-persoalan kajian yang dibina dan data yang diperolehi telah dianalisis dengan menggunakan ANOVA, post hoc dan analisis perantara bootstrap. Eksperimen ini dijalankan terhadap 600 orang pelajar Kejuruteraan Elektrik dari tujuh buah politeknik di Malaysia. Pelajar dibahagikan kepada empat kumpulan yang berlainan menggunakan kaedah persampelan pelbagai tahap, di mana setiap kumpulan terdiri daripada 150 pelajar yang menerokai empat reka bentuk ejen maya dengan tahap realistik yang berbeza. Ujian ANOVA menunjukkan terdapat perbezaan yang signifikan terhadap keseronokan ($F (3, 596) = 15.48$, $p=0.00$, $\eta_p^2=0.07$), rangsangan ($F (3, 596) = 15.79$, $p=0.00$, $\eta_p^2= 0.07$) dan emosi dalam pembelajaran ($F (3, 596) = 2.89$, $p=0.35$, $\eta_p^2= 0.01$) disebabkan oleh reka bentuk ejen maya dengan tahap realistik yang berbeza.Dapatan kajian menunjukkan ejen rupa kartun memperolehi skor min yang terendah bagi kedua-dua dimensi keseronokan dan rangsangan dan ianya diikuti oleh ejen *stylized*, ejen realistik dan ejen separa realistik. Juga didapati bahawa kesemua reka bentuk tahap realistik ejen maya berada dalam situasi afektif yang tinggi dan boleh dikatakan bebas daripada kesan *uncanny valley*. Menariknya, reka bentuk rupa kartun memperolehi skor min tertinggi bagi emosi dalam pembelajaran yang diikuti oleh separa realistik, realistik dan *stylized*. Kesimpulannya, reka bentuk rupa kartun adalah reka bentuk terbaik berbanding reka bentuk lain untuk merangsang emosi positif dalam pembelajaran. Seterusnya, analisis perantara menunjukkan bahawa hanya rangsangan mempunyai kesan perantara bagi hubungan antara reka bentuk tahap realistik ejen maya yang berbeza dan emosi dalam pembelajaran ($ß=-0.311$, CI = -0.564 to -0.114). Oleh itu, kajian ini mencadangkan reka bentuk rupa kartun merupakan pendekatan terbaik bagi ejen maya 2D diikuti oleh reka bentuk separa realistik, realistik dan stylized. Dapatan kajian ini boleh menjadi panduan berguna bagi pereka bentuk karakter dalam menentukan penampilan agen maya 2D yang ideal, yang mana reka bentuk tersebut dapat berperanan menghasilkan impak maksimum dalam penjanaan emosi positif bagi persekitaran pembelajaran berasaskan multimedia.

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LIST OF ABBREVIATIONS

AEQ	Achievement Emotions Questionnaire
MLE	Multimedia Learning Environment
PSSUQ	Post-Study System Usability Questionnaire
Q-MLE	Quiz based Multimedia Learning Environment
SAM	Self-Assessment Manikin
SAM	Successive Approximation Model
SF-L-AEQ	Short-Form Learning-related Achievement Emotions Questionnaire

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CHAPTER 1

INTRODUCTION

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1.1 Introduction

Virtual agents are animated life-like characters generally used in virtual learning environments to facilitate learning tasks (Bian et al., 2016; Choi & Clark, 2006; Craig, Gholson & Driscoll, 2002; Gulz, 2005; Hong, Chen & Lan, 2014; Johnson, Rickel & Lester, 2000; Moreno, 2005; Tien & Kamisah, 2010). Based on the functionality and behaviours, virtual agent is also known as pedagogical agent (Baylor, 2002, 1999; Baylor & Kim, 2004; Johnson & Lester, 2016; Liew, Mat Zin & Sahari, 2017), virtual character (Ferstl, Kokkinara & McDonnell, 2016; Gulz, 2004; Heyselaar, Hagoort & Segaert, 2017; Veletsianos & Russell, 2014), avatar (Chen et al., 2012); talking-head (Dey, Maddock & Nicolson, 2010; Mohd Najib, Ahmad Zamzuri & Annuar, 2015), virtual peer (Moreno, Reislein & Ozogul, 2010; Ryokai, Vaucelle & Cassell, 2003), or

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embodied conversational agent (Bickmore & Cassell, 2005; Nunamaker, Derrick, Elkins, Burgoon & Patton, 2011). This clearly indicates how virtual agent have been widely used in various learning platforms and conditions.

With virtual agent, students can hold meaningful interactions throughout the learning process for more effective cognition (Katerina, 2011; Veletsianos, 2010; Yang & Zapata-Rivera, 2010). Virtual agent often offers students with additional life-like communication that could increase the interaction capability of the instructional media and consequently improves its capability to engage and motivate learners (Chen et al., 2012; Gulz & Haake, 2006a; Hong et al., 2014). Studies suggested that virtual agent plays many different roles in the multimedia learning environment, such as demonstrating, scaffolding, coaching, modelling, testing, and so on (Clarebout, Elen, Johnson & Shaw, 2002; Schroeder & Adesope, 2012). In addition, social interaction still exists among students though human peers are absent (Kim & Wei, 2011; Mohammadhasani, Fardanesh, Hatami, Mozayani & Fabio, 2018). Since, social relationship between the virtual agent and learner is important, thus bigger prominence should be granted in the design phase of the virtual agent's appearance (Persson, Laaksolahti & Lonnqvist, 2002; Rosenberg-Kima, Baylor, Plant & Doerr, 2008; Shiban et al., 2015).

Positive emotions arise in the multimedia-based learning environment able to affect learners' experience, therefore facilitate cognitive processes and learning (Um, Plass, Hayward & Homer, 2012). Hence, the effectiveness of virtual agent in term of promoting positive emotion is very much related to character realism influence (Mohd Najib, 2015; Moore, 2012). Based on previous studies in animation and games

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industries, it clearly indicated that the realism factors had impact on the success of the animation and games (Butler & Joschko, 2009; Freedman, 2012; MacDorman & Chattopadhyay, 2016; MacDorman & Entezari, 2015; Schwind, Wolf, Henze & Korn, 2015). Hence, a question arises if the same effects will befall on the virtual agent, specifically for education purposes. Therefore, it is essential to conduct studies that address this phenomenon in instructional settings.

1.2 Research background

Animated characters usually relate to movies, cartoons or special effects. However, there were numerous positive results indicated that animation have major contribution in education field as well (Balasubramanyam, 2012; Kogilathah, Ahmad Zamzuri & Tan, 2013; McMenemy & Ferguson, 2009). These days, animations are consolidated as a feature of computer based multimedia learning aid to facilitate human learning through technologies such as virtual agent (Baylor, 2002; Johnson et al., 2000; Kearsley, 1993; Tien & Kamisah, 2010). A virtual agent is a potential approach of instructional material in assisting learning (Massaro, Liu, Chen & Perfetti, 2006; Mohammadhasani et al., 2018; Mohd Najib, 2015). It is based on the capability of the virtual character in delivering learning content visually and verbally in students' memory structure compared to verbal only methods which only benefits in terms of verbal channel (Massaro et al., 2006; Mohd Najib, 2015). Therefore, virtual agents are animated life-like characters (Bian et al., 2016; Choi & Clark, 2006; Craig et al., 2002; Gulz, 2005; Hong et al., 2014; Johnson et al., 2000; Moreno, 2005; Tien & Kamisah,

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2010) presented on a computer screen in multimedia learning environments to guide users in learning (Heidig & Clarebout, 2011; Mohammadhasani et al., 2018).

People are happened to be attracted by the visual of face of others in communication processes. When individuals interact, they typically take a glance at each other, seeing the elements of others in vivid detail as shown in Figure 1.1 (Gulz & Haake, 2006a; McCloud, 1993). Every one likewise maintains a steady awareness with his or her own face, however this mental picture is of an iconic environment (Gulz & Haake, 2006a; McCloud, 1993). Therefore, when users are exposed to an agent, identification and social affinity between user and agent occurs naturally and effortlessly. Consequently, it can increase the impact of an agent on users (Gulz & Haake, 2006a). Past studies showed that an animated agent can be more effective compared to without an agent (Baylor & Plant, 2008) or compared to text-only (Atkinson, 2002; Moreno, Mayer, Spires & Lester, 2001; Walker, Sproull & Subramani, 1994).



Figure 1.1. People who interact see each other faces in vivid detail, but in their mind they only have a schematic or iconic representation of their own faces. Source: McCloud (1993)

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In the aspect of designs of virtual agent, the level of realism of the virtual agent is among the most vital attribute that should be addressed (Ahmad Zamzuri & Mohd Najib, 2016; Baylor & Kim, 2004; Fan et al., 2014; Kokkinara & McDonnell, 2015; Mohd Najib & Ahmad Zamzuri, 2014; Schindler, Zell, Botsch & Kissler, 2017; Schneider, Wang & Yang, 2007). It is to ensure that the virtual agent is capable of obtaining maximum impact in learning (Baylor, 2011; Johnson et al., 2000; Liew, Su-Mae & Jayothisa, 2013; Mohd Najib & Ahmad Zamzuri, 2014). Welch, Blackmon, Liu, Mellers and Stark (1996) contend that pictorial realism increases involvement and the sense of presence in a digital environment. Meanwhile, Nass, Isbister and Lee (2000) suggested that embodied conversational agents should accurately mirror humans and resemble the targeted user group as closely as possible. However, according to Liu, Massaro, Chen, Chan and Perfetti (2007), level of realism of agent may cause distress to the users, especially when the character mimics like human; which was based on the uncanny valley phenomenon highlighted by Mori (1970, 2012).

The concept of uncanny valley originally referred to the design of humanoid robots. In the late 1990s, the concept has been migrated across disciplines to animation industries where people began to refer the uncanny valley phenomenon for character designs as well. According to Mori (1970, 2012), a character that is too realistic or almost resembles a human would eventually cause viewers to feel fearful and horrified when viewing these characters which is also known as the uncanny valley phenomenon (Burleigh, Schoenherr & Lacroix, 2013; Butler & Joschko, 2009; Mohd Najib, 2015; Olivera-La Rosa, 2018; Schwind, Wolf & Henze, 2018a; Tinwell, 2015). For instance, too realistic animated characters in the Final Fantasy: The Spirits Within (Lee, Aida, Sakaguchi & Sakakibara, 2001) was claimed to be among the failure contributors of the

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movie (Geller, 2008; Kaba, 2013). Besides, such realistic design in the film causes heavy financial loses, for example Walt Disney Studio's Mars Needs Moms (Zemeckis, Rapke, Starkey, Boyd & Wells, 2011) lost about $150 million (Schwind, et al., 2018a). Likewise in the film Alita: Battle Angel (Figure 1.2), the character was highly criticized for the creepy look (Kummer, 2019; Schwind, et al., 2018a; Wizard, 2019). This is also supported by a study conducted by Tinwell, Grimshaw, Nabi and Williams, (2011), which found that the use of too realistic three-dimensional animated characters causes notable discomfort to the viewers.

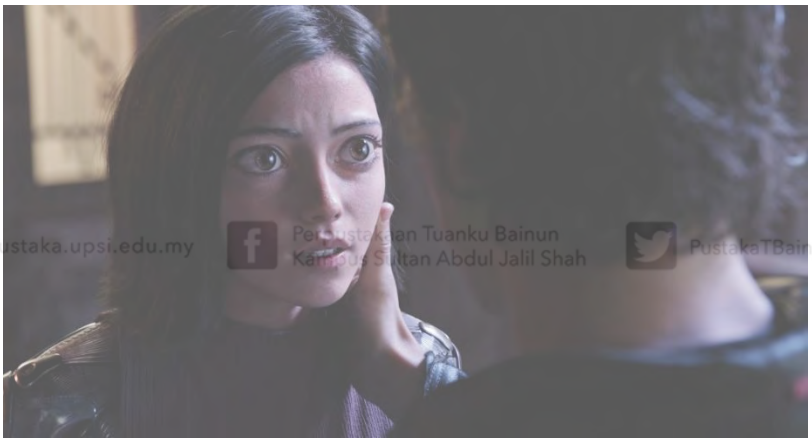


Figure 1.2. Alita: Battle Angel. Source: 20th Century Fox Movies (2019)

Since social relationship between the virtual agent and student is important, bigger prominence should be granted in designing phase of the virtual agent's appearance (Shiban et al., 2015). Adding to this, the ability of virtual agent in promoting positive emotions is very much related to character's realism influences (Mohd Najib, 2015). Correspondingly, the emotional effects on the different realism designs of virtual agents can be identified in the dimension of arousal and valence. These two dimensions represent the affective state experienced by students during their interaction with virtual agents. The affective experience of valence varies from pleasant-to-unpleasant state

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while arousal varies from low-to-high state of excitement (Barrett & Russell, 1999; Kensinger & Corkin, 2004). However, very high arousal along with negative valence towards the virtual agent can produce negative feeling among students which lead to the occurrence of uncanny valley phenomenon (Mori, 1970, 2012). At this point, the appearance of virtual agent reached beyond the maximum possible degree of realism in human-likeness and it seen as eerie or disgusting among students. Consequently, students refused to accept the virtual agent as their learning companion. In addition, students' affective experiences influence their perceptions and behaviour. Thus, it becomes an important goal for students to recognize and use their emotions on the content of learning and the circumstances of learning. Pekrun, Goetz, Frenzel, Barchfeld and Perry (2011) and Ahmad Zamzuri and Mohd Najib (2016) have been highlighted the important of emotions in identifying cognition success in the learning process. According to the view of Ciechanowski, Przegalinska, Magnuski and Gloor (2019), virtual agents play an important role as interactive mediate to distribute cognitive tasks to the students in interactive learning environment. Hence, an enhancing and suitable design of virtual agent would be more susceptible for an emotions induction.

Commonly, the realism design of three-dimensional animated characters is higher in resembling the actual human compared to a two-dimensional animated characters (Mohd Najib, 2015; Walker, 2009). It means, the level of discomforts and human emotions will be more effected when three-dimensional animated characters are used, compared to two-dimensional animated characters (Mohd Najib, 2015; Walker, 2009). In addition, somehow the both 2D and 3D animation techniques produce a flat image on the screens (Walker, 2009). Therefore, this study will focus on various realism

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designs of 2D characters only. Most studies on the impact of the realism design focused on the film industry and very less in education (Brutscher, 2013). Therefore, it is important to conduct studies that analyse the impact of different realism designs of the virtual agents in teaching and learning media.

Furthermore, the gender selection for virtual agent ultimately impacts learning process. Previous work indicated that precollege students with low prior knowledge benefit from the signalling by a young female animated pedagogical agent (APA) in instruction with multiple visual representations (Johnson, Ozogul, Moreno & Reisslein, 2013). In addition, according to Baylor (2011), the impact of the animated pedagogical agent on female students' motivation can be maximized by presenting the agent as female, young, attractive and cool. Female agent enhanced both male and female student motivation in learning (Arroyo, Woolf, Cooper, Burleson & Muldner, 2011). Moreover, viewers were facing uncanniness in male human-like character (Tinwell et al., 2011). Other than that, elements of virtual agent should reflect the cultural value of the country where it was originated and tested (Minghua & Ping, 2010; Sloan, 2015). For instance, animation series such like 'Upin & Ipin' (Burhanuddin, Ainon, Mohd Nazmi, Mohd Faiz & Adam, 2007) and 'BoBoiBoy' (Nizam, Jean & Dzubir, 2011) that represent local culture of Malaysia attracted the local audience and consequently led to their success. Accordingly, female virtual agents with native look of Malaysian were selected for the investigation purpose of the current research. Thus, the look of the female virtual agents localise Malaysian Malay young lady as a subjective approach to cultural acceptance.

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In addition, voice is a vital element in communication. Thus, past studies concluded that the presence of voice promotes deeper and better learning (Mayer & Estrella, 2014; Mayer, Sobko & Mautone, 2003; Moreno & Mayer, 2002). Atkinson (2002) found that participants who were exposed to the agent in combination with narrated voice instructions demonstrated better learning than participants who were exposed to voice-only instructions. However, agent with human voice is more preferred by the learners thus it engage them in learning compared to agent with machine voice (Atkinson, Mayer & Merrill, 2005; Baylor, Ryu & Shen, 2003; Mayer et al., 2003). Therefore, the current study principally used human voice in the development phase of virtual agent.

In conclusion, the realism design should be taken seriously, and virtual agent should be designed with the consideration of the emotional and psychological impact on human (MacDorman & Chattopadhyay, 2016; MacDorman, Green, Ho & Koch, 2009; Mohd Najib, 2015; Seyama & Nagayama, 2007; Tondu & Bardou, 2009). The close relationship between learning and emotion is not new but still very little is known about it (Cleveland-Innes & Campbell, 2012; Dirkx, 2008; Hascher, 2010; Pekrun & Frese, 1992; Pekrun, Goetz, Titz, & Perry, 2002b; Schutz & Lanehart, 2002; Värlander, 2008). Many previous studies only focused on virtual agent's appearance and limited on realism design of the virtual agent (Baylor, 2009; Rosenberg-Kima et al. 2008, Shiban et al., 2015; van der Meij, van der Meij & Harmsen, 2015; Zibrek & McDonnell, 2014). There was also study on effects of realism designs of animated virtual character on students' learning performance and emotions, but the study only focused on the relation between emotions and performance caused by the male virtual agents in the entire learning process and not in isolated (Mohd Najib, 2015). So far, previous studies

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only focused on students' emotions on the entire learning process and not on emotions caused by character's appearance in isolated or vice versa. Therefore, the current study aims to address the gap by studying the effect of different realism designs of virtual agents. Firstly, the virtual agent's design in isolated on students' emotions in the dimension of valence and arousal will be measured. Secondly, students' emotions in the learning will be measured. Thirdly, the relationship between valence and arousal caused by different realism designs of virtual agents and students' emotions in learning will be studied. For that, four different realism designs of virtual agents in Quiz based Multimedia Learning Environment (Q-MLE) had been developed as experimental items and tested to analyse its effect, specifically on emotion caused by the virtual agents' realism designs and emotions in learning. The four prototypes for the current study namely realistic agent (Baylor & Kim, 2004; Beun, De Vos & Witteman, 2003; Ruhland, Zibrek, & McDonnell, 2015; Saidatul Maizura et al., 2010; Zell et al., 2015), semi-realistic agent (Saidatul Maizura et al., 2010; Zell et al., 2015), stylized agent (Mohd Najib, 2015; Schwind et al., 2015; Zell et al., 2015) and cartoon-like agent (Baylor & Kim, 2004; Gulz & Haake, 2006a; McDonnell et al., 2012; Ruhland et al., 2015; Saidatul Maizura et al., 2010) were amended base from the past studies.

In sum, the four 2D female virtual agent prototypes are as follows:

1. Cartoon-like agent

   In this design the virtual agent was designed to match an iconic typical cartoon model (simplified geometry of the face) with audio narrative.

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2. Stylized agent

   In this design the virtual agent was designed with stylized features (cartoon character with exaggerated features) with audio narrative.

3. Semi-Realistic agent

   In this design the virtual agent was designed with medium realistic (not as detailed as the realistic) with audio narrative.

4. Realistic agent

   In this design the virtual agent was designed with realistic (designed very detailed and it resembles like human) with audio narrative.

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1.3 Problem Statement

The different realism design of virtual agent may cause distress to the users, especially when the character mimics human; which was based on the uncanny valley phenomenon highlighted by Mori (1970, 2012). A character that is too realistic or almost resembles a human would eventually cause viewers to feel fearful and horrified when viewing such characters (Mori, 1970, 2012). Based on previous studies in the animation and the games industries, it clearly indicated that the realism factors had impact on the success of the animation and games (MacDorman & Chattopadhyay, 2016). Hence, a question arises if the same effects will befall on the virtual agent, specifically for education purposes.

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Animated virtual agent has potential to engage students while increasing their positive emotion. This is due to the capability of virtual agent to hold a conversation in the form of animated character. Therefore, animated virtual agent can be used to assist the learners throughout the learning. However, the use of animated virtual agent would be an issue if it does not provide positive emotion as expected. In this case, learners would reject animated characters once they begin feeling ‘‘eerie’’ or begin to experience negative emotions due to the uncanny human realism of the animated characters where this is known as the uncanny valley phenomenon (Mori, 1970, 2012).

Since social relations between virtual agents and learners are important, a greater emphasis should be given in designing the realism level of a virtual agent. Different realism level of virtual agent will give different impacts on learners. Adequate realism levels of virtual agent might have an impact in simulating positive emotions among the learners. Consequently, students’ interest in learning can be increased as well. Clearly, the adequate realism level of the virtual agent is among the most important attribute to be identified, to obtain the maximum impact in learning. Although, different realism level of virtual agent would create different emotions among learners, it is still unclear on how to design the appearance of a virtual agent to improve students’ positive emotions. The relationship between learning and emotion is not something new but still very few numbers of researchers who have studied about it. Therefore, it is essential to conduct studies that address this phenomenon in instructional settings.

Moreover, past studies only focused on students’ emotions on the entire learning process and not on emotions caused by character’s designs in isolated. In view of that,

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this study aims to address the gap by studying the effects of different realism designs of virtual agents. In particular, firstly, this study focus on emotions that arise after seeing the designs of the virtual agents (in isolated) in the dimension of valence and arousal, secondly on emotions that occurs in learning and finally its mediating effects on emotion in learning.

1.4 Significance of the study

As the power of computer technologies advances, the presence of virtual agent in the multimedia learning environment to play human instructional roles has increased dramatically (Johnson et al., 2000; Moreno et al., 2001). Most often, multimedia designers design the virtual agent based on their own preference without ever knowing how their work impacts a larger goal. Unsuitable design selection allows unreliable predictions of its effectiveness. In order to achieve a meaningful design, especially for instructional purpose, research based outcome should be used to guide the development of ideal multimedia design to elicit maximum effectiveness. Therefore, the findings of this research is a useful guideline for multimedia designers in developing virtual agent through the use of appropriate design.

In the twenty-first century, with emerging technologies, multimedia designers are able to design animated virtual agent easily using two-dimensional software technology. The uniqueness of this study exists in the fact that realism design is a key element in the design of virtual agents. In order to demonstrate the potential of this approach, it is important to develop appropriate realism design of a character that is

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likeable to target audience. Certainly, appropriate virtual agent that designed using two-dimensional software technology can generate positive emotion in audience that can leave a lasting impression. Most of the studies focused on the use of virtual agent in education regardless of the effects of different realism designs of animated virtual agents in multimedia learning environments. Accordingly, studies on realism design of animated virtual agent need to look in detail so that the negative impact of students' emotions in learning can be avoided.

This research bridges the gap between education and design needs in the field of multimedia for teaching and learning. This study is an important contribution to create Multimedia Learning Environment (MLE) as new pedagogical model to transform the teaching-learning environment. A successful MLE uses virtual agent as the primary design component. It creates an environment that connects the content with the students on positive emotional level. Thus, this research provides a guideline to assist multimedia designer in the development of a virtual agent with appropriate realism design. Also, this research proposes to Ministry of Higher Education, an alternative and efficient way to deliver interactive multimedia design based educational materials using ideal virtual agents' realism design.

Moreover, addressing the specific factors involved in the research outcomes, such as background, colour, gender, age and narration are capable to provide a more expansive interpretation of the research. In view of that, the researcher discovered the best visual style and specific formats for presenting and applying in the MLE that suitable for multimedia learning. These effective formats aid multimedia designers to quickly create multimedia environments by eliminating the need to spend additional

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time preparing multimedia learning environment in a more robust way for any other course material.

In addition, the use of virtual agent in quiz based MLE (Q-MLE) is a new approach in educational settings. This offers a significant opportunity to engage students with different learning styles. Consequently, the contribution of this study is obvious as the resulting outcomes can be capitalized as guidelines specifically on the choice of virtual agent to be used in MLE, intelligent tutoring system, games, and so on which were previously only explored in the animated film industry. With the role as instructional guide in the Q-MLE, the ideal virtual agent is capable to communicate and attract students' attention and enhances their interest in learning. In addition, the students will be very interested to learn independently. In fact, the Q-MLE aims to help the students to remember important terms or concepts that are pointed in the quiz. Indirectly, students will be well prepared for both their class and exams. On the face of it, they can improve their course grade as well.

1.5 Theoretical framework

Basically, human brain is attracted and capable to respond fast to the elements that has been seen and heard in multimedia learning. In accordance to that, there are various theories that support multimedia learning such as Baddeley's (1986) model of working memory theory, Paivio's (1981) dual coding theory and Sweller's (1988) cognitive load theory. In addition, the work of Mayer (1997) makes the cognitive theory of multimedia learning becomes popular. According to Mayer's multimedia learning cognitive theory,

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learners in multimedia learning environment (MLE) go through material in verbal (such as on-screen text or narration) as well as pictoral form (such as photos or illustrations, and dynamic materials such as video or animation). Therefore, Mayer's multimedia learning cognitive theory is the basis for the construction of conceptual framework of this study. Based on Mayer (2009), still image with words also called as multimedia. Usually, in instructional design method, the designers only give important to the usage of technology to deliver the multimedia. The design based on the perspective and learner's limitation is often ignored.

Apparently, there are three types of memory system involved in multimedia learning which are sensory memory, working memory and long term memory. According to the principle of limited capacity, in a certain period of time, limited information only can be processed in the working memory (Mayer, 2009). In order to overcome this problem, the use of two channels (information-processing) at once is capable to process the received information efficiently which result to a meaningful learning (Mayer, 2009).

Therefore, Mayer's cognitive theory divides information channels into two main components, which are verbal channel and visual channels (Mayer, 2009). In this manner, a multimedia user goes through three main cognitive processes. In the first cognitive process, audio and text selection process occurs with the use of working memory through verbal channel. At the same time, image or graphic selection process occurs with the use of working memory through visual channel. In the second cognitive process, the selected audio and text are translated into a verbal mental model while the selected image and graphic are translated into a visual mental model. Consequently, in

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the third cognitive process, both the verbal mental model and the visual mental model will be combined. With the assistance of existing knowledge, both combined models will be used for the formation of schemes that will be registered permanently in long term memory (Mayer, 2009). These cognitive processes are illustrated in Figure 1.3.

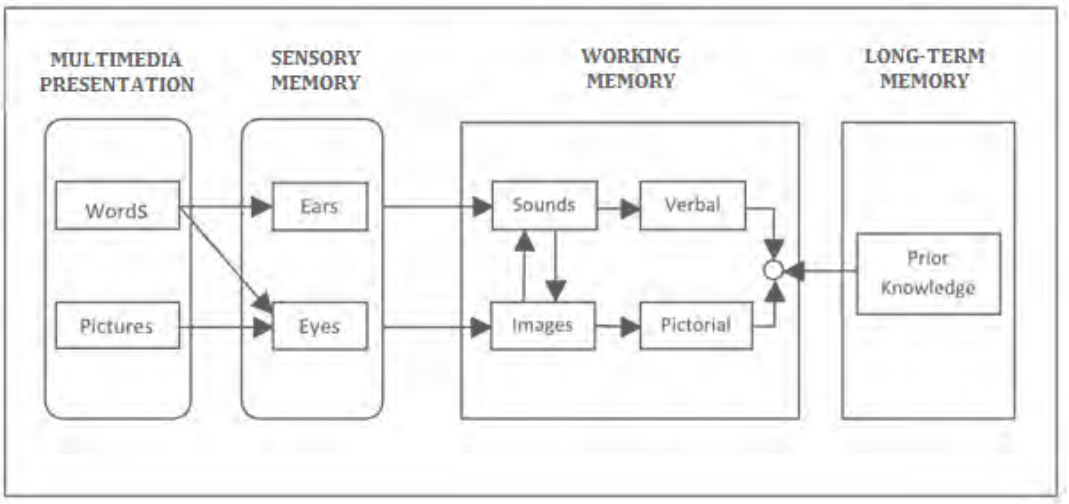


Figure 1.3. Mayer's Cognitive Theory of Multimedia Learning. Source: Mayer (2009)

An animated virtual agent is able to talk and hold a conversation with human users. The implementations of animated virtual agent in MLE, is capable to interface with user throughout the learning. From the point of Mayer's cognitive theory, the use of animated virtual agent in MLE could potentially involve the utilization of visual and verbal channels. This is due to the concept that an animated virtual agent is working on facial animation combined with audio-visual speech processing. Lip movements of animated virtual agent will be processed through the visual channel while the audio and text processed through verbal channels.

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However, the appropriate design of animated characters plays an important role for the effective multimedia learning through the use of both visual channel and verbal channel. This is because the realism factor of an animated character will affect the students' level of comfort and their emotion throughout the learning process, especially through the use of animated characters that are too realistic (MacDorman et al., 2009; Minato, Shimda, Ishuguro & Itakura, 2004; Tinwell et al., 2011). This effect may also have an impact on the success of the animated instruction that used for learning. Thus, it is important for the study to be conducted in order to see the effect on the learning by applying different realism design on animated virtual agent.

Appropriately, uncanny valley phenomenon highlighted about the effects exists from the usage of a realistic animation character. Based on the theory, the different level of a character's realism will affect the comfort and human emotions (MacDorman, 2006; Mori, 1970, 2012). This phenomenon illustrates through the uncanny valley graph as shown in Figure 1.4.

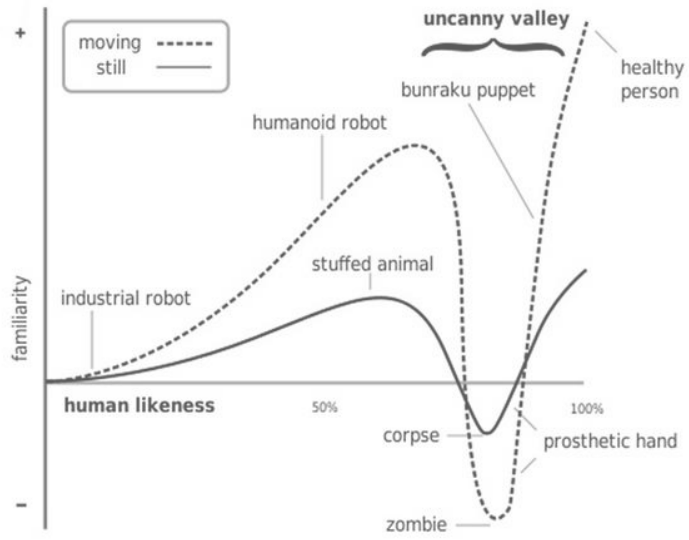


Figure 1.4. Mori's Graph of the Uncanny Valley. Source: Mori (2012)

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Based on the Figure 1.4, the uncanny valley phenomenon divides characters into two main categories, namely, dynamic characters and static character. The results shows that human emotions arise towards positive when the character is more like humans (human likeness). However, when both dynamic and static character are increasingly dire, human emotional level decreased to a negative to the extent of 80 to 85 percent. The decline in the level of human comfort in this graph is called uncanny valley. The level of human emotions rise back to positive when the characters are real people (MacDorman, 2006; Mori, 1970, 2012). As conclusion, the uncanny valley effect is higher to the dynamic character compared to the static character. Therefore it is important to build a graph to analyse the relationship between the levels of human emotions with realism animation instruction level, especially animated agent.

Many theories had contributed to the scientific clarification of emotion such as Darwin (2009), Pekrun, Goetz, Titz and Perry (2002a), Russell (1980), Ekman, Friesen and Ellsworth (1972), Izard (1971) and Schlosberg (1954). These theories and data made a major contribution to perspective on emotion. For the current study Russell's Circumplex Model of Affect (1980) was used to analyse students' emotion on the designed character.

Russell introduced Circumplex Model of Affect in 1980. According to Russell (1980), affective states occurs from the behaviour of two independent neurophysiological systems. The model represented the variations and similarities among the affective states as two orthogonal and bipolar dimensions. Valence on the horizontal axis ranges from negative to positive whereas arousal on the vertical axis ranges from low arousal to high arousal (Figure 1.5). Consequently, any affective states

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will fall in this two dimensions. For example, excitement and enthusiasm would be considered combinations of pleasure and high arousal, while boredom and depression would be a mixture of displeasure and low arousal (Kapoor, Czerwinski, MacLean & Zolotovitski, 2013). Consequently, the measurement of valence and arousal can determine the occurrence of uncanny valley on the virtual agents (Cheetham, Wu, Pauli & Jancke, 2015). In addition, circumplex models also have been used to test stimulus of emotion words, emotional facial expressions, and affective states (Rubin & Talarico, 2009).

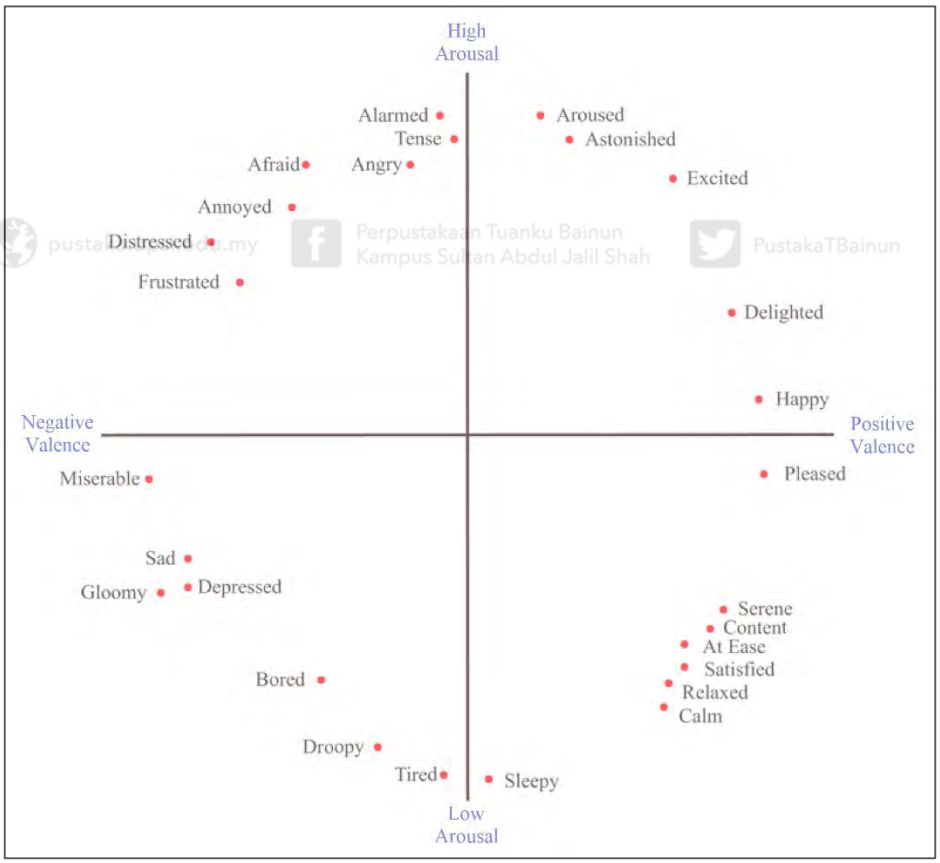


Figure 1.5. Russell's Circumplex Model of Affect (Russell, 1980). Source: Seo & Huh (2019)

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1.6 Research Objectives

In conclusion, this study looked at relation of the uncanny effects of different realism designs of animated virtual agents on students' emotions.

The self-assessment manikin (SAM) nonverbal pictographic questionnaire was used to measure students' individual emotions in the dimensions of valence and arousal on the different realism designs of the animated virtual agents. Whereas, the Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ) was used to measure students' emotions in learning.

Accordingly, the specific objectives of the study are as follows:

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a) To design four different realism designs of the 2D female virtual agents namely realistic, semi-realistic, stylized and cartoon-like agents.

b) To develop a Quiz based Multimedia Learning Environment (Q-MLE) with four different realism designs of the 2D female virtual agents.

c) To analyse the effect of different realism designs of the 2D female virtual agents on students' valence.

d) To analyse the effect of different realism designs of the 2D female virtual agents on students' arousal.

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e) To analyse the effect of Quiz based Multimedia Learning Environment (Q-MLE) with different realism designs of the 2D female virtual agents on students' emotions in learning.

f) To analyse whether valence and arousal caused by different realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning.

1.7 Research Questions

a) Is there any significant effect of different realism designs of the 2D female virtual agents on students' valence?

b) Is there any significant effect of different realism designs of the 2D female virtual agents on students' arousal?

c) Is there any significant effect of Quiz based Multimedia Learning Environment (Q-MLE) with different realism designs of the 2D female virtual agents on students' emotions in learning?

d) Are valence and arousal caused by different realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning?

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1.8 Hypotheses

H1. There will be significant effect of different realism designs of the 2D female virtual agents on students' valence.

H2. There will be significant effect of different realism designs of the 2D female virtual agents on students' arousal.

H3. There will be significant effect of Quiz based Multimedia Learning Environment (Q-MLE) with different realism designs of the 2D female virtual agents on students' emotions in learning.

H4. Valence and arousal caused by different realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning.

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1.9 Limitations

a) This research was focused on multimedia design and its effect on students' emotions. This research does not involve research in the field of any courses content involves.

b) This research involved participants from seven polytechnics out of 16 and students' age between 19 to 23.

c) This research was fully focused on realism designs of virtual agents and not on facial expression.

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d) Only female agents with native looks of Malaysia were used in the research. Clothing kept the same across agents so as to avoid confounding the results.

e) Human voice was used to the virtual agents in the research.

1.10 Operational definition

a) Arousal

Arousal describes through emotional experience that enrich with excitation or calm.

b) Cartoon-like agent

Animated characters that are iconic match a typical cartoon model (simplified geometry of the face).

c) Multimedia learning environment

A multimedia learning environment is an app or software program combination of text, audio, video, animation and graphic designed for educational purposes.

d) Realistic agent

Animated characters that are closely looks like human (designed very detailed and it mimics like human)

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e) Semi-realistic agent

Animated characters that are medium realistic (not as detailed as the realistic).

f) Stylized agent

Animated characters that are stylized (cartoon character with exaggerated features).

g) Uncanny valley

A character that is too realistic or almost resembles a human would eventually cause viewers to feel fearful and horrified when viewing these characters which is known as the uncanny valley phenomenon.

h) Valence

Valence is a fundamental component of emotional responding and it refers to the pleasant-to-unpleasant state.

i) Virtual agent

Virtual agents, are animated life-like characters generally used in virtual learning environments to facilitate learning tasks.

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1.11 Summary

Virtual agent is one of the pedagogical agent in human–computer interaction systems. Animated virtual agent acts as computer generated animated character, lifelike video character or only a man/woman on a site that can talk and hold conversation or telling story to the learners. Virtual agent has realism speech, interactive and the persuading emotions which could increase students' emotions and subsequently motivation. However, mistakes in selecting the virtual agent in the instruction animation development will have a negative impact on students. It is because, level of realism on agent may cause distress to the users, especially when the character mimics like human based on uncanny valley phenomenon. Therefore, this study focuses on the realism impacts of virtual agents on students' emotions in learning. Students' emotions on this Quiz based Multimedia Learning Environment (Q-MLE) measured using Self-Assessment Manikin (SAM) and Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ). For that, four prototypes of animated virtual agents with varies realism designs as the experimental group were developed. The findings of this research is guideline for the development of animated characters in order to give maximum impact to increase students' positive emotions towards learning.

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CHAPTER 2

LITERATURE REVIEW

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2.1 Introduction

Often, virtual agent used in different fields such as entertainment, film industry, finance, education, etc. The visual design of virtual agent varies enormously from one field to another field of its application. The appearance of virtual agent can be influenced by target audience preferences, cultural differences and even depending on the role it plays. In any analysis of characters' appearance, the visual design is the most essential element to consider first. When working on visual design, the choice of realism design might have a greater impact on the presentation of virtual agent, subsequently, on audience perception. Likewise, the early part of this chapter discussed briefly about the impact of virtual agent especially in educational setting in term of its different realism visual design. Thus, the understanding of fundamental of emotions is

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essential in order to develop good virtual agent that might affect the emotions of students in learning. In view of that, this study conducted based on references and previous studies. The literature of the study draws the emotions to the particular attention in the dimension of valence and arousal to investigate effect of realism based on the uncanny valley phenomenon. Accordingly, this chapter consider some important aspect in designing appropriate virtual agent such as arousal, valence and the overall emotions in learning especially in Quiz based Multimedia Learning Environment (Q-MLE). Taking this a step further, this chapter also aims to explain the proposed conceptual framework to analyze the effects of different realism designs of virtual agents on emotions based on specific emphasis on Mayer's multimedia learning cognitive theory, Mori's uncanny valley phenomenon and James Russell's Circumplex Model of Affect.

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2.2 Virtual Agent

2.2.1 Introduction

Interactive learning has been increasingly applied since 1990s through the usage of animated on-screen character which is known as virtual agent (Baylor, 2011). Animated virtual agent has the potential to inspire users (Hayes-Roth & Doyle, 1998; Laurel, 1997; Nagao & Takeuchi, 1994). This is due to the high degree of interactivity by the animated virtual agents with human beings (Cassell, 2000). The interaction occurs visually and verbally as virtual agents can represent a human role (Clark & Mayer, 2016). They can represent real people in the form of human characters by

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presenting instruction, giving feedback and directing attention (Dehn & Van Mulken, 2000; Heidig & Clarebout, 2011; Moreno, 2005).



Figure 2.1. Pedagogical Agents with Three Different Degrees of Realism. Source: Saidatul Maizura et al. (2010)

2.2.2 The Application of Virtual Agent

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The technology of using virtual agent widely utilized in different fields such as entertainment, film industry, education (Moreno et al., 2001; Rickel & Johnson, 1999; Saidatul Maizura et al., 2010; Tien & Kamisah, 2010) and finance (Cassell et al., 2000). In each different field, virtual agent appears with different contexts. For example, virtual agent plays role as character in video games, avatar in immersive worlds and lifelike pedagogical agent in multimedia learning environments (Schroeder & Gotch, 2015). There are various learning platforms created by using virtual agent.

One of the first pedagogical conversational agent (PCA) created by Lester et al. (1997b) for children is called as Herman the Bug (Pérez-Marin & Pascual-Nieto, 2013). Here, children learnt to create plant with the assistance of Herman which is an

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insect without human shape. Similarly, Steve (Soar Training Expert for Virtual Environments) was created as a social collaborator agent with human shape to interact face-to-face with students in a three-dimensional (3D) navy training virtual word (Rickel & Johnson, 1999). Besides that, Nunes et al. (2002) created Guilly to give awareness about urban garbage selection among children aged between eight to ten years (Pérez-Marin & Pascual-Nieto, 2013). Also, virtual agent designed for storytelling purpose for children which can be seen through the creation of Sam (Gulz, 2004; Pérez-Marin & Pascual-Nieto, 2013) as an agent by Ryokai et al. (2003). Anne and Pierre, created by Sabot et al. (2005) for the benefit of medicine students to diagnose X-rays (Pérez-Marin & Pascual-Nieto, 2013). Moreover, virtual agent also used in blended learning web system through the creation of Willow by Perez-Marin, Pascual-Nieto, Alfonseca, Anguiano and Rodriguez (2007). This system able to provide formative assessment to the students in Spanish or English conceptual domains. AutoTutor which is a 3D animated agent with mixed dialogue designed by Graesser et al. (2008) to review some lessons through the interaction with students' feeling. Furthermore, Leite et al. (2011) created a Social Robot which has some empathic capabilities to improve its relationship with children by playing chess with them (Pérez-Marin & Pascual-Nieto, 2013).

In addition, past studies show that there are variety of courses using virtual agents such as environmental science (Moreno & Mayer, 2000), art (Hayes-Roth, Maldonado & Moraes, 2002), mathematics (Atkinson, 2002; Kim, Flann, Wei & Ko, 2006), ecosystems (Biswas et al., 2004), language (Maldonado et al., 2005; Prendinger, Saeyor & Ishizuka, 2001), ecology (Clarebout & Elen, 2007) and space (Kizilkaya &

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Askar, 2008). In Malaysia, virtual agents have been applied in Islamic religious education (Tien & Kamisah, 2010) and pronunciation learning as well (Kogilathah, et al., 2013; Mohd Najib, 2015).

2.2.3 The Virtual Agent in Education Environment

The key function of virtual agent has expanded to aid learning process in the field of education (Chou, Chan & Lin, 2003; Craig et al., 2002; Johnson et al., 2000; Mohammadhasani et al., 2018; Moundridou & Virvou, 2002; Prendinger et al., 2001; Saidatul Maizura et al., 2010). This is through the motivational role of virtual agent to increase motivation among the learners in order to produce meaningful learning (Kim & Baylor, 2006; Kim & Wei, 2011; Kramer & Bente, 2010; Lusk & Atkinson, 2007; Mohanty, 2016). Such roles include tutors, coaches and actors (Payr, 2003), expert, motivator and mentor (Baylor & Kim, 2005a), learning companions (Kim, Baylor & Shen, 2007), change agents (Kim & Baylor, 2008) and lifelong learning partners (Chou, Chan, & Lin, 2003).

With such roles, virtual agent communicates and collaborates with learners in the facilitation of course contents (Atkinson, 2002; Baylor & Kim, 2004; Clark & Mayer, 2016; Craig et al., 2002; Moreno et al., 2001; Wang, Chignell & Ishizuka, 2005). This strategy helps to stimulate learners' interest and keep them focused on the provided content (Clark & Choi, 2005). When they engage in learning tasks, a good social interaction will be created and maintained between virtual agent and learners (Berry, Butler & Rosis, 2005).

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The frequent social interaction between virtual agent and learners lead to address variety of learners' sociocultural needs and provide cognitive support to the learner (Baylor, 1999). Moreover, interactive interfaces such as virtual agent mediates to distribute cognitive tasks to learners in an interactive learning environment (Ciechanowski et al., 2019). This is in accordance with the capability of virtual agent in supporting both cognitive processing and metacognitive skills (Clarebout & Elen, 2007) through flexibility, support and scaffolder guidance (Biswas et al., 2004; Hawryskiewycz, 2006; Lin, Chen, Wu & Yeh, 2008). Consequently, learners enrich with lots of learning experience (Gulz, 2005). Along with this, better cognitive level capable to increase students' performance in the learning process (Clark, 2017).

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2.2.4 The Previous Research on Virtual Agent for Learning

Virtual agents have been researched for nearly two decades. However, the effectiveness of using a virtual agent in a learning environment still remains debatable. In point of fact, the presence of a virtual agent in an interactive learning environment can promote learning process and generate positive perception of the learning experience (Lester et al., 1997a; Mitrovic & Suraweera, 2000; Ryu & Baylor, 2005). Although there is a positive impact on learning, the potential of virtual agents in facilitating the learning process is too broad.

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The existing studies on virtual agent are often criticized as it is designed without control conditions to achieve unique pedagogical or motivation benefits (Clark & Choi, 2005; Heidig & Clarebout, 2011). Therefore, the current study focused on establishing the suitable design for a virtual agent in an educational setting in order to promote positive emotions in learning.

2.2.5 The Importance of Emotions in the Design of Virtual Agent

The appropriate design is very important for the development of virtual agent because it determines how far it has been reached to the learners. Some studies show that, learners influenced to virtual agents until accept the agents as conversational partners throughout the learning process (Graesser & McNamara, 2010). On the other hand, there are also some studies that indicate some designs of virtual agent could lead to frustration and disappointment among the learners (De Angeli & Brahnam, 2008). Undoubtedly, this is due to the characteristics of virtual agent that are not able to influence the emotions of learners although it can enhance learning (Lester et al.1997a, b). Initially, human attitudes always change during the interaction with artificial beings (Fussell, Kiesler, Setlock & Yew, 2008). This is due to the different human emotional responses caused by uncanny valley phenomenon (Mori, 2012, 1970) where it will be discussed later in this chapter.

Usually, social models play a very important role in stimulating positive impressions on attitudes, motivations and behaviors (Bandura, 1986; Gulz, Haake, Silvervarg, Sjödén, & Veletsianos, 2011; Schunk, 1981). These positive impressions

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result in high processing fluency (Kuchinke, Trapp, Jacobs & Leder, 2009; Reber, Schwarz & Winkielman, 2004; Reber, Winkielman & Schwarz, 1998). Correspondingly, virtual agent can serve as a social model to induce positive impressions among learners by influencing their attitudes, motivations and behaviors (Baylor, 2009; Baylor, Rosenberg-Kima & Plant, 2006; Gulz & Haake, 2010; Kim, Wei, Xu, Ko & Ilieva, 2007). Learners are likely to accept virtual agents' design that enhance their own positive emotions (Coates, 2003; Norman, 2007). Hence, it is a clever idea to provide a more refined approach to virtual agents' visual and aesthetic representations that can stimulate learners' emotions to generate positive impressions on virtual agent (Gulz & Haake, 2006b).

2.3 Uncanny Valley

2.3.1 The Theory of Uncanny Valley

In particular, emotional variation in humans depends on a realistic human representation by a virtual agent (Bailenson & Yee, 2005; Blascovich et al., 2002). In 1970, there is a theory about psychological effects of lifelike robotics published by roboticist Masahiro Mori which is called as uncanny valley. This theory was designed to investigate aesthetics on robots. However, it is commonly assumed that uncanny valley exists in computer-animated characters which are artificial characters as well (Kätsyri, Mäkäräinen & Takala, 2017; MacDorman et al., 2009; Mohd Najib, 2015; Schneider et al., 2007; Schwind, Leicht, Jäger, Wolf & Henze, 2018b; Seyama & Nagayama, 2007; Tinwell, Grimshaw & Williams, 2010). Based on uncanny valley

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phenomenon, physical presence is important medium to investigate level of realism (MacDorman et al., 2009; Seyama & Nagayama, 2007). As the degree of realism increases, the level of pleasantness increases too except for the uncanny valley phenomenon (Seyama & Nagayama, 2007). Previous studies have shown that a character that is too realistic or almost resembles a human would eventually cause viewers to feel fearful and horrified when viewing such characters (Burleigh, et al., 2013; Butler & Joschko, 2009; Mohd Najib, 2015; Olivera-La Rosa, 2018; Schwind, et al., 2018a; Tinwell, 2015).

Towards the likability of human, the appearance of a robot gradually increased up to a certain level of similarity (Mori, 2012, 1970). However, beyond a maximum possible degree of similarity (between 80% and 85% human-likeness), the appearance of a robot seen as eerie or disgusting. This is the point called as uncanny valley at which the realism will drop. Figure 2.2 shows a visualization of Mori's theory that displays steady increment of familiarity as perceived human-likeness increases. In certain point, it decreases sharply which caused a valley-shaped dip. This is referred as the uncanny valley phenomenon with reference to the precipitous fall in likability (Mori, 1970, 2012).

The uncanny valley phenomenon happens when people experience fear, anxiety, shock and disgust (Ho, MacDorman & Pramono, 2008). These kind of unpleasant psychological effects occur due to the peoples' difficulty in accepting a strange appearance (Sjödahl, Gard & Jarnlo, 2004). In addition, a mismatch in the visual elements of a virtual agent can produce the feeling of eeriness (Mitchell et al., 2011). It shows that a very high level of human-likeness in a virtual agent can produce negative

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feelings instead of attraction (Bartneck, Kanda, Ishiguro & Hagita, 2007; Chaminade, Hodgin & Kawato, 2007; MacDorman et al., 2009; Pollick, 2010). If a virtual agent does not exhibit socially acceptable behavior, then people may reject it. Obviously, this phenomenon can be seen in characters such as Shark Tale and Howdy Doody that appear as human but less attractive and fall in the dip in correlation as described by Mori (Schneider et al., 2007). However, positive relationship between human likeness and familiarity allows the design of virtual agent free from the effect of uncanny valley (Ciechanowski et al., 2019). As a conclusion, the acceptance of a virtual agent dependent on its pleasant appearance (Millstein, Heger & Hunter, 1986).

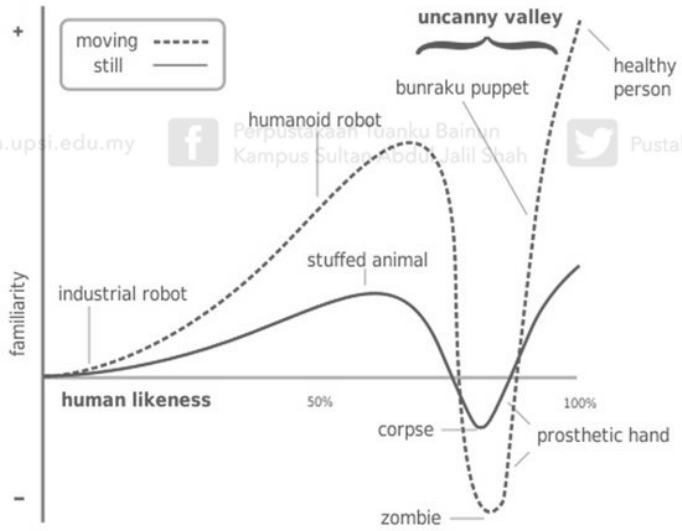


Figure 2.2. Mori's Graph of the Uncanny Valley. Source: Mori (2012)

2.3.2 Previous Researches on Uncanny Valley

There are few studies that tested uncanny valley across different researchers. For example, a continuum of morphed facial pictures from a doll to a person (Hanson, 2005); real androids in the lab (MacDorman et al., 2005); computer-generated avatars

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of incremental photorealism (MacDorman et al., 2009), pictures of existing humanlike robots of various forms (Ho & MacDorman, 2010) and experimental paradigms such as subjective ratings, MRI (Saygin, Chaminade, Ishiguro, Driver & Frith, 2012) and preferential looking (Steckenfinger & Ghazanfar, 2009).

Besides that, previous studies on virtual agents covered several aspects such as physical appearance of their faces (Hanson, 2005; MacDorman et al., 2009; Seyama & Nagayama, 2007), emotional expressions (Tinwell et al., 2011), body movements (Chaminade et al, 2007; Groom, Nass, Chen, Nielsen, Scarborough & Robles, 2009; Mitchell et al., 2011; Piwek, McKay & Pollick, 2014; Saygin et al., 2012; Thompson, Trafton & McKnight, 2011) and a combination of several factors that contribute to realism (Tinwell et al., 2010).

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In addition, the fall of robots' appearance into uncanny valley has been seen through realistic characters and animation based on the motion capture of live actors in films like Mars Needs Moms (Zemeckis, et al., 2011), A Christmas Carol (Starkey, Zemeckis, Rapke & Zemeckis, 2009) and The Polar Express (Starkey, Zemeckis, Goetzman, Teitler & Zemeckis, 2004), (Butler & Joschko, 2009; Freedman, 2012; Hale, 2011; Hodgins, Jörg, O'Sullivan, Park & Mahler, 2010; MacDorman, Srinivas & Patel, 2013; Melina, 2011). High realism in Polar Express (Starkey et al., 2004) has been criticized as "unnerving" (Hanel, 2008), "creepily unlifelike" (Keegan, 2009) and as having a "bizarre wax-museum quality" (Burleigh, 2011; Levy, 2004). It also reported in horror movie titled The Hills Have Eyes (Craven, Maddalena, Locke, Aja, 2006), wax figures in movie titled House of Wax (Silver, Zemeckis, Levin & Collet-Serra, 2005), sculptures (Brenton, Gillies, Ballin & Chatting, 2005), mannequins, dolls and

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3D animation characters (Kaba, 2013). Likewise, in the film Alita: Battle Angel, the character was highly criticized for the creepy look (Kummer, 2019; Schwind, et al., 2018a; Wizard, 2019).

Also, there is a study carried by Goetz et al. (2003) to investigate human reactions on robots' appearance, behavior and task domain. Goetz et al. (2003) underlined that the degree of human-likeness of an agent varies according to its role as the appearance matched with the type of task being performed.

2.3.3 The Gap in Uncanny Valley's Research

While studies on virtual agents have great progress, there are many areas of inquiry that have yet to be explored including uncanny valley phenomenon. Although, there are many studies focused on investigating the existence of uncanny valley, a strong experimental evidence that concerning on the observation of emotional effects cause by uncanny valley in the use of virtual agent for educational setting is very lack. The uncanny valley effects on virtual agent may cause emotions such as fear, disgust or the feeling of unease. In order to clarify these emotional effects, the fundamental issues occurred in the design of virtual agent need to be addressed. Based on the previous studies, the evidence on the existence of uncanny valley in the realism design of virtual agent remained inconsistent (Cheetham et al., 2015; MacDorman et al., 2013; Tinwell & Grimshaw, 2009).

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Therefore, it is necessary to analyze physical presence of virtual agents to understand how the uncanny valley affects the learners (Kiesler, Powers, Fussell & Torrey, 2008). Due to limited research about aesthetics on virtual agents in interactive learning environment, this research addresses the gap by analyze virtual agent that varied in appearance with four different realism designs. This research aims to examine what level of realism influences learners' emotions through their aesthetic attraction towards virtual agents' design. Therefore, the designs of virtual agents served as independent variables in identifying the relationship between appearance and students' emotions. In addition, a mismatch in virtual agents' visual elements, such as pairing skin texture with a typical face height, eye separation and eye size could attribute to eeriness (MacDorman et al., 2009; Seyama & Nagayama, 2007). Hence, these mismatched features are the factor for the occurrence of uncanny valley as well (Langlois & Roggman, 1990; MacDorman et al., 2009; Rhodes et al., 2001). In view of that, the different realism designs of virtual agents developed by ensuring that all visual elements are properly matched.

2.3.4 The Realism Design in Current Technology

Nowadays, most of the existing virtual agents appear to resemble real human appearance. In fact, individuals feel excited and happy to see close and highly familiar people that induced to produce positive valence along with high arousal among them (Vogel, Ram, Conroy, Pincus & Gerstorf, 2017). For instance, in video games, designers always ensured that the designed characters are more realistic as they enable viewers to appreciate and engage fully in the game (Doerr, 2007; Hoggins, 2010;

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Ravaja, Turpeinen, Saari, Puttonen & Keltikangas-Järvinen, 2008). On the other side of the coin, viewers have shared their strange experiences as the responses towards the realistic characters that displayed in the animation and video games (see e.g. Brenton et al., 2005; Doerr, 2007; Geller, 2008; Green, MacDorman, Ho & Vasudevan, 2008; Ho & MacDorman, 2010; Hoggins, 2010; MacDorman et al., 2009; Rose, 2011; Tinwell et al., 2011; Tinwell, Nabi & Charlton, 2013).

2.3.5 The Realism Design in the Current Study

Clearly, a well- chosen virtual agent with appropriate realism design may affect the positive attitude of learners to be more likely to grasp the content of course (Baylor et al., 2006; Gulz & Haake, 2010; Kim et al., 2007; Plant, Baylor, Doerr & Rosenberg-Kima, 2009). Previously, Gulz and Haake (2005) studied about students' preferences on the realism of pedagogical agent. The research results discovered that most of the students chose cartoon, followed by moderately realistic and highly realistic agent.

Generally, Mori's robotics design theory which is known as uncanny valley is used as common reference in order to design a virtual agent (Schneider et al., 2007). Accordingly, this research analyzed uncanny valley theory to describe how emotional reactions vary with perceived virtual agents. Basically, human realism can be defined across several domains: static, dynamic appearance and "contextual responsiveness" (contingent interaction) (Hanson et al., 2005). However, for the experimental control purpose, realism examined by placing virtual agent on four different realism scales which varies from cartoon-like to realistic; cartoon-like, stylized, semi-realistic and

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realistic. Specifically, the categorization of faces designed based on multiple perceptual cues such as skin texture, skin color and size of eyes. With the four different realism designs of virtual agents, the existence of uncanny valley and the emotional effect in the learning process could be investigated.

2.3.6 Two-Dimensional and Three-Dimensional Designs of the Virtual Agents

In between that, it is significant to consider about the selection of two-dimensional (2D) or three-dimensional (3D) for virtual agents' design. Commonly, 3D animated virtual agent resembles actual human with high realism level when compared to 2D animated virtual agent (Mohd Najib, 2015; Walker, 2009). For instance, viewers felt uncanniness in realistic characters in 3D movie such like The Polar Express (Starkey et al. 2004) (see figure 2.3) compared to 2D movie such like A Scanner Darkly (Pallotta, Walker-McBay, West, Smith & Linklater, 2006) (see figure 2.4). Even the both movies uses realistic characters but viewers felt horrified with characters in The Polar Express (Walker, 2009). It is because towards the actual look of human, the facial structure of 3D animated virtual agent produced discomfort, uneasiness and anxiety feelings on learners. Consequently, human emotions towards 3D animated virtual agent will be more effected as discussed in uncanny valley phenomenon (Mohd Najib, 2015; Walker, 2009). In order to prevent this, 2D filters used in this research to provide realistic, semi-realistic, cartoon-like and stylized virtual agents. 2D animated virtual agents capable to produce high level of comfortability and positive emotions among the learners (Walker, 2009).

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Figure 2.3. The Polar Express. Source: Castle Rock Entertainment (2004)



Figure 2.4. A Scanner Darkly. Source: Thousand Words (2006)

2.3.7 Four Types of Realism Designs That Investigated in This Research

Realistic virtual agent represents high level of human resemblance (Sansoni, Wodehouse, McFadyen & Buis, 2015). Higher level of realism on virtual agent usually involving greater texture detail (Cheetham, Suter & Jancke, 2014; MacDorman et al.,

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2009). Virtual agent with a more naturalistic visual appearance can lead the learners to believe that the agent resembles human beings (Dehn & Van Mulken, 2000). Also, a realistic agent seems to be attractive and believable to learners (James et al., 2015). This is due to the ability of virtual agent to emulate human behavior through realistic simulations (Sklar & Richards, 2010; Veletsianos & Russell, 2014). When the design of virtual agent is highly realistic, the overall emotional connection also highly increased (Gulz, 2005; Woo, 2009). Additionally, the more human-likeness in a virtual agent, the higher the arousal level (Cheetham et al., 2015). This arousal experiences attract and motivate learners to engage in learning activities (Elliot & Devine, 1994; Van Veen, Krug, Schooler & Carter, 2009). However, the perceived likeability towards a realistic virtual agent depends on its' design (Rosenthal-Von Der Pütten & Krämer, 2014). Hence, a realistic virtual agent that looks like real human has been developed for this research.

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However, human characteristics in more realistic virtual agent are disproportionately unsettling compared to less realistic virtual agents (MacDorman et al., 2009; Mitchell et al., 2011; Mori, 1970, 2012; Seyama & Nagayama, 2007). Along with this line, typical faces with average features are considered more attractive than atypical face (Kätsyri, Förger, Mäkäräinen & Takala, 2015). Therefore, another semi-realistic virtual agent created by adding less human-like attributes. This semi-realistic virtual agent represents medium level of human-likeness by resembling the anatomical shape of human limbs (Sansoni et al., 2015).

Generally, cartoon-like agent represents a typical cartoon model (Baylor, 2005b; Gulz & Haake, 2006; Saidatul Maizura et al., 2010). The design of cartoon-like

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agent is very simple compared to realistic agent. An unrealistic character easily accepted by user as it represents consistently unrealistic as seen in cartoon-like character (Schwind, et al., 2018a). Moreover, people are more likely to accept a character that represented in less detail such as cartoon-like graphics (Dowling, 2000; Masterton, 1998). These can be seen in games where the use of simple abstract style virtual agent allow the players fill their self-image into it easily and generates more effects in their experience (Jin, Gromala & Tong, 2016). In addition, children are greatly influenced to cartoon agent where they are easily attracted to the cartoon content that allows them to watch cartoons for long hours (Habib & Soliman, 2015). However, the abstract features of cartoon-like agent made it look different than real human even though it resembles human appearance (Schneider et al., 2007). In addition, the unreal face of cartoon-like agent less attractive compared to real face of human (Wang & Rochat, 2017). Study carried out by Kätsyri et al. (2017) stated that the highest strangeness in the cartoonish character makes it less likeable by the audience. Also, an abstract appearance of virtual agent can exhibit uncanny effect in a similar way that may occur with cosmetically atypical humans (Hanson, 2006). Taking this into consideration, cartoon-like agent also included for this research.

Moreover, character that created by modifying human face could be used to induce uncanny valley phenomenon (Seyama & Nagayama, 2007). Still, if virtual agent's appearance and associated behaviors consistent without reach to the extent of uncanny valley, the design is effective and acceptable (MacDorman, 2005; Woods, Dautenhahn & Schulz, 2004). In particular, stylish look of a virtual agent can be designed by modifying its appeal or expressivity, especially by exaggerating or softening specific features (Zell et al., 2015). In view of that, stylized virtual agent

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created for this research by transforming the agent with new mixture of elements such as exaggeration and personification in order to bring life to the virtual agent. Generally, stylized agent perceived as an appealing design (Adamo-Villani, Lestina & Anasingaraju, 2016). Moreover, Schneider et al. (2007) found that stylization on a character in Japanese video games increases the perceived attractiveness.

In addition, stylized design often preferred compared to realistic design (Geller, 2008), but the reason for this still unclear. In order to investigate it, stylized virtual agent developed by changing its render style and facial geometry with bigger eyes (Ruhland et al., 2015;. A character that rendered in an appealing style can be perceived to have more positive personality traits (Zibrek & McDonnell, 2014) as it provides element of liveliness and also looks visually aesthetic. However, some combinations of visual elements for the design of stylized virtual agent might result in negative effect. Moreover, modification to the appearance of human-like virtual agent can cause less attractiveness as well (Wang & Rochat, 2017). This is in conjunction with the look of human-like virtual agent that viewed as creepy as they look like human yet contained features such as exaggerated eyes which is not ‘entirely right’ (Kätsyri et al., 2015).

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Figure 2.5. Female Realistic and Stylized Cartoon Agent. Source: Ruhland et al. (2015)

2.3.8 The Age of Virtual Agent

Besides that, there are various approaches need to be considered in the design of virtual agent for computer-based instructional module. Accordingly, the suitable age selection for virtual agent is very important. Young virtual agent capable to promote better learning outcomes (Johnson et al., 2013). In addition, students preferred a young agent over an old agent for their learning interactions (Baylor et al., 2006; Ozogul, Johnson, Atkinson & Reisslein, 2013).

2.3.9 The Gender of Virtual Agent

Furthermore, the gender selection for virtual agent ultimately impacts learning process. In a computer environment, students assume that the information received from a male agent is more reliable than a female agent (Arroyo, Woolf, Royer & Tai, 2009; Moreno, Klettke, Nibbaragandla, & Graesser, 2002), in a later study (Arroyo et al., 2011) favored

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the female agent for a mixed population to enhance student motivation. Besides, Johnson et al. (2013) found that precollege students with low prior knowledge benefit from the signaling by a young female animated pedagogical agent (APA) in instruction with multiple visual representations. According to Baylor (2011), the impact of the animated pedagogical agent on female students' motivation can be maximized by presenting the agent as female, young, attractive and cool. Moreover, the study by Plant et al. (2009) suggests that such a design ''may benefit both genders equally'' (p. 214).

Apart from that, the study conducted by Shiban et al. (2015) found that female agent increases students' interest in the subject compared to male agent. Based on the study, higher program ratings recorded by female students as they fond to female virtual agent that matched to their gender. Also, male students attracted to female virtual agent that opposite gender with them which caused to report higher program ratings than female students (Ozogul, et al., 2013). In the other way around, viewers tend to face uncanniness in male human-like character (Tinwell et al., 2011).

Other than that, element of virtual agent should reflect the cultural value of the country in which it originated and tested (Minghua & Ping, 2010; Sloan, 2015). For that reason, female virtual agent with native look of Malaysia selected for the investigation purpose of this research. Thus, the look of the female virtual agent localizes Malaysian Malay young lady as a subjective approach to cultural acceptance. Figure 2.6 shows different ethnics of virtual agents in the study conducted by Baylor and Kim (2004).

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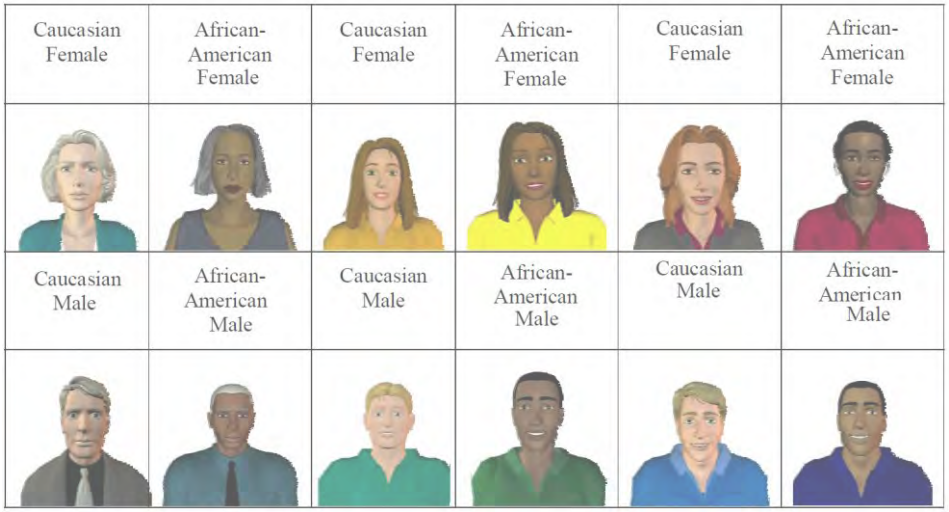


Figure 2.6. Different ethnics of Virtual Agents. Source: Baylor & Kim (2004)

2.4 Learning and Emotions

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2.4.1 Emotions

The definition about emotions by Wenger, Jones & Jones (1962) still recognized as a basic reality description about emotions.

Emotion is a peculiar word. Almost everybody thinks he understands what it means, until he attempts to define it. Then practically no one claims to understand it. Scientists who investigate it disagree. Philosophers, novelists and others who write about it disagree. (p. 3)

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Basically, there are two types of human emotions; primary or also known as basic and secondary. The basic emotions are generated through stimulation such as feeling of fear that evoked in sudden noise. At the same time, secondary emotions arise as a result of individual developments that exist when the basic emotions is connected to a particular situation or a particular object (Damasio, 2008; Feidakis, Daradoumis, Caballé & Conesa, 2012). Example of secondary emotions are embarrassment, jealousy, guilt, pride and so on.

In general, basic emotions also called as discrete emotions (e.g., Ekman, 1993; Izard, 1994, 2007; Panksepp, 2007; Plutchik, 2001; Scherer, 2005). Basic emotions categorized based on primitive instincts of survival (O'Regan, 2003). This can be seen through Plutchik's circumplex model. Plutchik's circumplex model is a well-known structural model that was developed in 1958 to describe the relation between basic emotions (Plutchik, 2001) as shown in Figure 2.7. Specifically, in this model, eight basic emotions categorized into four pair of opposites; joy-sadness, trust-distrust, fear-anger, surprise-anticipation and eight advanced emotions with each composed of two basic emotions (Feidakis et al., 2012; Feidakis & Daradoumis, 2013; Feidakis, Daradoumis & Caballé, 2011; Shuman & Scherer, 2014).

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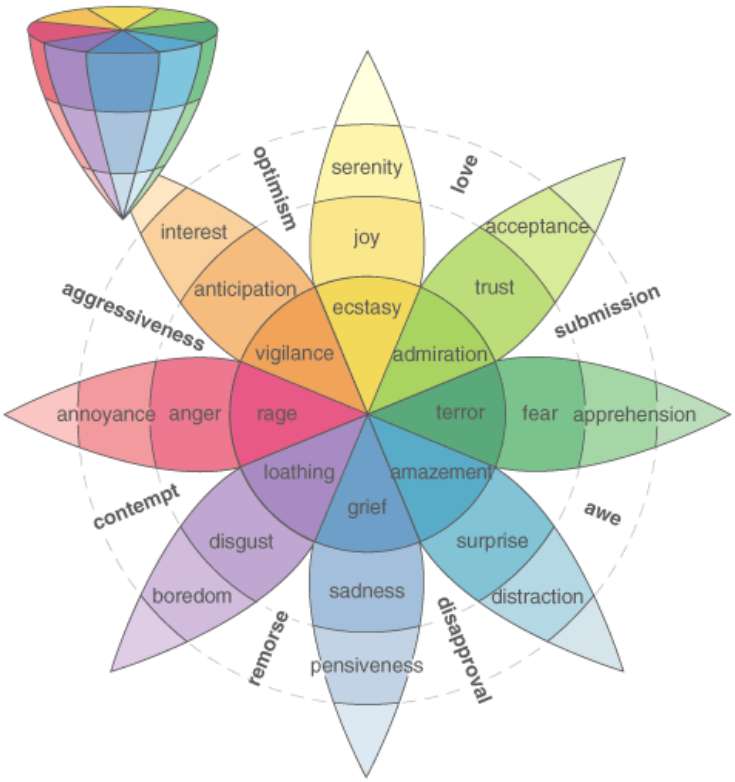


Figure 2.7. Plutchik's Circumplex Model. Source: Plutchik (2001)

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2.4.2 Learning and Emotions

Since 1970s, there has been a dramatic increase in attention to emotions in many scientific disciplines, including economics, neurosciences, anthropology and humanities. However, strong focus on emotions in education still in basic stage (Pekrun & Linnenbrink-Garcia, 2014).

Emotions are very important contribution towards learning. Usually, students experience various emotions throughout the learning process (Scholae, 2013). Emotions play a very important role in creating strong connection between learners and virtual agent during learning process (Roxas, Richards, Bilgin & Hanna, 2018). The

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close relationship between learning and emotions has been emphasized by Greek philosophers like Aristotle, influential psychologists like Wilhelm Wundt and innovative educators like Maria Montessori (Hascher, 2010). The phases of emotions towards learning described using learning cycle model which consists of four quadrant model (Kort & Reilly, 2002) as shown at Figure 2.8. Based on this learning cycle model, there are six possible emotions axes that may arise in the process of learning such as anxiety-confidence, ennui-fascination, frustration-euphoria, dispirited-enthusiasm, terror- excitement and humiliated-proud.

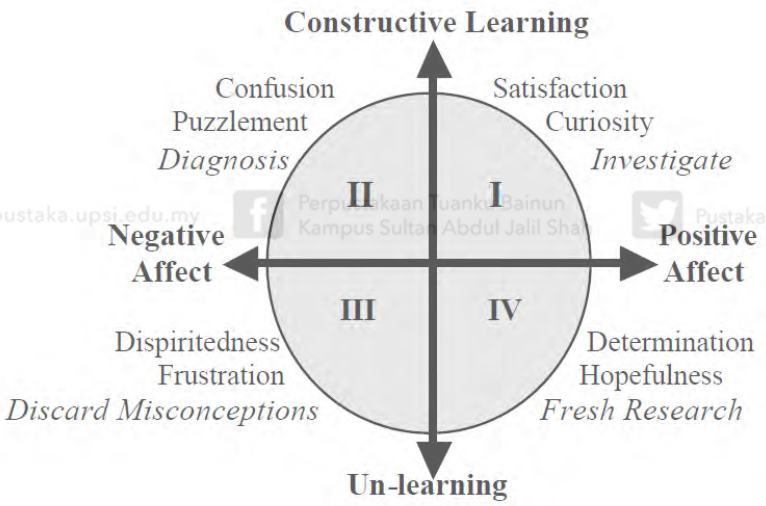


Figure 2.8. Learning Cycle Model. Source: Kort & Reilly (2002)

Generally, emotions in educational setting related to the contents of learning and teaching. From a pedagogical point of view, it becomes a critical goal for learners not only to learn the content but also to recognize and use their affective experience on the content of learning and the circumstances of learning. Learners' affective experience interconnected with motivation and cognitive learning processes (Chen & Sun, 2012). An individual's emotions influences the cognition success in the learning

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process (Ahmad Zamzuri & Mohd Najib, 2016; Pekrun, et al., 2011). Recent studies have demonstrated that emotional experiences during learning influence motivation to learn and learning achievement (e.g., test scores) (Chung, Cheon & Lee, 2015; Fassbender, Richards, Bilgin, Thompson & Heiden, 2012; Goetz, Frenzel, Pekrun, Hall & Lüdtke, 2007; Pekrun 2006; Pekrun et al., 2002a; Pekrun, Elliot & Maier, 2009; Robinson, 2013; Trautwein, Niggli, Schnyder & Lüdtke, 2009).

Moreover, emotional experiences also impact learners' interest, engagement and personality development towards achievement in learning (Cleveland-Innes & Campbell, 2012; Hascher, 2010; Linnenbrink-Garcia & Pekrun, 2011; Pekrun, 2005; Scholae, 2013). Adding to this, the increment of self-efficacy beliefs through emotional experiences encourage students to attach to difficult tasks and previous failures (Hascher, 2010; Trope & Neter, 1994). Subsequently, positive emotions facilitates learning and thereby promotes effective teaching and learning (Scholae, 2013).

Therefore, the understanding of the nature of emotions in the context of learning is very important because human responses with appropriate emotions throughout the process of learning help in achieving its goals (Barbalet, 2002; Cleveland-Innes & Campbell, 2012).

Commonly, emotions exist comprehensively in the human experience (Cleveland-Innes & Campbell, 2012; LeDoux, 1996; Plutchik, 2003; Stets & Turner, 2014; Wosnitza & Volet, 2005). In particular, specific feelings that experienced by learners in academic settings known as academic emotions (Ganotice, Datu & King, 2016; Schutz & Pekrun, 2007). Learners experience a variety of emotions before,

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during and after activities through various psychological (motivational, affective, cognitive) and physiological processes in academic settings that influence their perceptions and behavior (King & Areepattamannil, 2014; Lazarus, 1991; Scherer, 2000). Apart from that, the academic emotions are also significantly related to self-regulation, academic self-concept and academic achievement (Pekrun et al., 2002a; Valiente, Swanson & Eisenberg, 2012). Therefore, emotions cannot be separate from the learning environment (Brookfield, 2015; Cleveland-Innes & Campbell, 2012; Lehman, 2006; Lipman, 2003).

Generally, the academic emotions in education settings can categorized into positive emotions and negative emotions (Ganotice et al., 2016; Scholae, 2013). In short to illustrate it, a table consist of academic emotions was proposed by Pekrun and his colleagues (Pekrun, 1992; Pekrun, et al., 2002b; Pekrun et al., 2011) in order to specify emotions within instructional context, covering emotions that are directly tied to learners' learning, classroom instruction and achievement (Feidakis et al., 2011). They proposed that academic emotions can be classified into positive activating emotions (enjoyment hope, pride); positive deactivating emotions (relief); negative activating emotions (anger, anxiety, shame) and negative deactivating emotions (hopelessness, boredom) (Ganotice et al., 2016).

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Table 2.1

Academic Emotions (Pekrun et al. (2011))

Activation	**Valence**	
	Positive	Negative
Activating	Enjoyment	Anxiety
	Pride	Anger
	Hope	Shame/fault Relief
Deactivating	Relief	Boredom
		Hopelessness

According to the Table 2.1 of academic emotions, positive emotions (enjoyment, hope and pride) are expected to have a positive influence in boosting students' motivation and enjoyment in class that lead to improve their achievement in learning (Ganotice et al., 2016; Pekrun et al., 2002a; Pekrun, Goetz, Perry, Kramer, Hochstadt & Molfenter, 2004). This is due to the capability of educational enjoyment that motivates students to pay more attention and concentration during the learning process (Fredrickson, 2001, 2004) and Buff, Reusser, Rakoczy and Pauli (2011). In the other way around, negative emotions (anger, anxiety, shame, hopelessness and boredom) found to be associated with avoidance motivation that lower students' interest towards a particular task and impede their academic achievement (Daniels et al., 2009; Ganotice et al., 2016).

Even though there is an obvious connection between learning and emotions, still very little is known about it. For decades, learning was mainly analyzed in terms of cognitive or motivational aspects. Whereas, emotions have been neglected by educational research until the 1990s (Cleveland-Innes & Campbell, 2012; Dirkx, 2008; Hascher, 2010; Pekrun et al., 2002a; Pekrun & Frese, 1992; Schutz & Lanehart, 2002;

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Värlander, 2008;). Recently, there are no proven strategies to address the presence of emotions in learning, specifically to prove that positive emotions raise learning while negative emotions are detrimental for learning.

New research regarding the impact of emotions and its relationship with learning should be examined further (Cleveland-Innes & Campbell, 2012; Damasio, 2003; Dirkx, 1997, 2008; Eich, Kihlstrom, Bower, Forgas & Niedenthal, 2000; LeDoux, 1996). Therefore, the evaluation of emotions in learning should focus on at least two distinct groups such as individual emotions (emotions evoked by different realism designs of virtual agents) and overall emotions (overall emotions in learning). Interestingly, the findings on different affective state help to clarify which factors contribute to positive emotions to flow or negative emotions into frustration.

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2.5 Arousal and Valence

2.5.1 The Importance of Arousal and Valence in the Measurements of Emotions

As mentioned earlier, emotions play an important role in human life. A stimulation on emotions can influence a person's behavior directly (Winkielman, Berridge, & Wilbarger, 2005). One’s emotions recognized through its received stimulus which is called as affective experience. Affective experience is related to psychophysiological indices that differentiated by valence and arousal (Bradley & Vrana, 1993; Cacioppo, Petty, Losch & Kim 1986; Foti & Hajcak, 2009; Lang et al., 1997b; Lang, Greenwald, Bradley & Hamm, 1993; Schupp et al., 2000). Therefore,

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arousal and valence are two primary properties to examine affective experience of human. The both arousal and valence of affective experience help to define various emotional states (Barrett, 1996) as the notion of the uncanny effect. Valence refers to pleasant-to-unpleasant state while arousal refers to low-to-high state of excitement (Barrett & Russell, 1999; Kensinger & Corkin, 2004).

The physiological responses for different type of emotions reliably linked to variations in arousal and valence (Barrett, 2006). Negative emotions such as disgust, sadness and fear result in different valence and arousal ratings (Bradley, Codispoti, Cuthbert & Lang, 2001). In contrast, positive emotions like happiness and satisfaction provide the same results for valence and arousal evaluation (Javela, Mercadillo & Martín Ramírez, 2008).

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These variation allows to categorize emotional experience into specific array of discrete emotions. There are variety of discrete emotions that are commonly associated with learning contexts, such as boredom, confusion, curiosity, hopelessness, shame, anxiety, anger, surprise, relief, hope, pride and enjoyment of learning (D'Mello & Graesser, 2012; Pekrun, et al., 2011). Of these outcomes, emotions are related to achievement, self-regulation, motivation and several other processes in a variety of ways. Positive emotions increase learners' intrinsic motivation by stimulating their curiosity to explore new knowledge and thus lead to better learning performance (Pekrun et al. 2011; Pekrun & Stephens, 2010). These motivational capabilities measured from the emotional information provided by valence and arousal (Lang, 2006; Lang et al., 1997b). Accordingly, low arousal with positive valence produce better overall cognitive-motor performance while high arousal with negative valence

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produce poorer overall cognitive-motor performance (Lu, Jaquess, Hatfield, Zhou & Li, 2017)

2.5.2 Arousal

Arousal is a physiological mechanism that makes theoretical claims based on its potential for physiological mobilization. Arousal describes through emotional experience that enrich with excitation or calm (Russell, 2003). This arousal categories into positive or negative states through approach or avoidance behavior (Posner & Russell, 2005). In other words, arousal ranges from being sleepy to being energized (energetic arousal) and from being calm to being tense (tense arousal).

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Higher feeling of excitement on the presently focused process can lead to achieve higher arousal without considering its later consequences (Perkins, Wilson & Kerr, 2001). Commonly, an individual seek for frequent interaction with close and highly familiar people (Vogel et al., 2017). The communication with familiar people motivates an individual's behavior (Lang & Davis, 2006) and increase their arousal as well (Vogel et al., 2017). However, further increases in arousal cause the elimination of information that relevant to task (Chajut & Algom, 2003). Usually, high arousal caused by the increment in one's own heartbeat (Barrett, Quigley, Bliss-Moreau & Aronson, 2004).

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Besides that, arousal is a factor that contribute to memory enhancement effect (Kensinger, 2004). Arousal capable in driving attention and visual processing priority (Vesker, Bahn, Degé, Kauschke & Schwarzer, 2018). Individual likely to give more attention on emotional arousal elements compare to neutral elements. This leads to the enhancement on memory performance. Still, high impact of arousal causes a narrowing of attention and motivation to learn (Clark, 2017).

2.5.3 Valence

Similarly, valence is also a fundamental component of emotional responding. Valence varies from pleasure to displeasure. Commonly, the dimension of valence consists of positive valence and negative valence with a low and a high pole (bivariate valence) (Cacioppo, Gardner & Berntson, 1999; Shuman & Scherer, 2014). Specifically, positive valence range includes pleasant impressions due to attractiveness, pretty and fascinating impressions whereas negative valence range includes unpleasant impressions due to unattractive, ugly and uncanny impressions (Seyama & Nagayama, 2007).

Aside from that, positive valence refers to the feeling of enjoyment and happiness while negative valence refers to the feeling of anger, anxiety or boredom. Negative valence is more reactive than positive valence as negative valence produces more negative affect compared to positive valence (Baumeister, Bratslavsky, Finkenauer & Vohs, 2001; Peeters & Czapinski, 1990; Taylor, 1991).

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2.5.4 Interconnection between Arousal and Valence

Typically, there is a model called circumplex model which describes affective states with two dimensions, valence and arousal (Barrett & Russell, 1999). There are several studies indicated that valence and arousal are independent of one another (Figure 2.9), (Barrett & Russell, 1999; Carver & Scheier, 1990, 2014; Larsen & Diener, 1992; Reisenzein, 1994; Russell, 1980). Correspondingly, emotional valence categorized value of a specific emotions as either positive or negative while emotional arousal, indicating its intensity (Bradley & Lang, 2000; Russell, 2003).

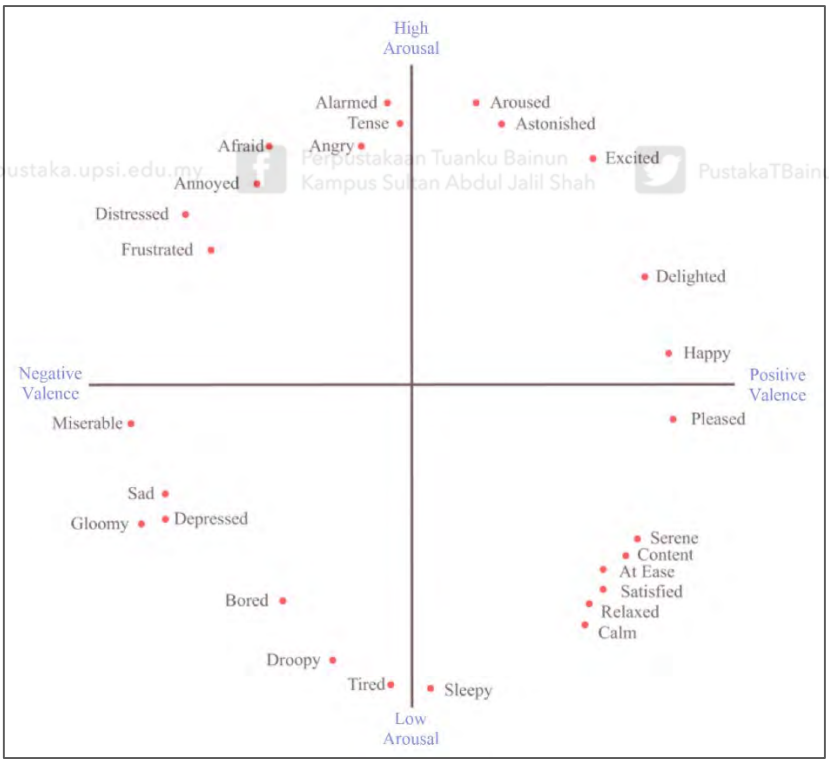


Figure 2.9. Russell's Circumplex Model of Affect (Russell, 1980). Source: Seo & Huh (2019)

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This model characterized the relationship between valence and arousal through affective experiences (Barrett & Russell, 1999) and emotional reactions (Lang et al., 1997b). Importantly, the effect of valence and arousal allow for the understanding of various feeling states (Citron, Gray, Critchley, Weekes & Ferstl, 2014; Nielen et al., 2009; Watson, Wiese, Vaidya & Tellegen, 1999). Additionally, the relationship between valence and arousal determines the effect on health, psychopathology, memory, attention, perception, decision making or any other psychological domain.

The position of arousal and valence in the circumplex model contributed to the identification of various emotional states (Russell, 1980; Yik, Russell & Steiger, 2011). In circumplex model, valence on the horizontal axis ranges from negative to positive whereas arousal on the vertical axis ranges from low arousal to high arousal as shown in Figure 2.9. The affective states will fall in this two dimensions. Based on the model, excitement and astonishment would be considered as the combinations of positive valence and high arousal whereas boredom and depression would be a mixture of negative valence and low arousal (Kapoor et al., 2013). At the same time, high arousal and negative valence contributed to a feeling of tension while low arousal and positive valence contributed to a feeling of calmness. The different feeling states are served by distinct underlying neural systems (Colibazzi et al., 2010; Gerber et al., 2008; Nielen et al., 2009; Wilson-Mendenhall, Barrett, & Barsalou, 2013).

In other words, affective states in circumplex model are grouped according to four broad categories of emotions achievement (Feldman Barrett & Russell, 1998); positive activating (such as happiness, delightfulness, arousal, excitement); positive deactivating (such as gladness, relaxation, calmness); negative activating (such as

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anger, afraid, annoy, frustration) and negative deactivating (such as tiredness, sadness, boredom, miserable) (Linnenbrink, 2007; Pekrun, 2006).

2.5.5 The Application of Valence and Arousal in the Present Study

Although previous studies examined valence and arousal in daily life (Barrett, 2004; Feldman, 1995; Kuppens, 2008; Kuppens, Oravecz & Tuerlinckx, 2010; Kuppens, Van Mechelen, Nezlek, Dossche & Timmermans, 2007; Nezlek, 2005), the relationship between valence and arousal in education setting still remains unclear (Braem et al., 2013; Padmala, Bauer & Pessoa, 2011). This is due to the confusion in deciding whether valence or arousal is underlying affect's impact on learners. For instance, despite a wealth of research, it remains unclear whether mainly valence (Kensinger & Schacter, 2016) or arousal (Mather, 2007) affect memory and even whether they facilitate or impede it (Cook, Marsh, ClarkFoos & Meeks, 2007; Mather & Nesmith, 2008). Similar observations have been made regarding the influence of affect on vision (Lane, Chua & Dolan, 1999), judgment and decision making (Blanchette & Richards, 2010).

In educational setting, the presence of emotionally arousing component aids to induce external mood and maintain it throughout the learning process (Isen, Daubman & Nowicki, 1987; Isen & Reeve, 2005; Um et al., 2012; Wolfson & Case, 2000). The induced emotional experiences can influence cognitive processing (Gomez, Zimmermann, Guttormsen Schär & Danuser, 2009; Um et al., 2012). Positive emotions can help learners pay closer attention to learning content (Park & Lim 2007) and increase their cognitive interest and motivation (Um et al., 2012). Therefore, the

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exploration to different intensity levels of positive and negative emotions are very important. Several researchers found that positive emotions are superior to negative emotions for learning.

In view of that, virtual agent used as emotionally arousing component to increase attention and improved memory for learning content (Joëls, Pu, Wiegert, Oitzl & Krugers, 2006). This is in accordance with the capability of different realism designs of virtual agents in generating different arousal and valence states. The various arousal and valence states capable to activate brain region and lead to the stimulation of different emotions. The emotionally arising virtual agent sufficient to boost learning as it grabs more amount of attention.

Hence, the aim of this research is to examine valence and arousal for four different realism designs of virtual agents. Arousal and valence measured in order to identify the most appropriate feedback intervention strategy. Usually, individual experiences various affective experiences in term of valence and arousal that focus on different amount of attention (Barrett, 2004).

Based on previous studies, images can associate with affective experience. The evaluation on images varies where negative images produce high arousal while positive images produce low arousal (Eder & Rothermund, 2010; Robinson, Storbeck, Meier & Kirkeby, 2004). Furthermore, images that emotionally aroused were remembered better than the neutral images (Bradley, Greenwald, Petry & Lang, 1992). Also, valence-focused images lead to high speed of processing (Barrett & Niedenthal, 2004).

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Accordingly, the measurement of valence and arousal in this research are based on learners' rating on their affective experience when view the different realism designs of virtual agents (Cuthbert, Bradley & Lang, 1996; Eisenberg, Sadovsky & Spinrad, 2005; Mikels et al. 2005). Consequently, the learners' emotional state will fall within four quadrants of arousal and valence which are positive activating, positive deactivating, negative activating and negative deactivating (Pekrun, Goetz, Titz & Perry, 2002a). Learners who express positive emotions during the first view of the virtual agent may maintain interest throughout the learning process, whereas those who express negative emotions may show decreased interest throughout the learning process. This permit the understanding of emotions that help in choosing appropriate realism designs for virtual agents. The suitable realism designs of virtual agents influence learning and improve the efficiency of learning environment.

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2.6 Quiz Based Multimedia Learning Environment

In educational environment, new information learned through lectures, course notes, readings or discussions. The fundamental aspect of instructed material and theory in educational practice can be evaluated using summative test that able to assess students' acquisition and retention (Mcdaniel, Thomas, Agarwal, Mcdermott, & Roediger, 2013). In line with that, the effectiveness of learning new information measured by using quizzes in order to identify the capability of learners in recalling the information (Brown, Bice, Shaw & Shaw, 2015; Marden, Ulman, Wilson & Velan, 2013; Van Blerkom & Van Blerkom, 2004).

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Quizzes are useful assessment method to examine overall about what has been taught (Gholami & Morady Moghaddam; 2013). Additionally, quizzes can be presented in two different techniques; formative or summative. The formative quizzes able to determine course progression directly through the evaluation on the concept understanding by learners (Brown et al., 2015; Hope & Polwart, 2012; Rolfe & McPherson, 1995). Conversely, the summative quizzes evaluate students' performance in the course by determining their grades (Brown et al., 2015; Cilliers, Schuwirth & Van der Vleuten, 2012). In addition, quiz items that created by focusing on application and the combination of concept (Nguyen & McDaniel, 2014) able to promote flexibility in the usage of information.

Besides that, quizzes that created with various interactive way capable to encourage learners to pay closer attention and indirectly improve their understanding (Brothen & Wambach, 2004; Graham, 1999; Johnson & Kiviniemi, 2009; Narloch et al., 2006). Hence, quizzes that presented conventionally through in-class quizzing (Bangert-Drowns, Kulik & Kulik, 1991; Leeming, 2002; Lyle & Crawford, 2011; Mcdaniel et al., 2013; Roediger, Agarwal, McDaniel & McDermott, 2011) can be transformed to online quizzing (Angus & Watson, 2009; Daniel & Broida, 2004; Kibble, 2007; Roediger et al., 2011).

Moreover, repeated quizzing in online platform led to better performance than repeated reading of in-class quizzing (Roediger et al., 2011). This helps to enhance learners' performance. Likewise, quizzes that developed through online can assist learners in remembering important terms or concepts. Also, the integration of quizzes with other instructional activities in a teaching strategy has been very favorable to

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learners (Salas-Morera, Arauzo-Azofra & García-Hernández, 2012). Students highly appreciated the role of the quizzes in online platform as it helps keep students up with the course and strengthened their involvement. Consequently, this kind of online quizzes provide a very positive impact on academic outcomes.

In consideration to these points, Quiz based Multimedia Learning Environment (Q-MLE) with 20 multiple-choice questions created for research purpose. Wherein, the animated virtual agent functions as learning companion in the Q-MLE and interacts with students via narration.

2.7 Research Conceptual Framework

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Mayer's multimedia learning cognitive theory, Mori's uncanny valley phenomenon and James Russell's Circumplex Model of Affect are basis of the proposed conceptual framework as shown in Figure 2.10.

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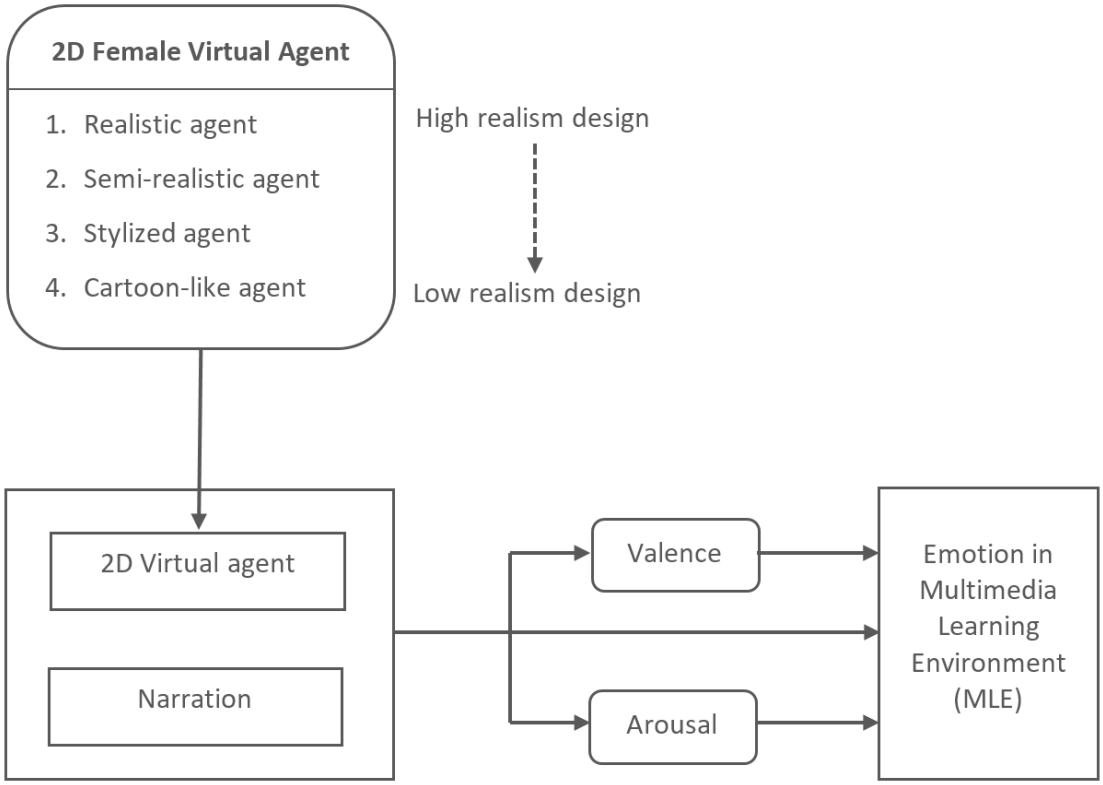


Figure 2.10. Proposed Research Conceptual Framework

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Based on the framework developed, animated two-dimensional (2D) female virtual agent plays major role in the Quiz based Multimedia Learning Environment (Q-MLE). In fact, interaction occurs between virtual agent and students throughout the Q-MLE. Thus, an appropirate design of animated virtual agent is very important to induce positive emotions in learning among students.

In view of that, four different realism designs of 2D female virtual agents have been used in the Q-MLE which are realistic agent, semi-realistic agent, stylized agent and cartoon-like agent. The visual appearance of virtual agents that consist of different realism designs of facial structure are likely to induce emotions among learners. This emotions can be measured through the experience of arousal and valence from the neural systems. Valence refers to positive-to-negative state of pleasantness while

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arousal refers to the low-to-high state of excitement (Barrett & Russell, 1999; Kensinger & Corkin, 2004). In addition, the arousal and valence can affect the learners' overall emotions in learning.

When the animated 2D female virtual agent with lip movement of spoken text presented with many pieces of screens that overflowing with on-screen text, the students capable to enter visual channel and verbal channel simultaneously. Visual information (in the form of animated 2D female virtual agent and on-screen text) can enter through visual sensory modality while verbal information (in the form of audio or narration) can enter through auditory sensory modality.

However, question arises whether the use of virtual agents with appropriate realism designs and the application of verbal and visual channels on it could influence learners' emotions? Therefore, the evaluation of emotions in this study focused on two distinct groups. Firstly, the study focused on students' emotions in the dimension of valence and arousal on the virtual agent's appearance in isolated. Secondly, overall emotions in learning where students capable to rate their overall emotions that occurs throughout the learning process in Q-MLE and thirdly its relation. Accordingly, this study able to look for answers to the problems that exist in the construction of a conceptual framework.

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2.8 Summary

In general, chapter two (literature review) has started discussion on the presence of virtual agents in previous studies and the importance of emotional factor for the design of its appearance. To consider this, issues related to uncanny valley phenomenon discussed. According to the literatures, a character that is too realistic or almost resembles a human would eventually cause viewers to feel fearful and horrified when viewing these characters. Also, a mismatch in virtual agents' visual elements could attribute to negative impact on students as well. Thus, adequate realism design of virtual agent produces an impact in inducing positive emotions among learners. From there, the relationship between emotions and learning has been discussed. In this case, four different realism designs of virtual agents in Quiz based Multimedia Learning Environment (Q-MLE) were amended. Basically, quizzes are a useful assessment method that can be performed to examine overall about what has been taught. Besides, the integration of quizzes with other instructional activities in a teaching strategy is indeed favorable to learners. Therefore, the virtual agent functions as learning companion in the Q-MLE and interacts with the students via narration. Besides that, students' affective experience interconnected with emotions in learning. To build on these concepts, the arousal and valence of students measured to identify the realism effects of the four different realism designs of virtual agents. These arousal and valence rated within four quadrants; positive activating, positive deactivating, negative activating and negative deactivating. Thereafter, students' emotions in learning also measured to identify whether the arousal and valence does effect students' emotion in learning the Q-MLE. Finally, the conceptual framework for the research has been proposed in this chapter.

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CHAPTER 3

RESEARCH METHODOLOGY

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3.1 Introduction

This research aims to address the effects of realism designs of virtual agents on students' emotions; firstly, the character's appearance in isolated in inducing students' emotions in the dimension of valence and arousal, secondly students' emotions on overall learning and thirdly its relation. Thus, a prototype of Quiz based Multimedia Learning Environment (Q-MLE) was designed and developed with four different realism designs of virtual agents. The Q-MLE contains 20 multiple choice questions from first chapter of Interactive Multimedia Application subject. This subject is offered to fourth and fifth semester students in the electrical engineering department of polytechnic Malaysia. These students are comprised of those who enrolled in Diploma in Electrical Engineering (DET), Diploma in Electronic Engineering (Communication) (DEP), Diploma in Electronic Engineering (Control) (DJK), Diploma in Electronic

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Engineering (Computer) (DTK), Diploma in Electronic Engineering (Medical) (DEU) and Diploma in Electrical & Electronic Engineering (DEE). The study was conducted at seven polytechnics in total from north, central and south zone out of 36 polytechnics. Students were chosen from the selected cluster to participate in four different experimental groups, namely realistic, semi-realistic, stylized and cartoon-like agents. There were total number of 600 students participated where each group assigned with 150 students. The quasi-experimental study was conducted separately for all the groups in the controlled lab environment.

3.2 Research Design

This is a quasi-experiment study that used to investigate students' emotion on virtual agent' design and overall emotions in learning. Quantitative research design had been applied which focuses the collection and analysis of data in the form of numbers. Besides that, experimental groups that consist of four different prototypes were formed as independent variables of the study. On the other hand, the emotions on virtual agent's design and overall emotions in learning were dependant variable for this study. This experimental study was performed to 22 groups from seven polytechnics in the controlled lab environment. Students answered the quiz questions in the Quiz based Multimedia Learning Environment (Q-MLE) individually using desktops at the computer lab. The following methods applied to take a further step into execution phase of the research:

1. First of all, students were briefed about the Q-MLE. This helps to smoothen the interaction process that occurs between virtual agent and students only.

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2. Secondly, selected virtual agent was played and students were explored it for five minutes. Then the Self-Assessment Manikin (SAM) nonverbal pictographic questionnaire (two items) had been given to them. The purpose of this questionnaire is to study about students' emotions on the different realism designs of the animated virtual agents in the dimensions of valence and arousal.

3. Then, students were allowed to access the Q-MLE and answer the quiz questions which contains 20 multiple choice questions. The duration of the Q-MLE is 30 minutes.

4. At the end of Q-MLE, students' overall emotions in learning were measured using Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ) (24 items).

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3.3 Variables

There are three types of variables involved in this study; independent variables (IV), mediator variables (MV) and dependent variables (DV).

Independent variable (IV):
Four different realism designs of 2D female virtual agents' prototypes were developed as follows:

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1. Cartoon-like agent

   This strategy uses animated character that iconic match a typical cartoon model (simplified geometry of the face) with audio narrative.

2. Stylized agent

   This strategy uses animated character that stylized (cartoon character with exaggerated features) with audio narrative.

3. Semi-Realistic agent

   This strategy uses animated character that medium realistic (not as detailed as the realistic) with audio narrative.

4. Realistic agent

   This strategy uses animated character that realistic (designed very detailed and it mimics like human) with audio narrative.

Mediator variable (MV):

A mediator variable is the variable that causes mediation in the dependent and the independent variables. In other words, it explains the relationship between the dependent variable and the independent variable. Accordingly, valence and arousal are mediators of this study.

Dependent variable (MV):

The dependant variable of the research is emotion in learning among students. The changes in the dependant variable depend on the independent variable. Therefore, this

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research determined the relationship between dependant variable and independent variable.

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		Experimental Group			
Instrument	**Duration**	**Group 1**	**Group 2**	**Group 3**	**Group 4**
	5 minutes	View the realistic virtual agent	View the semi-Realistic virtual agent	View the stylized virtual agent	View the cartoon-like virtual agent
		↓	↓	↓	↓
Self-Assessment Manikin (SAM)	5 minutes	Test on emotions of virtual agent's design (Arousal & Valence)	Test on emotions of virtual agent's design (Arousal & Valence)	Test on emotions of virtual agent's design (Arousal & Valence)	Test on emotions of virtual agent's design (Arousal & Valence)
		↓	↓	↓	↓
	30 minutes	Participate in Q-MLE	Participate in Q-MLE	Participate in Q-MLE	Participate in Q-MLE
		↓	↓	↓	↓
Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ)	15 minutes	Test on emotions in learning	Test on emotions in learning	Test on emotions in learning	Test on emotions in learning

Figure 3.1. Research Design

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3.4 The Population of the Study

The population of the study that takes part in this Quiz based Multimedia Learning Environment (Q-MLE) were students from fourth and fifth semester who enrolled in DEC5082: Interactive Multimedia Applications subject. This subject offered to students in electrical engineering department of polytechnic Malaysia who enrolled in Diploma in Electrical Engineering (DET), Diploma in Electronic Engineering (Communication) (DEP), Diploma in Electronic Engineering (Control) (DJK), Diploma in Electronic Engineering (Computer) (DTK), Diploma in Electronic Engineering (Medical) (DEU) and Diploma in Electrical & Electronic Engineering (DEE). In particular, the subject offered at 12 out of 36 polytechnics as shown in the Table 3.1. With this in mind, the study was conducted at seven polytechnics with the participation of 600 students. This study took place after students learned the first chapter from their lecturers in regular class environment.

Table 3.1

Total Population of the Study by Zone

	Polytechnic	Programme	Population	Zone
1.	Politeknik Ungku Omar (PUO)	1. Diploma in Electronic Engineering (Communication) (DEP)	38	North
2.	Politeknik Sultan Abdul Halim Mu'adzam Shah (POLIMAS)	1. Diploma in Electrical & Electronic Engineering (DEE) 2. Diploma in Electrical Engineering (DET)	94	North

(continue)

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Table 3.1 *(continued)*

	Polytechnic	Programme	Population	Zone
3.	Politeknik Seberang Perai (PSP)	1. Diploma in Electrical & Electronic Engineering (DEE)	39	North
4.	Politeknik Sultan Azlan Shah (PSAS)	1. Diploma in Electronic Engineering (Communication) (DEP) 2. Diploma in Electrical Engineering (DET)	114	North
5.	Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA)	1. Diploma in Electronic Engineering (Communication) (DEP) 2. Diploma in Electronic Engineering (Control) (DJK) 3. Diploma in Electronic Engineering (Medical) (DEU)	172	Centre
6.	Politeknik Sultan Idris Shah (PSIS)	1. Diploma in Electronic Engineering (Communication) (DEP)	75	Centre
7.	Politeknik Port Dickson (PPD)	1. Diploma in Electronic Engineering (Computer) (DTK)	21	South
8.	Politeknik Merlimau (PMM)	1. Diploma in Electronic Engineering (Communication) (DEP) 2. Diploma in Electrical Engineering (DET) 3. Diploma in Electronic Engineering (Computer) (DTK)	143	South
9.	Politeknik Mersing (PMJ)	1. Diploma in Electrical Engineering (DET) 2. Diploma in Electrical & Electronic Engineering (DEE)	16	South
10.	Politeknik Sultan Haji Ahmad Shah (POLISAS)	1. Diploma in Electrical & Electronic Engineering (DEE)	38	East

(continue)

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Table 3.1 *(continued)*

	Polytechnic	Programme	Population	Zone
11.	Politeknik Kota Bharu (PKB)	1. Diploma in Electronic Engineering (Communication) (DEP) 2. Diploma in Electrical & Electronic Engineering (DEE) 3. Diploma in Electrical Engineering (DET)	29	East
12.	Politeknik Sultan Mizan Zainal Abidin (PSMZA)	1. Diploma in Electronic Engineering (Communication) (DEP) 2. Diploma in Electrical & Electronic Engineering (DEE) 3. Diploma in Electronic Engineering (Computer) (DTK)	130	East
Total			**909**	

3.5 Sampling Method

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The population of this study determined using multistage sampling method. It is a combination of cluster sampling and simple random sampling. In order to carry on with this multistage sampling method, first of all, polytechnics that offer Interactive Multimedia Applications subject had been identified. Secondly, the identified polytechnics divided into five clusters based on zones. Thirdly, three out of the four clusters were selected using random sampling method for this study. The sample design of this study illustrated as shown in Figure 3.2. The selected polytechnics are Politeknik Ungku Omar (PUO) and Politeknik Seberang Perai (PSP) from north zone, Politeknik Sultan Azlan Shah (PSAS), Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA) and Politeknik Sultan Idris Shah (PSIS) from centre zone and Politeknik Port Dickson (PPD) and Politeknik Merlimau (PMM) from south zone.

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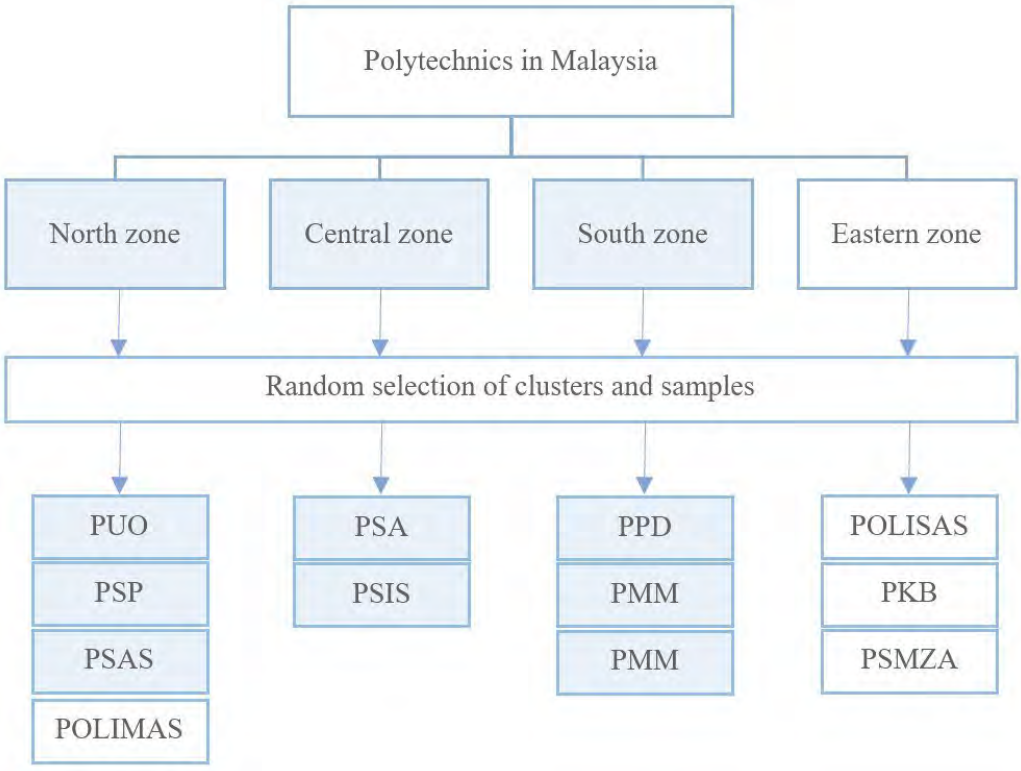


Figure 3.2. Research Sampling Method

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3.6 Sample Size

The sample size of this study was determined using the formula of G*power 3.1 (Faul, Erdfelder, Buchner & Lang 2009; Faul, Erdfelder, Lang, & Buchner, 2007). Here, power analysis was performed by taking into account the following criteria; effect size of 0.25, alpha of 0.05, power of 0.95 and four groups as shown in Figure 3.3.

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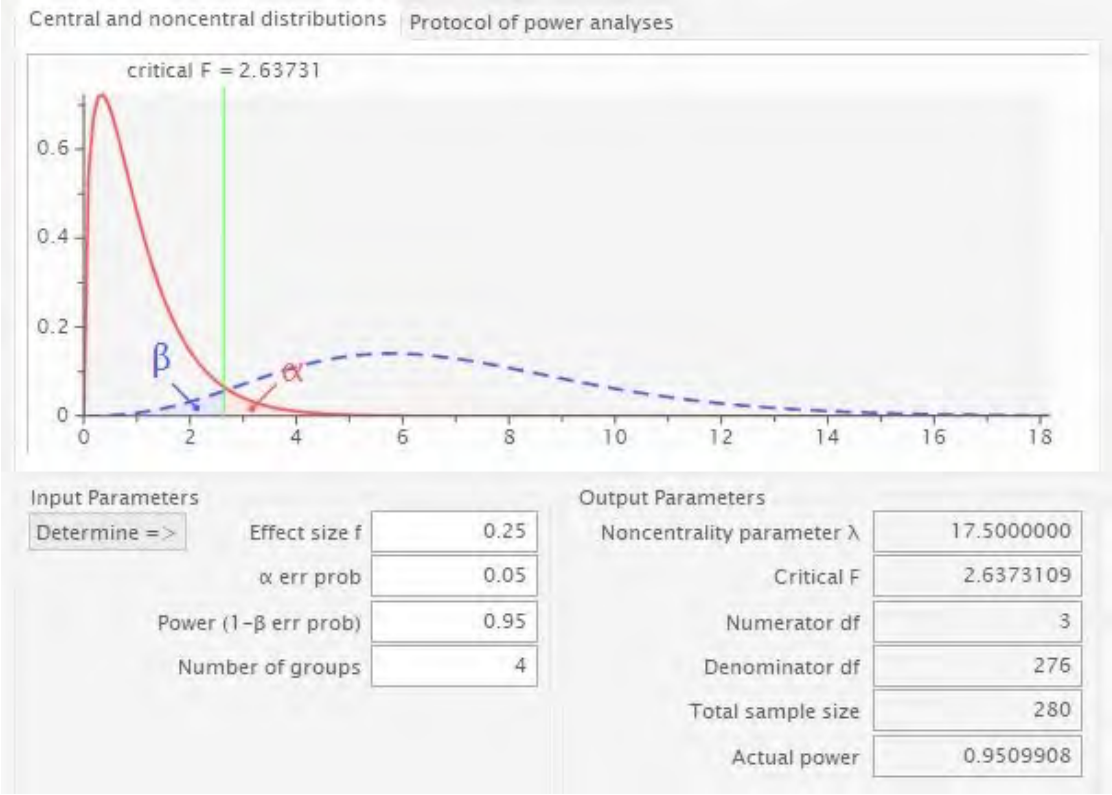


Figure 3.3. The Output of Sample Size Using G*Power 3.1

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The analysis result revealed that 280 sample size would be required for the research. However, based on researcher's assumption, the effect size for the research could be medium, thus 600 sample size (150 for each group) had been chosen as shown in Table 3.2 with the power of one (Figure 3.4). This is according to the total amount of 600 students that enrolled for the subject of Interactive Multimedia Applications at the chosen zones. It seems clear, 600 students were selected as the sample of study out of the population of 909 students that undertaking Interactive Multimedia Applications subject from 12 polytechnics as presented in Table 3.3.

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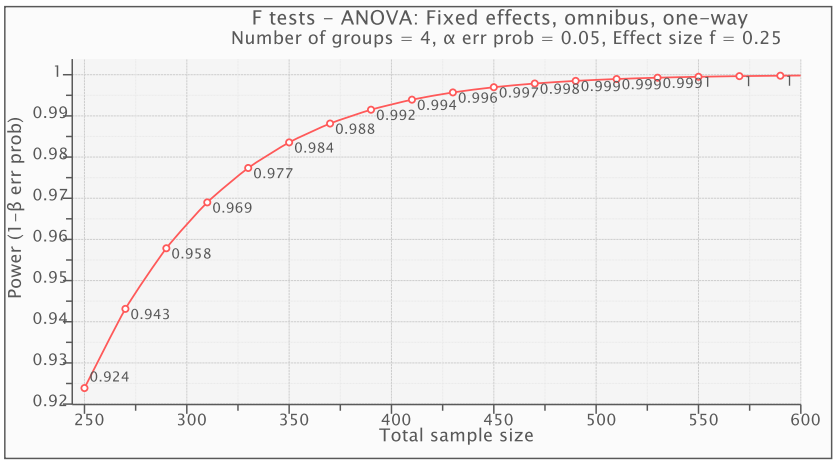


Figure 3.4. The Power Plot

Table 3.2

Sample Size for Each Group

Group	Sample Size
Group 1 – Realistic agent	150
Group 2 – Semi-Realistic agent	150
Group 3 – Stylized agent	150
Group 4 – Cartoon-like agent	150
Total	**600**

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Table 3.3

The Sample Size of the Study from the Participated Polytechnics

	Polytechnics	Realistic	Semi-Realistic	Stylized	Cartoon-like	Total
1	PUO			DEP5 (37)		37
2	PPD				DTK4 (21)	21
3	PSA	DEU5A (28)	DEP5B (36) DEU5B (34)	DJK4 (18) DEP5C (22)	DEP5A (34)	172
4	PSP	DEE5 (39)				39
5	PMM	DET5B (21) DET4AB (19)	DTK5B (32)	DTK5A (37)	DEP5A (34)	143
6	PSAS	DEP5A (14) DET5CD (29)		DET4AB (36)	DEP5B (34)	113
7	PSIS		DEP5A (24) DEP5B (24)		DEP5C (27)	75
	Total	**150**	**150**	**150**	**150**	**600**

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3.7 Research Instruments

Students' valence and arousal stimulated by different realism designs of virtual agents in isolated was measured using Self-Assessment Manikin (SAM). Additionally, students' emotions in the learning of Quiz based Multimedia Learning Environment (Q-MLE) was measured using Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ).

3.7.1 Self-Assessment Manikin (SAM)

Self-Assessment Manikin (SAM) is an effective rating system that widely used to measure three dimensions of emotions which are valence, arousal and dominance (Bradley & Lang, 2007; Lang, 1985; Lang et al., 1997a). Besides that, SAM is non-verbal pictorial assessment technique devised by Lang (1980) to measure valence, arousal and dominance associated with a person's affective reaction to an object or a stimulus (Bradley & Lang, 1994). Accordingly, the current study examined students' emotional states in the dimension of valence and arousal using SAM. Thus, students capable to rate the different realism designs of virtual agents based on their experiences of valence and arousal from the neural systems.

Here, students rated each virtual agent using nine-point scales with pictorial manikins which represent varying values of valence (ranging from unpleasant to pleasant) and arousal (ranging from low to high arousal). For the valence, the vignette ranges from a smiling, happy to a frowning and unhappy. Whereas, for the arousal, the

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vignette ranges from an excited, wide-eyed to a relaxed and sleepy (Lang et al., 1997a). Generally, the score of one is lowest rating that represents a usual emotional experience while the score of nine is highest rating that represents the most intense experience of the emotions.

Hence, the analysis of SAM data helps to identify emotional content for different realism designs of virtual agents and enable to categorise them within four quadrants of arousal and valence which are positive activating, positive deactivating, negative activating and negative deactivating. Figure 3.5 shows the paper-and-pencil version of SAM. The first row is a representation of valence dimension and the second row represents an arousal level. Each dimension has nine options (five pictures and four spaces between pictures) (Lang et al., 1997a; Redondo, Fraga, Padrón & Comesaña, 2007). The SAM questionnaire is in English but has been translated to Malay and delivered in both languages. The translation was validated and evaluated by the linguistic experts from local university.

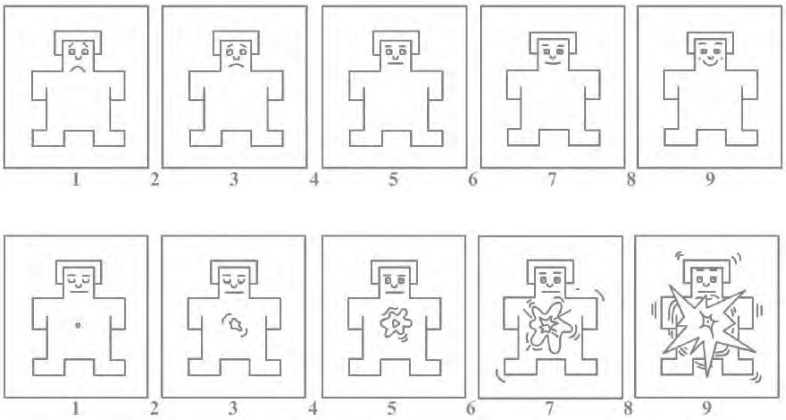


Figure 3.5. The Self-Assessment Manikin (Sam) (Bradley & Lang, 1994) Used to Rate the Affective Dimensions of Valence (Top Panel) and Arousal (Bottom Panel). Source: Redondo et al. (2007)

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3.7.1.1 Validity and reliability of Self-Assessment Manikin (SAM)

An alternative approach to investigate affective experience of human and humanlike entities is to consider affective experience in terms of its psychologically well-validated components. As stated earlier, in the uncanny valley phenomenon, Mori (1970, 2012) used graph to illustrate the relation between the human likeness of an entity and the perceiver's affinity for it (1970, 2012). Alternatively, valence and arousal can be used to identify the existence of the uncanny valley phenomenon (Cheetham et al., 2015). The indication of valence and arousal capable to provide a sound basis for examining affective experience of variously humanlike entities along with the notion of uncanny effect in the dimension of human likeness (Cheetham et al., 2015).

Generally, valence refers to the pleasant-to-unpleasant quality (hedonic tone) while arousal refers to the low-to-high degree of excitement of affective experience (Barrett & Russell, 1999; Cheetham et al., 2015; Kensinger & Corkin, 2004). These valence and arousal form a primary orthogonal dimensions of affective experience (Cheetham et al., 2015; Posner et al., 2005, Russell, 1980, 2003; Schlosberg, 1954; Yik, Russell & Barrett, 1999). Accordingly, emotional states can be defined in the emotional space that determined by using these two dimensions (Barrett & Russell, 1999; Bradley & Lang, 1994; Cheetham et al., 2015; Mehrabian & Russell, 1974; Osgood, Suci & Tannenbaum, 1957; Smith & Ellsworth, 1985).

In order to investigate the affective experiences of arousal and valence on different realism designs of virtual agents, well-validated Self-Assessment Manikin (SAM) (Bradley & Lang, 2007; Lang, 1985; Lang et al., 1997b) had been used in this

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research. Past research findings showed that the reliability of the items in Self-Assessment Manikin (SAM) questionnaire is high with alpha cronbach values 0.74 for valence and 0.84 for arousal (Rubin, Rubin, Perse, Graham & Seibold, 2009).

Table 3.4.

Recent Studies That Uses Self-Assessment Manikin (SAM) Questionnaire

Authors & year	**Title**	**Journal**
Gernot, Pelowski & Leder (2018)	Empathy, Einfühlung, and aesthetic experience: the effect of emotion contagion on appreciation of representational and abstract art using fEMG and SCR	Cognitive Processing
Waltemate, Gall, Roth, Botsch & Latoschik (2018)	The impact of avatar personalization and immersion on virtual body ownership, presence, and emotional response	IEEE Transactions on Visualization and Computer Graphics
Liu, Yu, Zhao, Song, Ge & Shi (2018)	Real-time movie-induced discrete emotion recognition from EEG signals	IEEE Transactions on Affective Computing
Minge & Thüring (2018)	Hedonic and pragmatic halo effects at early stages of User Experience	International Journal of Human Computer Studies

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3.7.2 Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ)

The Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ) (Yang, 2018) was derived from Achievement Emotions Questionnaire (AEQ) which designed by psychologists to evaluate the impact of emotions experienced in academic contexts (Pekrun et al., 2002b; Pekrun et al., 2011). The original AEQ subdivided into three main sections; emotions relating to attending class, when studying and while taking exams. Frequently, AEQ utilized to measure class-related (80 items), learning-related (75 items) and test-related (77 items) emotions (Linnenbrink-Garcia, Wormington & Ranellucci, 2016). However, only one context had been chosen for this study which is emotions in learning-related. In view of that, SF-L-AEQ was used to measure students' emotions in learning as a whole.

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There are eight different emotions categories in the SF-L-AEQ, which are enjoyment, hope, pride, hopelessness, boredom, anger, anxiety and shame with total of 24 items for each. SF-L-AEQ assesses a broad range of positive and negative emotions that are important for students' learning. By varying the instructions accordingly, the SF-L-AEQ is able to assess students' general emotional reactions in academic situations (Yang, 2018; Pekrun & Bühner, 2014). Also, SF-L-A-EQ is a likert type questionnaire with four degree ranging from one (strongly disagree) to four (strongly agree). The SF-L-AEQ questionnaire was delivered in dual languages, Malay and English. The Malay translations version was from Ahmad Zamzuri (2018).

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3.7.2.1 Validity and reliability of Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ)

The Achievement Emotions Questionnaire (AEQ) (Pekrun et al., 2011) has been widely used in educational emotions research (Ahmad Zamzuri, 2018; Kim & Pekrun, 2014). Previous studies have shown that the AEQ has a high degree of reliability to explore relationships between emotions, task significance (Dermitzaki, Bonoti & Kriekouki, 2016; Marchand & Gutierrez, 2012; Noteborn, Carbonell, Dailey-Hebert & Gijselaers, 2012; Pekrun et al., 2011) and self-regulated behavior (Artino & Jones, 2012; Rienties & Rivers, 2014).

Based on past research findings, the reliability of the items in this questionnaire is high where the alpha cronbach values are 0.7 ($\alpha > 0.7$) (Yang, 2018). In addition, the validity of each item in the questionnaire ensured through qualitative study that conducted by referring to several relevant experts (Pekrun et al., 2002a; Yang, 2018). With the high reliability and validity, SF-L-AEQ has been used widely to measure academic related emotions.

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Table 3.5.

*Recent Studies That Uses Short-Form Learning-related Achievement Emotions Questionnaire (*SF-L-AEQ*)*

Authors & year	Title	Journal /Conference
Yang (2018)	Developing a 24 items' short-form of learning-related achievement emotions questionnaire (SF-L-AEQ) in Chinese students	Positive Psychology
Yang, Sin, Wang & Gao (2018)	Self-concept, Emotions, and Career Planning: Multiple Voices from Stakeholders in Inclusive Education and Special Education	The Learning & Teaching
Sin & Yang (2015)	Developing a Chinese version of learning-related achievement emotions questionnaire (LAEQ)	Redesigning pedagogy
Yang & Sin (2013)	Pilot study on feelings toward class, learning and test: Achievement emotions of Chinese students in vocational education	Research Report, The Hong Kong Institute of Education

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3.8 Procedures on Data Collection

Data collection procedures are divided into three stages namely before, during and after as the following:

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3.8.1 Before Data Collection

Before proceeding with data collection process, the researcher ensured that all important procedures were successfully completed as below:

i) Researcher sent a letter to polytechnic education department to request permission to conduct this study on polytechnic students.

ii) After received the approval from the polytechnic education department, researcher contacted subject lecturers from each selected polytechnic to explain about the research process. Lecturers were kindly requested to teach first chapter of the subject to students before carried out the experiment.

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iii) Researcher arranged schedule that in line with subject lecturer's timetable for data collection process.

3.8.2 During Data Collection

The procedures that have been followed during the data collection process are as follows: The experiment was carried out in controlled lab environment.

i) Students were briefed on the purpose of the research and basic information about the virtual agents.

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ii) Pen drives that contains of virtual agent and quiz based Multimedia Learning Environment (Q-MLE) and headphones were provided to students.

iii) The first questionnaire, Self-Assessment Manikin (SAM) distributed to them.

iv) Students viewed the respective virtual agent in isolated for five minutes and it is followed by the process of answering the SAM questionnaire.

v) Thereafter, students were allowed to start the Q-MLE that guided by respective virtual agent. Upon completion of the Q-MLE, they were required to answer the second questionnaire, Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ) that had been distributed to them.

vi) It took around 50-55 minutes to complete the entire data collection processes.

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3.8.3 After Data Collection

The next steps taken after the completion of data collection processes are as below:

i) Researcher isolated and did take into account the incomplete questionnaires. It was found that there were two incomplete questionnaires.

ii) Data were recorded in Statistical Package for the Social Sciences (SPSS) for the respective analysis purpose.

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3.9 Data Analysis

Data analysis for this study was done using Statistical Package for the Social Sciences (SPSS) software. The results of the study analysed by using an Analysis of Variance (ANOVA) and mediation analysis (bootstrapping method). Both analysis are essential to identify whether there is any significant relation between students' emotions caused by different realism designs of the virtual agents and emotions in learning.

ANOVA test was used for the first, second and third research questions. The assumptions of ANOVA for normal distribution for each groups have been fulfilled for each research questions (refer appendix). Then, the equal variances were tested using Levene's test. The equal variances within each of the population is called as homogeneity of variance. In sum, the statistical analysis and to answer the research questions are as in Table 3.6.

Table 3.6.

Statistical Analysis Used to Answer the Research Questions

	Research question	Statistical Analysis used in the research
1	Is there any significant effect of different realism designs of the 2D female virtual agents on students' valence?	ANOVA
2	Is there any significant effect of different realism designs of the 2D female virtual agents on students' arousal?	ANOVA

(continue)

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Table 3.6. *(continued)*

	Research question	Statistical Analysis used in the research
3	Is there any significant effect of Quiz based Multimedia Learning Environment (Q-MLE) with different realism designs of the 2D female virtual agents on students' emotions in learning?	ANOVA
4	Are valence and arousal caused by different realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning?	Mediation analysis (Bootstrapping Method)

Consequently, in order to find out the pair of virtual agents that shows a significant difference, Tukey's Honestly Significant Difference (HSD) post hoc comparison tests was performed. In addition, descriptive analysis was used to obtain mean score, standard deviation and total sample size of each group.

In order to answer the forth research question, mediation analysis was tested using PROCESS macro (v3.3) for SPSS in order to test whether students' emotions in the dimension of valence and arousal play a role as mediators to the relationship between different realism designs of the virtual agents and emotions in learning.

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3.10 Summary

In chapter 3 (research methodology), the researcher described in detail the research methods adopted in conducting the study on different realism designs of virtual agents in inducing students' emotions in learning. Research designs, variables, population of the study, sampling method and research instruments were identified based on books and journals. The research is quasi-experiment design and the data of the research obtained in quantitative method. This method was utilized as limits in the potential scope of study for more concise analysis. Also, this chapter outlined the data collection process and the data analysis method for the completion of the research. ANOVA test and mediation analysis (bootstrapping method) were carried out to answer the research questions as discussed in chapter one. Besides that, this research was tested for the view of a potential relation between the independent variables, mediator and dependent variables.

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CHAPTER 4

DESIGN AND DEVELOPMENT

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4.1 Introduction

The intention of chapter four is to demonstrate all steps and aspects involved in developing Quiz based Multimedia Learning Environment (Q-MLE) for this research. Successive Approximation Model (SAM) iteration is valuable and powerful, thus designing and development process of this research was mainly base on it. Besides, the design of the Q-MLE is based on Gagne's model. The Gagne's model that consisting of nine instructional events used to enhance learning outcomes and deliver positive impacts to the users. In addition, the illustrated storyboard for this research is a perfect reference to ease the interface making process and lower the unexpected errors count ratio. From there, the Q-MLE drives with different functions through several screens namely home, question, feedback, hint, reward and review screens. Adding to this, the

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development of virtual agents' design began from the process of sketching, texturing and animate it using the software of Adobe animate CC. The four different realism designs of virtual agents went through in a similar manner of making process. The complete Q-MLE with the instructional role of virtual agent capable of encouraging students to pay closer attention, stimulate their emotions and indirectly improve their comprehension towards the subject.

4.2 Instructional Design Model

The development of multimedia-based learning material requires appropriate instructional design model as a guide to produce an effective design. An instructional design model provides design principles, structures and patterns to generate instructional content for the real world application. Basically, there are many models available that can be used for the instructional system design such as ADDIE (analyse, design, develop, implement and evaluate) model (Branch, 2010), SAM model (successive approximation model) (Allen, 2012), Dick and Carey model (Dick & Carey 2009), Agile model (Ambler, 2002), Kemp's instructional design model (Kemp, 1985) and so on.

Recently, Successive Approximation Model (SAM) became very popular as the most effective model for instructional design (Green, 2014; Thomas, Lee & Ess, 2015; Wang, Brown & Ng, 2012). This model introduced by Allen (2012), where the approach of SAM is approximately similar to Agile Model and ADDIE model. This is in line with the emphasis that given to three main aspects in the designing and

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development process of the model, which are cooperation, efficiency and repetition. SAM capable in providing greater focus on content organization, presentation of information and summative post-tests in order to enhance learning experiences, learner engagement and learner motivation (Allen, 2016).

Apparently, SAM is a good approach in which the three-step process will be repeated constantly to create the best learning experience in a controlled manner (Allen, 2012; Green, 2014). The concept of SAM is presented by repeating small steps (iterations) instead of repeating a huge step for a long time (Allen, 2012). All the phases work through these small steps to ensure the works are proceeding on the right path. Before heading to the next step, each small step is repeated until the desired degree of accuracy achieved (Allen, 2012). This also allows errors found in each step to be corrected easily. The solution discovered from previous attempts will be used for the further improvement of the design. Therefore, SAM is a series of attempts to solve an instructional problem until produce an effective instructional design. There are two types of SAM namely, Simple Successive Approximation Model Iteration (Simple SAM) and Three-Phase Successive Approximation Model (Three-Phase SAM).

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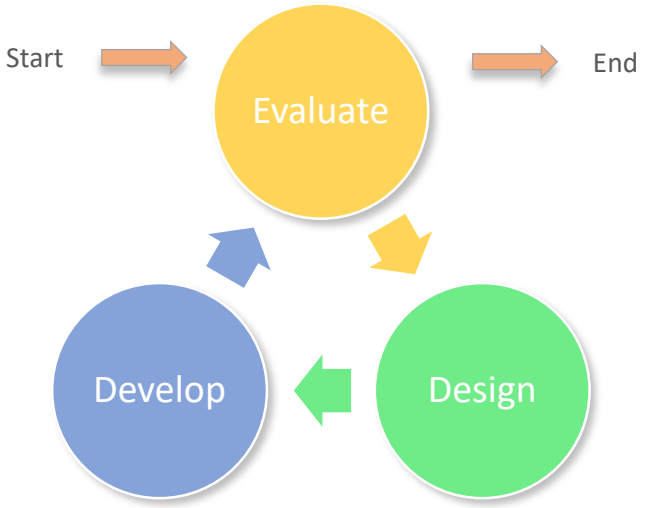


Figure 4.1. Simple Successive Approximation Model. Source: Allen (2016)

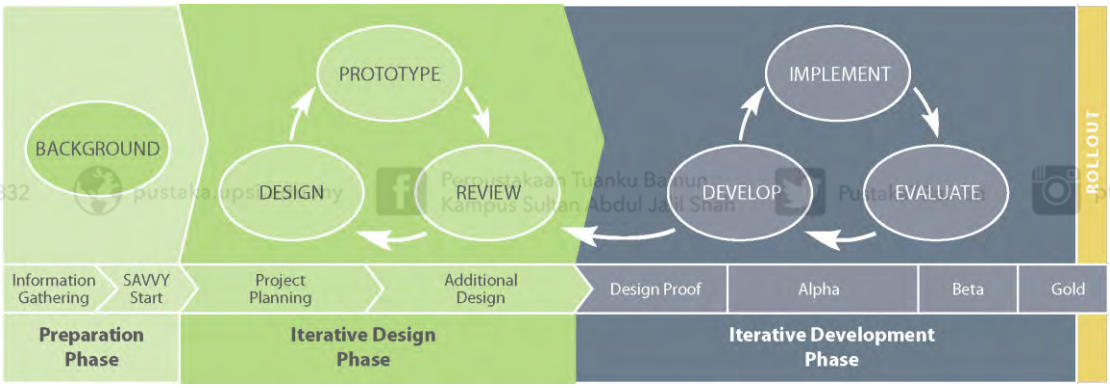


Figure 4.2. Three-Phase Successive Approximation Model. Source: Allen (2016)

Figure 4.1 shows the basic iterative processes that exist in Simple SAM. Although it looks simple, it actually represents a valuable and powerful way in developing effective design (Allen, 2012, 2016). Thus, Simple SAM iteration is suitable to use for research purpose. It is very effective and well suited to smaller projects especially when individual work done or a small team is used. Since the Simple SAM iteration is valuable and powerful, thus designing and development process of this research was mainly base on it. The three phases of the Simple SAM are evaluate

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(or analysis), design and develop. The three-step process in the Simple SAM starts with preliminary evaluation and end with final evaluation. The preliminary evaluation focuses on the situation, needs and alternative solutions. This continued with design phase. The physical design structures, the virtual agents' prototypes and instructional content covered in this design phase. Then, in development phase, the interface design, the virtual agents and the content developed.

After each successive cycle of design and development, the emerging solution evaluated again to determine appropriateness and effectiveness of the developed design. Information gathered from the preliminary evaluation is also re-examined again to ensure accuracy and sufficiency of the design. Upon completion of first cycle design, prototyping and evaluation continued iteratively in small steps. The iterative design process provides a way to get the most effective design possible within the constraints of a real project (Allen, 2012). Accordingly, two or more times the iteration repeated in order to produce an effective Quiz based Multimedia Learning Environment (Q-MLE).

4.3 Evaluation/Analysis phase

First iteration

Simple Successive Approximation Model Iteration (Simple SAM) model begins and end with evaluation phase. The needs of instructional design identified in this first iteration of evaluation phase, which allows the main objectives to discovered. Accordingly, the preliminary evaluation looks at the objectives of the instructional

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design and the target audience. Besides, the identification of the delivery platform is very important in this phase in order to decide on the software that used to develop the Quiz based Multimedia Learning Environment (Q-MLE). Thus, the content for the instructional design and method to deliver it outlined.

Second and third iteration

For the second iteration of the evaluation phase, the success of the first iteration determined. Here, analysis had been done again in order to determine if there are any additional situation, need and goals to add. Third iteration of the evaluation phase is similar to the second one. In third iteration, issues that aroused in second iteration cease to be re-examined.

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4.3.1 Objective

The main objective of this instructional design is to apply virtual agent as interactive pedagogical agent in developing effective Quiz based Multimedia Learning Environment (Q-MLE) for students. The objectives of the Q-MLE as follows;

a. To evaluate students' knowledge in the scalable and flexible learning environment.

b. To engage large number of participants to take part in the Q-MLE at the same time in a unique and fun way.

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c. To produce immediate feedback and results to the participant to assess students' comprehension in learning.

d. To set a timer for the whole quiz in order to complete the quiz in the allocated time.

e. To show one question at the time where students not able to skip a question and they cannot leave the answer blank.

4.3.2 Target audience

The target audience for this Quiz based Multimedia Learning Environment (Q-MLE) are electrical engineering department students from polytechnic Malaysia who enrolled in Interactive Multimedia Applications subject. The subject selected based on the difficulties faced by the students in mastering the theoretical part of the subject. The quiz helps to enhance students' performance and it can assist students in remembering important terms or concepts of the subject (Roediger et al., 2011).

4.3.3 Software

The Quiz based Multimedia Learning Environment (Q-MLE) and the virtual agents developed by using multiple software, which are available on market. Choosing the right software for the development is a very significant step. Hence, the software for

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the development of Q-MLE chosen based on the knowledge and ease of use as explained below.

4.3.3.1 Adobe Animate CC

The software of Adobe Animate CC used for the development of 2D animated virtual agents and lip-syncing. Basically, this software focused on the creation of facial designs and lips of the virtual agents. Animated buttons also created by using this software.

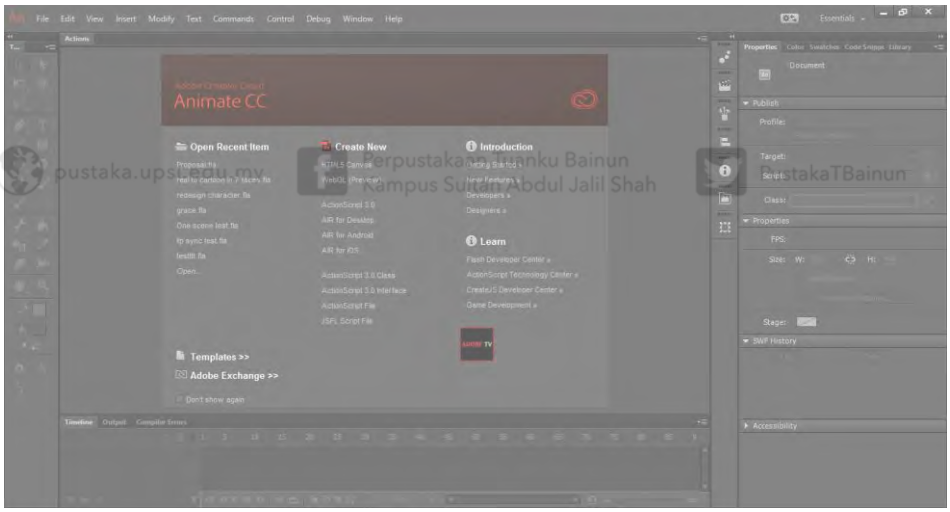


Figure 4.3. The Interface of Adobe Animate CC

4.3.3.2 Adobe Photoshop CS6 and Adobe Illustrator

Adobe Photoshop and adobe illustrator are photo-editing tools, which used to edit the background image, icons and the buttons for the Quiz based Multimedia Learning Environment (Q-MLE). Adobe Photoshop used to design realistic agent and semi-

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realistic agent as these both agents are pixel-based design. Whereas Adobe Illustrator used to design cartoon-like agent and stylized agent as it both are vector-based designs. Other than that, the two-dimensional (2D) artworks enhanced in this software in order to produce high quality images.

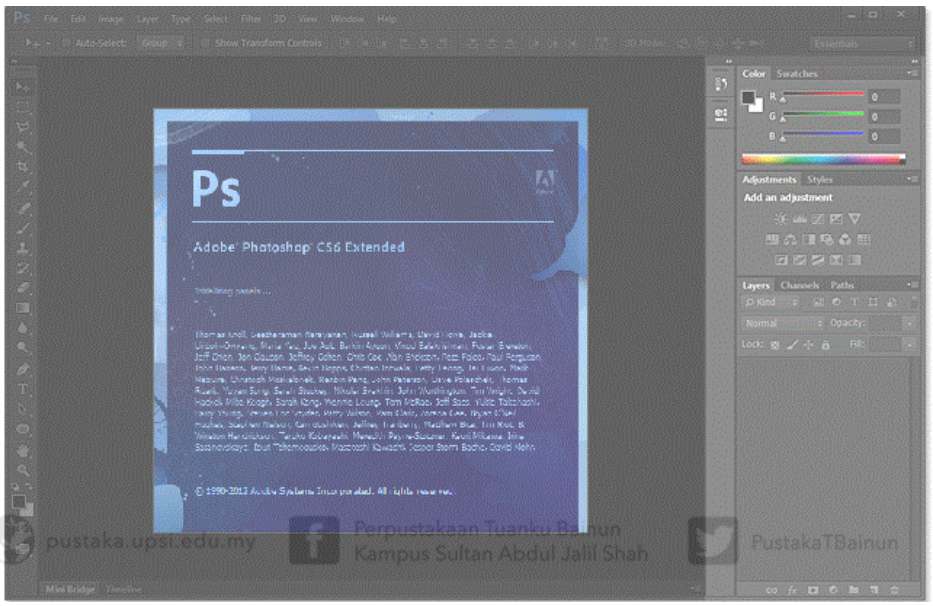


Figure 4.4. The Interface of Adobe Photoshop CS6

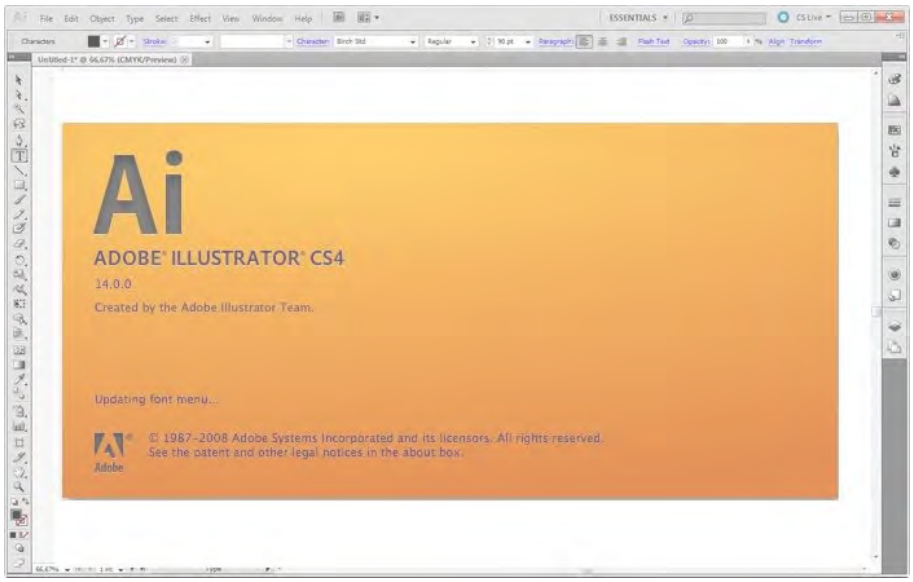


Figure 4.5. The Interface of Adobe Illustrator CS4

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4.3.3.3 Audacity 2.1.2

The verbal interactions allow students to respond to the virtual agent by clicking on multiple-choice answers. The software called Audacity 2.1.2 is used as a sound mechanism to record and edit the voice. Here, real human voice recorded for each agent. In particular, female voice (real human) had been chosen for the recording. After the creation of virtual agents, the recorded voice synchronized to the agent using this software. Besides that, this software also used to edit the virtual agent's voice and sound effects of the Quiz based Multimedia Learning Environment (Q-MLE).

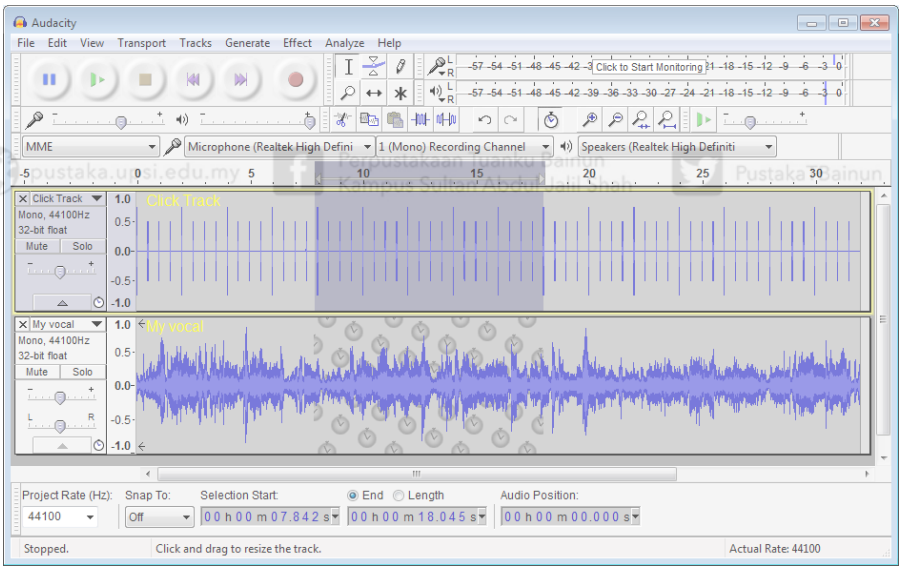


Figure 4.6. The Interface of Audacity 2.1.2

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4.3.3.4 Manga Studio 5 EX

Manga Studio 5 EX is a powerful art tool for every manga and comic artist. It is designed to enhance and produce a perfect illustration digitally. Thus, Manga Studio 5 EX used for the development of realistic virtual agent.



Figure 4.7. The Interface of Manga Studio 5 EX

4.3.4 Multimedia Learning Environment

The quiz was implemented in Multimedia Learning Environment (MLE) in order to promote students' learning (Mayer, 2008, 2014). A well-established line of researches revealed that students learn better from words and graphics than from words alone (Mayer, 1989, 2008; Moreno & Mayer, 1999). Thus, the Quiz based Multimedia Learning Environment (Q-MLE) designed with Gagne's nine events of instruction (Gagne, Wager, Golas & Keller, 2005) with the combination of multimedia elements

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such as text, graphic, audio, video and animation. Besides that, a successful learning experience can be created by designing well-made agent in a controlled learning environment (Johnson et al., 2000). In view of that, the developed virtual agents act as instructor to interact with the students through narration throughout the learning process.

Specifically, the Q-MLE contains 20 multiple-choice questions from first chapter of the chosen subject. Students are required to answer all the questions presented by the virtual agent. Virtual agent responded to the students based on the choice of answer by them.

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4.3.5 Content

Usually, students excel well in practical works. However, they are having difficulties in portraying the theory learned and difficult to remember it. Basically, Interactive Multimedia Applications subject consists of full theory that need understanding in order to remember the important terms and concepts. In view of that, first chapter from the selected subject chosen for the Quiz based Multimedia Learning Environment (Q-MLE). This Q-MLE helps students to remember important terms and concept in the subject. There are 20 multiple-choice questions in this Q-MLE that created based on the content of the first chapter of the subject.

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4.3.6 Method

Once the objectives and content of the instructional design identified, the method to deliver it to the target audience determined. Quizzes are useful assessment method to examine what has been taught in classroom (Gholami & Moghaddam, 2013). Correspondingly, the Quiz based Multimedia Learning Environment (Q-MLE) created with 20 multiple-choice questions from the first chapter of Interactive Multimedia Applications subject. Besides that, quizzes with various interactive way capable to encourage students to pay closer attention and indirectly improve their understanding on the subject (Brothen & Wambach, 2004; Graham, 1999; Johnson & Kiviniemi, 2009; Narloch et al., 2006). With this in mind, virtual agents developed as learning companions to conduct the quiz in interactive way in the Q-MLE.

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There were five different realism designs of virtual agents that developed for the Q-MLE, which later reduced to four virtual agents according to experts' feedback. The quiz questions for these prototypes are same. In the first prototype, realistic virtual agent has been used with the availability of audio narrative by the virtual agent. In the second prototype, semi-realistic virtual agent that are partially realistic has been used with the availability of audio narrative. At the same time, in the third prototype, stylized agent that are not realistic has been used which presented together with audio narrative. Fourthly, semi-stylized virtual agent that are partially stylized agent has been used with the availability of audio narrative (this agent was removed from the study at second iteration of the develop phase). Finally, cartoon-like agent has been used. This virtual agent is iconic with typical look of cartoon that presented together with audio narrative.

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Throughout the Q-MLE, the virtual agent presented at all times in order to guide the students with multiple spoken dialogues as the social affinity between virtual agent and students. The Q-MLE act as stand-alone quiz platform.

4.4 Design Phase

First Iteration

Once the evaluation or analysis phase is done for the first iteration, it continued with the design phase. The first design surely replaced in subsequent iterations, so it should have only just enough substance to identify strengths and weaknesses (Allen, 2016). Hence, a quick rough sketch is usually sufficient for the first iteration. The vital information lacks with limited analysis for the first iteration but it can evolve along the iteration. With this in mind, first prospective design generated for discussion (Allen, 2016). In this first iteration, designs were in the form of visual from the beginning but not elegant.

Second and Third Iteration

In the second iteration of the design phase, first designs kept aside. It enabled to come up with something entirely new and it brings out a superior design. At this phase, ideas need to be more detail that retained from previous iteration. Correspondingly, content that did not accommodate well in the first iteration had been identified and initial designs created. These include design of virtual agent, Quiz based Multimedia Learning Environment (Q-MLE), content and the flow of the Q-MLE in the form of flowchart. With this flowchart, interface design can be visualized for the appropriate screen. A

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storyboard prepared to outline the storyline of the Q-MLE. Appropriate interaction added for the result of high quality interaction design. In the third iteration of the design phase, design restrictions had been softened a bit.

4.4.1 Virtual Agent

The main objective of the study is to investigate on the impact of realism thus bigger prominence has been given in designing virtual agent. Therefore, five different realism designs of virtual agents were developed. The virtual agents for this Quiz based Multimedia Learning Environment (Q-MLE) are female virtual agents that localize Malaysian Malay young lady. The cloth for the five virtual agents kept same. Past researches on colour show an increase in pleasure and excitement due to the saturated and warm colours (Bellizzi & Hite, 1992; Plass, Heidig, Hayward, Homer & Um, 2014; Tucker, 1987; Um et al., 2012; Wolfson & Case, 2000) and it has been found that they can stimulate greater feelings such as pleasure and excitement. Consequently, the strongest effects can be found between warm, light colours (e.g., yellow, orange) and dark or achromatic colours (e.g., grey) (Kaya & Epps, 2004; Plass et al., 2014). Therefore, the hijab for the virtual agents is in orange colour and the cloth is in yellow colour. The five prototypes are as follows.

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4.4.1.1 Realistic Agent

Realistic agent mimics like human. Thus, the agent was designed with much more details compared to other four virtual agents. Consequently, the agent looks like human. Therefore, the eyes, nose, mouth and skin tone were designed to look realistic.

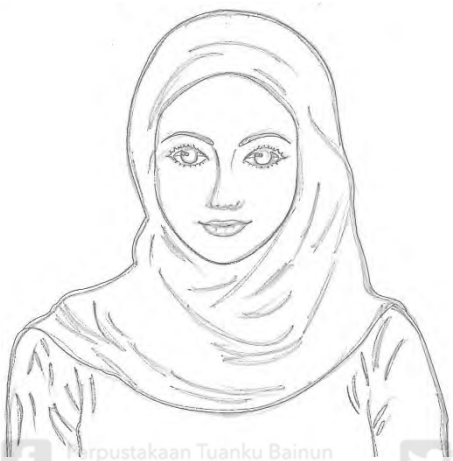


Figure 4.8. Sketched Realistic Agent

4.4.1.2 Semi-Realistic Agent

Semi-realistic agent is based on realistic agent. The virtual agent was designed partially realistic and not as detailed as the realistic. Even though the virtual agent designed to appear more human-like, but it still depicts stylized features such as eyes, nose, mouth and skin tone.

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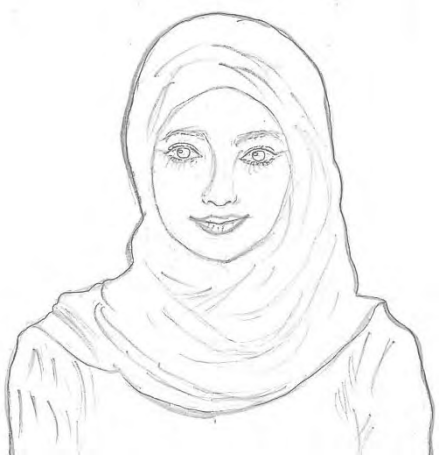


Figure 4.9. Sketched Semi-Realistic Agent

4.4.1.3 Stylized Agent

Cartoon-like agent which was designed with stylized elements or exaggerated features called as stylized agent. Designers rely on stylization to increase appeal or expressivity, exaggerating or softening specific features (Zell et al., 2015). Thus, the virtual agent designed with thin eyebrows, bigger and expressive eyelashes, larger pupils, thinner chin, plump nose and plump lips. Additional features such as glass and flower pin included on hijab as well.

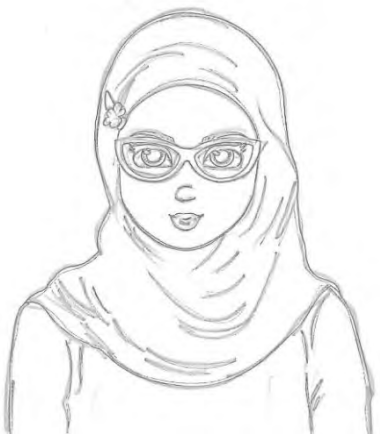


Figure 4.10. Sketched Stylized Agent

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4.4.1.4 Semi-Stylized Agent

At the same time, semi-stylized agent is based on stylized agent. The agent designed partially stylized. It designed with lesser-exaggerated features.



Figure 4.11. Sketched Semi-Stylized Agent

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4.4.1.5 Cartoon-Like Agent

The cartoon-like agent uses animated character that are iconic match a typical cartoon model. The design is simplified geometry of a face. The virtual agent designed with medium size eyebrows, medium size and expressive eyelashes, larger pupils, thinner chin, small nose, lips and hijab. In order to give the typical look of cartoon, the agent designed with lesser details.

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Figure 4.12. Sketched Cartoon-Like Agent

4.4.2 Multimedia Learning Environment

There are many theories for the development of instructional design. Among them, Gagne's model is widely used for the design of learning content. The application of Gagne's model in teaching has increased its learning outcome (Tsai, 2008). Besides that, the usage of Gagne's model in the teaching and learning process has brought huge changes and delivered positive impact to the students (Belfield, 2010).

In view of that, Gagne's model is the basis for the instructional design of this research. Gagne's model consists of nine instructional events as indicated in Table 4.1. The nine instructional events are effective way to enhance the quality of learning process by increasing the students' capability and performance (Gagne, 1977).

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Table 4.1.

Gagne's Events and Internal Mental Process. Adapted from Gagne et al. 2005

Gagne's Instructional Event	Internal Mental Process
1. Gaining attention	Activate the stimuli receptors
2. Informing students of objectives	Create level of learning expectation
3. Stimulating recall of prior learning	Retrieve an activate working memory
4. Presenting content	Perceive, recognize content and pattern
5. Providing learner guidance	Rehearse and encode the knowledge to memory
6. Eliciting performance	Retrieve, respond and enhance encoding by responding to questions
7. Providing feedback	Reinforce and assess the learning performance
8. Assessing performance	Reinforce the contents as the evaluation
9. Enhancing retention	Retrieve and generalize the learned skill to the situation or case

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In addition, the order of the instructional events can be changed according to the learning process needs to achieve the effective objectives (Martin & Klein, 2008). Therefore, Gagne's instructional event rearranged for the interface design of this research. This arrangement also in accordance to the research objectives. The usage of Gagne's nine events for the development of Quiz based Multimedia Learning Environment (Q-MLE) as shown in the Table 4.2.

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Table 4.2.

The Events in Quiz based Multimedia Learning Environment

Events	Gagne's Model	Features
Introduction Event	Event 2 in Gagne' model: Informing students of objectives ▪ Provide learning expectations in order to motivate students in completing the quiz.	• Introduction section and learning objectives are presented at the home screen.
Guidance Event	Event 5 in Gagne' model: Providing guidance to students ▪ Rehearse on rules of the quiz to enhance students' understanding.	• Instructions of quiz are presented at the info screen.
Assessment Event	Event 6 in Gagne' model: Eliciting performance ▪ Enhance the encoding of new knowledge	• Quiz is prepared to test students understanding about the specific chapters.
Question Event	Event 4 in Gagne' model: Presenting content ▪ Meaningfully present the questions to the students.	• Questions in the form of text appearance • Animated agent with voice where students could listen to the question.
Feedback Event	Event 7 in Gagne' model: Providing feedback ▪ Provide formative feedbacks as the result for the questions.	• Provide feedbacks upon the completion of each question.
Hint Event	Event 3 in Gagne' model: Stimulating recall of prior learning ▪ Provide hints to recall the existing knowledge	• The hints are presented before redo again the question.
Interval support Event	Event 1 in Gagne' model: Gaining attention ▪ Grab the students' attention to engage them throughout the section.	• Animated agent with concern-related dialogues are presented as the support elements.
Reward Event	Event 8 in Gagne' model: Assessing performance ▪ Evaluate the level of knowledge mastery	• Students' scored marks and time taken to complete the quiz are shown.

(continue)

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Table 4.2. *(continued)*

Events	Gagne's Model	Features
Review Event	Event 9 in Gagne' model: Enhancing retention ▪ Generalize the correct answers	• Review section is added by showing correct answer for each question for knowledge enhancement.

Besides the principles of Gagne's model, multimedia elements also used for the physical design structure of the Q-MLE. The combination of Gagne's model and multimedia elements able to produce better performance and ensure the existence of interactivity throughout the Q-MLE. Figure 4.13 represents this combination for the development of instructional design.

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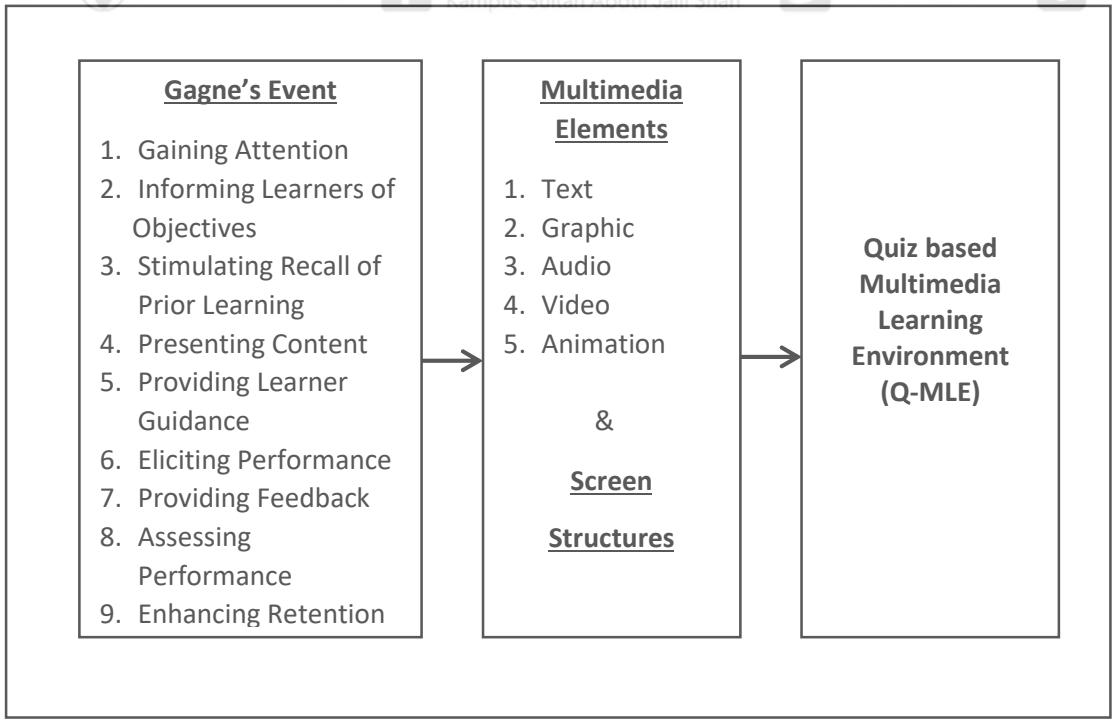


Figure 4.13. Development of Quiz based Multimedia Learning Environment (Q-MLE)

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4.4.3 Design Structures of Quiz Based Multimedia Learning Environment

There are five important multimedia elements involved for the psychical design structure of this Quiz based Multimedia Learning Environment (Q-MLE). These include text, audio, video, animation and graphic. In addition, the psychical design structure also concerns about screen design to produce computer-based application.

4.4.3.1 Text

The answers for the quiz in this Multimedia Learning Environment (Q-MLE) are presented in a text for the student to read. Students may respond by clicking on the available text responses. Text styles and background colours on the screen can affect the readability of the screen, external cognitive load and learning retention (Mayer, 2014; Swezller , 1994) Accordingly, the text used in this quiz selected by considering the following criteria:

- **Font Type** - The chosen font for this quiz is from san serif category which is Verdana. This font face is chosen due to its' good readability on screen display than the serif fonts which is more suitable for printed output (Ahmad Zamzuri, 2018; Ahmad Zamzuri, Rahani, Khairulanuar & Muhammad Zaffwan, 2013; Peck, 2003; Hughes, 1999). Thus, this font used for the texts in the screen.

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- **Font size** –Use of font size that smaller than 12-point lead to student's slower and harder reading (Leavitt & Shneiderman, 2006; Rello, Pielot & Marcos, 2016). Hence, the chosen size for the font is 12-point. This is to ensure the readability of the texts is easy and clear.

- **Font colour** – Black text on a blank background makes a big difference that allows students to read more quickly and easily (Leavitt & Shneiderman, 2006; Williams, 2000). Therefore, the font colour for the text is black.

4.4.3.2 Graphic

Graphic refers to any image that produced with the use of certain software and computer technology. In the Quiz based Multimedia Learning Environment (Q-MLE), graphics used as clickable icons such as home button, next button, replay button, info button and exit button. The behavioural aspects of button commands enable the end-user to activate an event (Mohamad Nizam, Santhimathy & Nurul Fazmidar, 2005). All the screens or events link to each other based on button interactivity. Thus, each button created with unique appearance based on the following criteria:

- **Button's appearance**- The use of image to represent an object is easier to remember than text (Krull & Watson, 2002; Leavitt & Shneiderman, 2006). The buttons produced by scratching the appropriate image using Adobe Photoshop CS6. Then, the scratched buttons designed with a 3-D appearance and modified by filling with colours.

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- **Button's text** - Students can integrate with a clickable image if it is designed together with the text (Leavitt & Shneiderman, 2006; Williams, 2000). The produced image buttons added with most common text. The buttons that designed together with text make the students aware of the name of the screen which links that button (Faiola, 2000; Poncelet & Proctor, 1993).

- **Button's state** - The existing screens of the Q-MLE portrayed with 'push down' state of the buttons.

4.4.3.3 Audio

Audio can be defined as any sound in digital form such as background music, narration and others that can be heard. The virtual agent's narration and background music (surprising elements) used alternatively in the Quiz based Multimedia Learning Environment (Q-MLE). The detail of audio that used as follows;

- **Narration** - The interaction between students and virtual agent established through an asynchronous voice dialogue (Burleson, Picard, Perlin & Lippincott, 2004). Taking this into consideration, the text already available on the screen when the recorded voice dialogue speaks by the virtual agent. The virtual agent speaks using standard and clear Malaysian's female voice. There is no any slang used in the voice. The selection of the voice is based on the consideration on the comforts of students. Usually, students feel familiar with the localized voice.

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- **Background music**- Past studies show that background sound that used as a music or ambient sound can harm learning (Peters, 2014). This is due to the repetitive sounds, sudden or loud sounds that unconvincing to the students (Peters, 2014). However, according to Nielsen and Loranger (2006), sound that used as feedback can be very effective to confirm selections or alert to errors. Moreover, the use a good audio in order to represent an instruction is very important to attract students even concentration of students not on the display (Alessi & Trolip, 2001). In view of that, appropriate sound played as surprising elements for various responses in the Q-MLE.

4.4.3.4 Video

The animated virtual agent saved as a movie clip symbol to present in each screen of the Quiz based Multimedia Learning Environment (Q-MLE). The movie clip had its own timeline within the symbol. Besides that, the movie clip saved in the library to access it easily during the development of the Q-MLE. The movie clip has navigational controls, such as play, pause and stop buttons. These enabled students to replay the clip as they wished.

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4.4.3.5 Animation

Animation is a technology that enables a still image to look as though it is alive, able to move, act and talk. Animated virtual agent used as pedagogical agent for the virtual interaction with the students throughout the Quiz based Multimedia Learning Environment (Q-MLE). The design and implementation of a virtual agent based on natural face-to-face interaction in the real world using verbal and nonverbal communication techniques (Johnson et al., 2000; Laurel, 1997). Also, cognitive styles of individuals produced by considering about personality, human nature and culture (Parrish & Linder-VanBerschot, 2010).

For that reason, two-dimensional animation (2D) virtual agents developed with five different realism designs (it had been reduced to four different realism designs later). In the development of a virtual agent, the consistent lip movements with speech also need to be considered (Ezzat & Poggio, 2000). Accordingly, synchronised lip movement implemented to the virtual agent to provide speech that communicate with students. It also increases the attractiveness of the Q-MLE. Some students are willing to spend time and effort in learning environment that use of interactive pedagogical agents (Railean, 2016).

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4.4.4 Screen Structures

Each screen is organized systematically so that it is connected to each other and limited to present one concept. In between that, variety of principles were considered while developing screen layout as below:

- **Screen size**

  The large screen size expands the interface between humans and screens (De Melo & Gratch, 2009). In line with that, the default size or resolution of the entire screen is 780x440 pixels ("eLearning design guide", 2013). This size had been chosen so that the full screen display is very convenient to the students.

- **Cues**

  All the clickable objects that placed consistently at the top and bottom of each screen can be better estimated by the student and easily achieved it at the time (Hornof & Halverson, 2003; Leavitt & Shneiderman, 2006).

  - **Home button**

    Home button placed on top of each page so that the student can reach the main page easily and immediately from any of other screen (Leavitt & Shneiderman, 2006; Lynch & Horton, 2008). Thus, the present of home button at top-right of the screen provides consistency and familiarity to the students to achieve it.

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- **Exit button**

  Students can exit from the screen by clicking on the exit button. This exit button also at the top-right corner of all screens to lead the student exit from the quiz easily.

- **Screen title**

  The clear and concise title on each screen allows the student to easily recognize and access the screen (Leavitt & Shneiderman, 2006). Therefore, the title of each screen placed at the top-center of all screens.

- **Background colour**

  Black text on a white background is easier to read than other combinations (Hall & Hanna, 2004). Moreover, a white background with black text provides maximum contrast (Lynch & Horton, 2008). Also, the usage of same colour throughout the screen produce consistent based on soothing factor and consistency factor in user interface design (Ambler, 2000). In view of that, white colour used as the background colour for the entire screen in Quiz based Multimedia Learning Environment (Q-MLE).

4.4.5 Flowchart of Quiz Based Multimedia Learning Environment

The Quiz based Multimedia Learning Environment (Q-MLE) begins with the home screen (main menu). The top menu is the starting point that includes the basic selection of menus and available in all the other menus in which students able to return to the home base (Galitz, 2002).

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Virtual agent in this home screen greets the students, introduces herself and provides briefing about the Q-MLE. In order to start the quiz session, the students need to press the start button. Thereafter, the students provided with a question. In addition, the students allowed to repeat the question as many times as they want by clicking on the play button. After the completion of each question, students received feedback based on their answer. If the students answered correctly, they could move on to the next question; however, if they answered incorrectly, they have to answer the question again but this time the virtual agent gives them a hint. The students need to repeat the question until answer it correctly. Along with the feedback, motivating and encouraging comments provided by the virtual agent throughout the Q-MLE.

Then, in the reward screen, total time scored say out by the virtual agent with additional expression. Finally, students can check the actual answers for all the questions by clicking at the review button. Students also can replay the quiz again by clicking to the start button appear in the screen. Hierarchical structure is suitable for use when many relationships exists between the alternative menus where the menu options depending on the previous selection menu (Galitz, 2002). Therefore, the overall relationship of the Q-MLE illustrated in the form of hierarchical flowchart as shown in the Figure 4.14.

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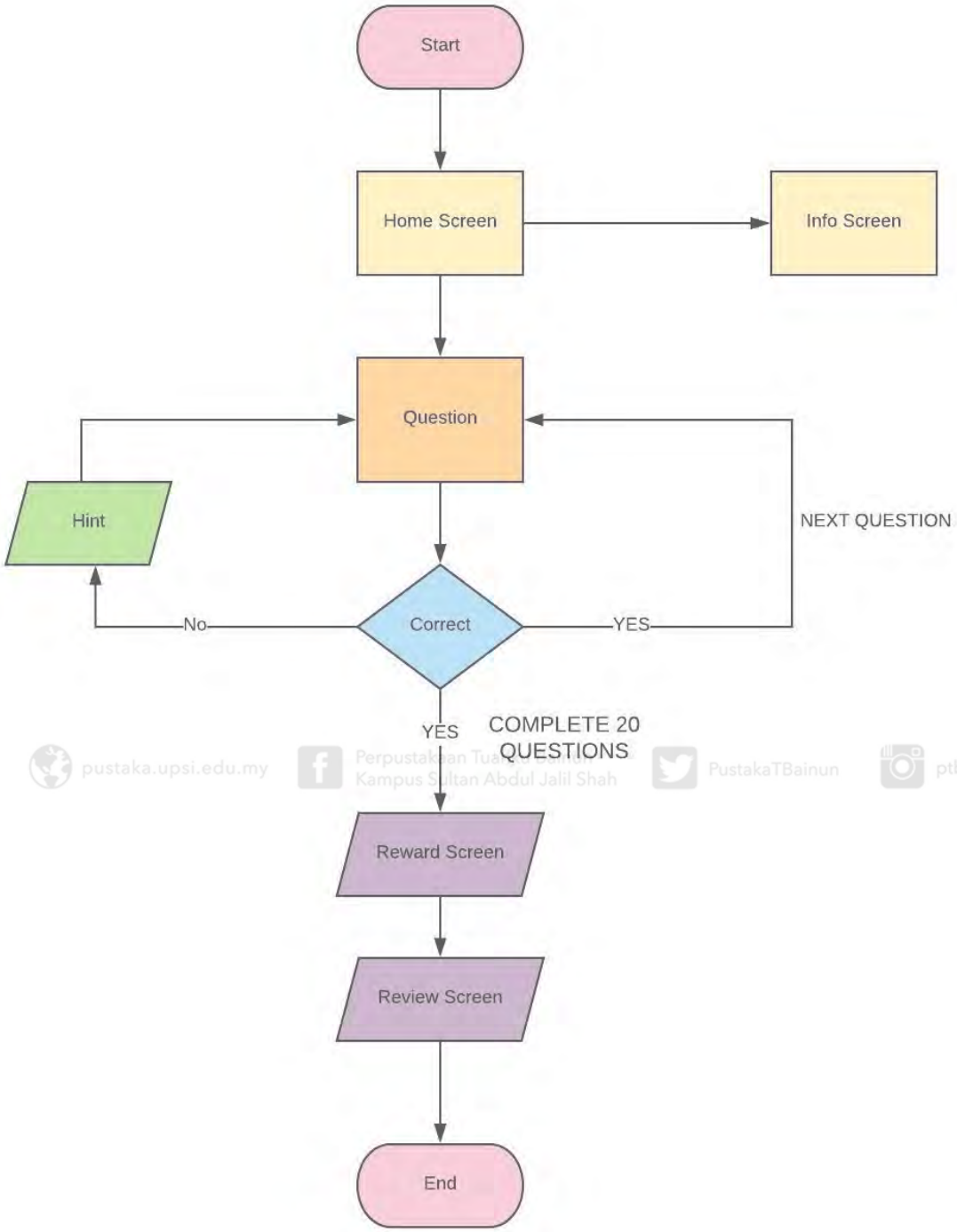


Figure 4.14. Flowchart of Quiz Based Multimedia Learning Environment

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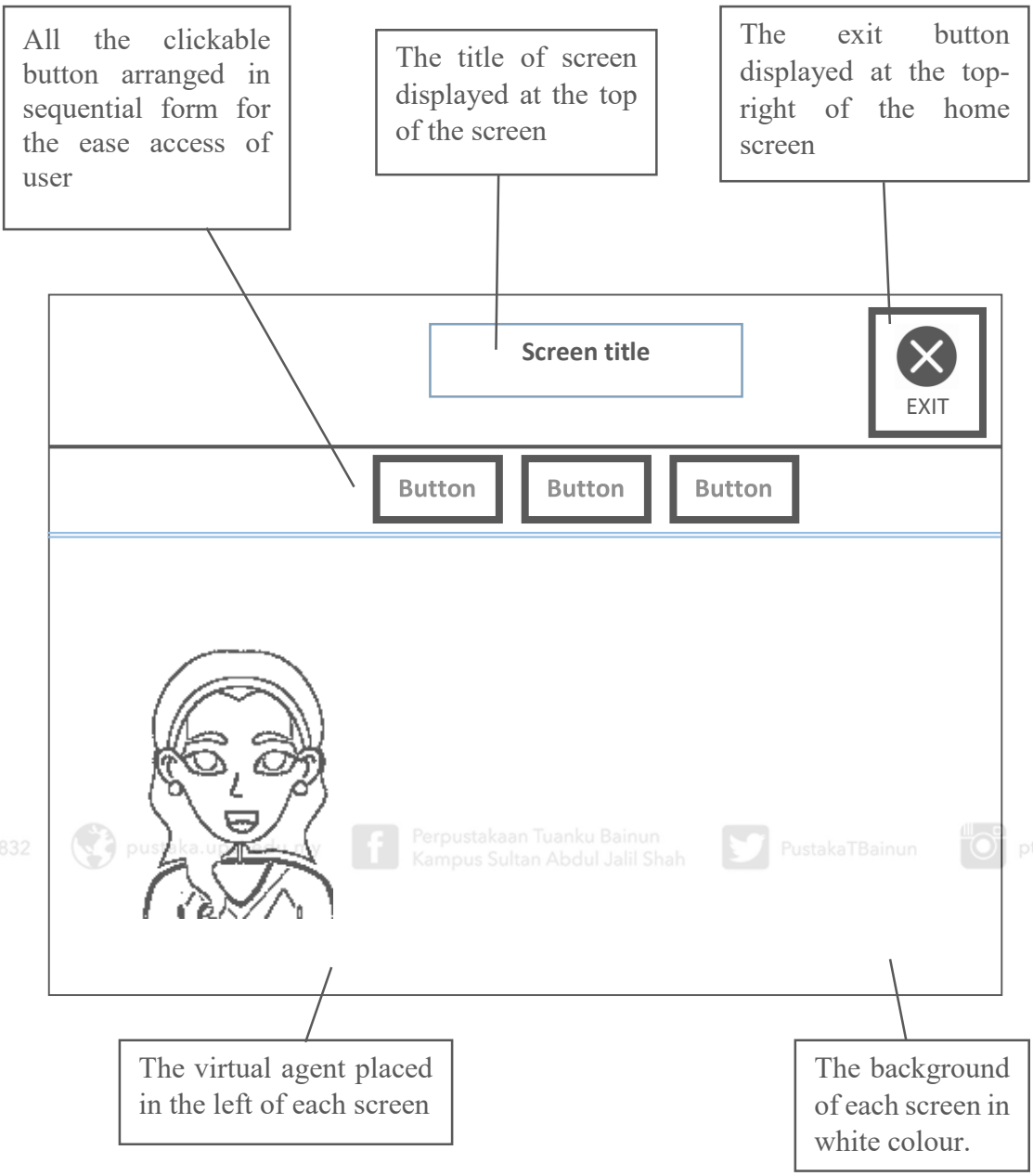


Figure 4.15. The Standard Look of the Screen in the Quiz Based Multimedia Learning Environment

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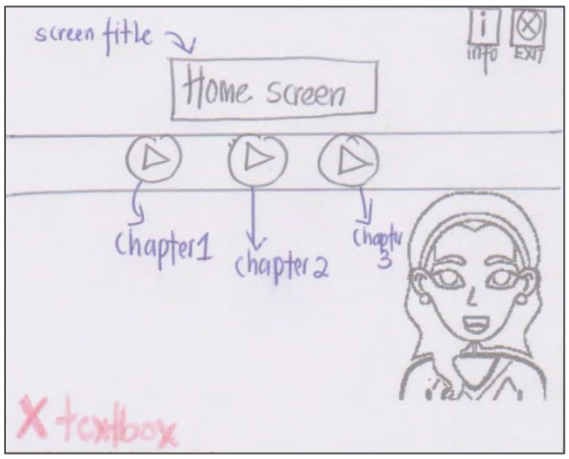
4.4.6 Storyboard

The Quiz based Multimedia Learning Environment (Q-MLE) consists of nine different events. The appropriate time period for the implementation of this quiz is 30 minutes. At each event in the Q-MLE, the dialogues presented by the virtual agent are corresponding to the students' response. The conversation tone is friendlier to create pleasant environment to the students. The storyboard along with virtual agent's dialogues, multimedia elements and the navigation buttons used for each screen explained in the table 4.3.

Table 4.3

Storyboard of the Q-MLE

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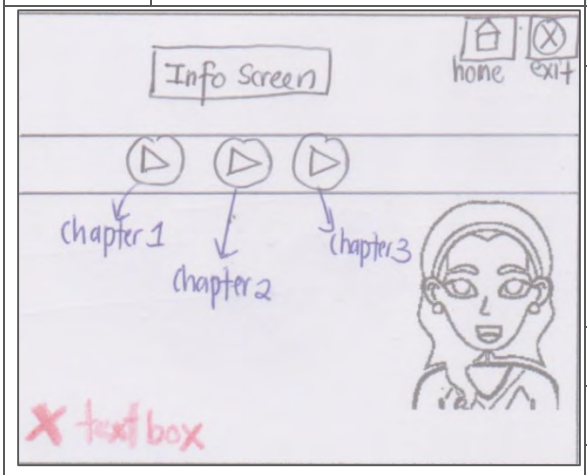
<table>
<tr><td>Screen 1</td><td>Screen Name: Home Screen-Introduction Event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2" rowspan="7">
</td><td>Text</td><td>Screen title</td></tr>
<tr><td>Image</td><td>button_start.gif
button_info.gif
button_exit.gif
button_play.gif
button_pause.gif
button-stop.gif</td></tr>
<tr><td>Audio</td><td>D1.2_.mp3</td></tr>
<tr><td>Music</td><td>none</td></tr>
<tr><td rowspan="2">Video</td><td>introduction.flv</td></tr>
<tr><td>duration : 3 minutes</td></tr>
<tr><td>Animation</td><td>female_virtual agent</td></tr>
</table>

(Continue)

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Table 4.3 *(continued)*

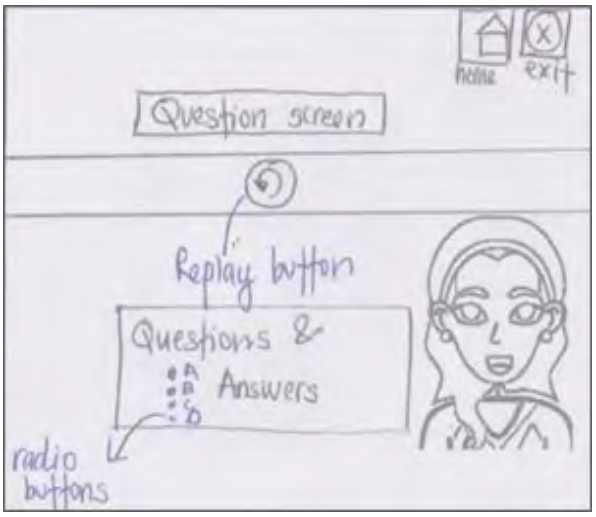
<table>
<tr><td>Screen 1</td><td colspan="2">Screen Name: Home Screen-Introduction Event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="6">Screen begins with virtual agent's introduction as the first event in the home screen before start the quiz. Here, the virtual agent greets the students and introduces herself. The students able to generate his or her impression to the virtual agent. In home screen, assessment event applied by providing start button that test the students understanding about chapter 1 of the Interactive Multimedia Applications subject. Students can attempt to answer the quiz as many as they want until produce satisfaction especially when they want to improve their time scores.</td><td>button_start.gif</td><td>start quiz of chapter 1</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
<tr><td>button_pause.gif</td><td>pause the dialogue presented by virtual agent</td></tr>
<tr><td>button_stop.gif</td><td>stop the dialogue presented by virtual agent</td></tr>
<tr><td>button_info.gif</td><td>go to info screen</td></tr>
<tr><td>button_exit.gif</td><td>exit from the quiz</td></tr>
<tr><td colspan="5">Narration Script</td></tr>
<tr><td colspan="5">"Hello, how are you? Welcome. I am Shamira. You are now with me in quiz-based multimedia learning environment (Q-MLE) for Fundamental of Multimedia course. It is a time to test your knowledge! Click on the chapter 1 and challenge yourself. You also can click on the info button to know the rules and regulations of the quiz …good luck!!! "</td></tr>
<tr><td>Screen 2</td><td colspan="2">Screen Name: Info Screen-Guidance Event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2" rowspan="7">
</td><td>Text</td><td>Screen title</td></tr>
<tr><td>Image</td><td>button_home.gif
button_exit.gif
button_start.gif
button_back.gif
button_play.gif
button_pause.gif
button_stop.gif</td></tr>
<tr><td>Audio</td><td>D2.2.mp3</td></tr>
<tr><td>Music</td><td>none</td></tr>
<tr><td rowspan="2">Video</td><td>information.flv</td></tr>
<tr><td>duration : 5 minutes</td></tr>
<tr><td>Animation</td><td>female_agent</td></tr>
</table>

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Table 4.3 *(continued)*

<table>
<tr><td>Screen 2</td><td>Screen Name: Info Screen-Guidance Event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="5"></td><td>button_home.gif</td><td>go to home screen</td></tr>
<tr><td>button_exit.gif</td><td>exit from the quiz</td></tr>
<tr><td>button_start.gif</td><td>start quiz of chapter 1</td></tr>
<tr><td>button_back.gif</td><td>go to home screen</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
<tr><td colspan="4">Narration Script</td></tr>
<tr><td colspan="4">“Dear students, there are 20 questions with four multiple choices of answers. It is important to achieve the correct answer for each question. Mouse over the answers and select a correct answer for every question in order to proceed to the next question. For the incorrect answer, participant need to repeat the question until answer it correctly. You will be prompt with hint button when you answer wrongly to the question. Please click the hint button to get hint related to the question.”</td></tr>
<tr><td>Screen 3</td><td>Screen Name: Question Screen-Question event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2" rowspan="6">
</td><td>Text</td><td>▪ Screen title answers appears on the textbox</td></tr>
<tr><td>Image</td><td>timer.gif
button_submit.gif
button_home.gif
button_exit.gif
button_play.gif
button_pause.gif
button_stop.gif</td></tr>
<tr><td>Audio</td><td>Q1.mp3 to Q20.mp3</td></tr>
<tr><td>Music</td><td>none</td></tr>
<tr><td>Video</td><td>question.flv
duration : 2 minutes</td></tr>
</table>

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Table 4.3 *(continued)*

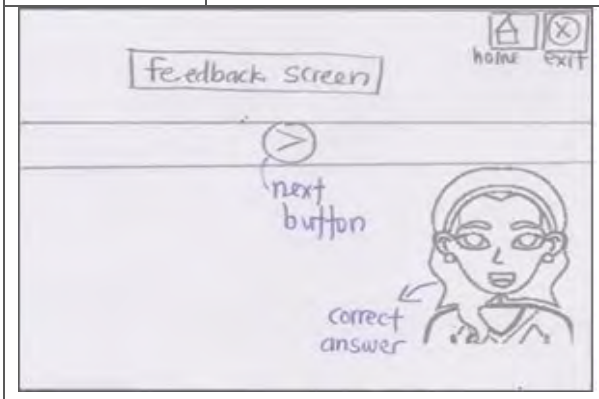
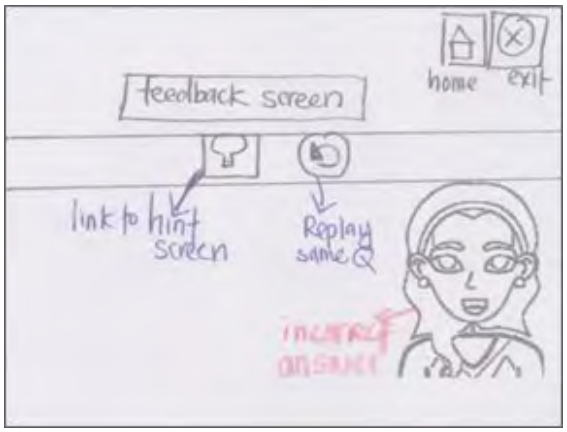
<table>
<tr><td colspan="4"></td></tr>
<tr><td>Screen 3</td><td colspan="2">Screen Name: Question Screen-
Question event</td><td>Multimedia elements:</td></tr>
<tr><td colspan="2"></td><td>Animation</td><td>female_agent</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="11">At the time students click on start button in home screen or info screen, virtual agent begins to conduct questions that available in each of the question screen. The virtual agent read the questions and choices of answers. Once the question starts, the countdown of the timer begins. Students need to pick a right answer from the given answer options. Then, they can click on submit button. Timer will stop momentarily when the submit button is pressed. The sequence of text displayed in text box represents the line of answers narrated by the virtual agent.</td><td>button_
submit.gif</td><td>link to feedback screen</td></tr>
<tr><td>button_home.gif</td><td>go to home screen</td></tr>
<tr><td>button_exit.gif</td><td>exit from the quiz</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
<tr><td>button_
submit.gif</td><td>link to feedback screen</td></tr>
<tr><td>button_home.gif</td><td>go to home screen</td></tr>
<tr><td>button_exit.gif</td><td>exit from the quiz</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
<tr><td colspan="2">Question Type :</td></tr>
<tr><td colspan="2">Multiple-choice questions</td></tr>
<tr><td colspan="2">Answer Keys:</td></tr>
<tr><td colspan="2">Radio button_choice A
Radio button_choice B
Radio button_choice C
Radio button_choice D</td></tr>
<tr><td colspan="2">Correct Answer:</td></tr>
<tr><td colspan="2">One of the radio button options</td></tr>
<tr><td colspan="4">Narration Script</td></tr>
<tr><td colspan="2">Reading the questions and answer options.</td><td></td><td></td></tr>
<tr><td colspan="4"></td></tr>
</table>

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Table 4.3 *(continued)*

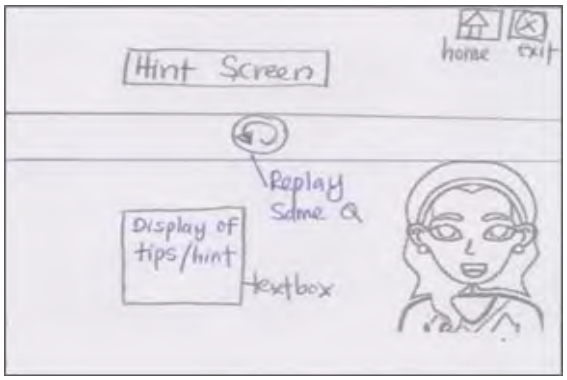
<table>
<tr><td>Screen 4</td><td colspan="2">Screen Name: Feedback Screen A- Feedback Event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2" rowspan="8">
</td><td>Text</td><td>none</td></tr>
<tr><td>Image</td><td>button_next.gif
button_play.gif
button_pause.gif
button_stop.gif</td></tr>
<tr><td>Audio</td><td>D3.1.mp3 to D3.3.mp3</td></tr>
<tr><td>Music</td><td>none</td></tr>
<tr><td>Video</td><td>Correct_feedback.flv
duration : 2 minutes</td></tr>
<tr><td>Animation</td><td>female_agent</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="4">This screen will be displayed with respect to the correct answer. The virtual agent provides positive feedback. There will be repetition of three types of scripts alternatively. From there, students able to proceed to next question by clicking on the next button. This cycle will be continued until the total of 20 questions completed.</td><td>button_next.gif</td><td>Link to next question</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
<tr><td>button_pause.gif</td><td>pause the dialogue presented by virtual agent</td></tr>
<tr><td>button_stop.gif</td><td>stop the dialogue presented by virtual agent</td></tr>
<tr><td colspan="5">Narration Script</td></tr>
<tr><td colspan="5">“Correct! You give it the best!” or “Wow!! Absolutely you are right!” or “Congratulations! Excellent Job!”</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Screen 5</td><td colspan="2">Screen Name: Feedback Screen B - Feedback Event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2" rowspan="7">
</td><td>Text</td><td>none</td></tr>
<tr><td>Image</td><td>button_redo.gif
button_hint.gif
button_play.gif
button_pause.gif
button_stop.gif</td></tr>
<tr><td>Audio</td><td>D4.1.mp3 to D4.3.mp3</td></tr>
<tr><td>Music</td><td>none</td></tr>
<tr><td>Video</td><td>Incorrect_feedback.flv</td></tr>
<tr><td></td><td>duration : 2 minutes</td></tr>
<tr><td>Animation</td><td>female_agent</td></tr>
</table>

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Table 4.3 *(continued)*

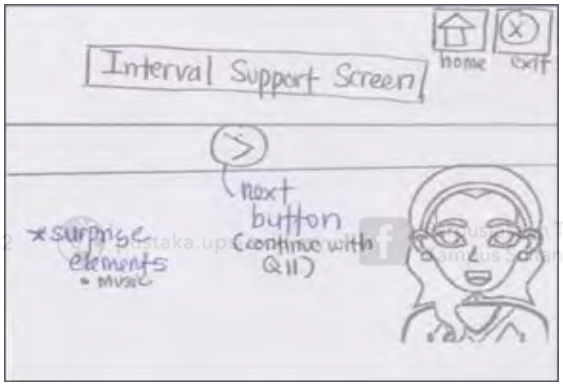
<table>
<tr><td colspan="4"></td></tr>
<tr><td>Screen 5</td><td colspan="2">Screen Name: Feedback Screen B - Feedback Event</td><td>Multimedia elements:</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="4">This screen will be displayed with respect to the attempt of wrong answer. There is a redo button to repeat again the same question where students will lead back to the question screen again. In case the students' answer still wrong in the second attempt, this feedback screen again will be displayed. Here, students need to redo again the same question until get correct answer. Hint button available here to link to hint screen. Timer will be continued from where it had left off.</td><td>button_redo.gif</td><td>Link to same question</td></tr>
<tr><td>button_hint.gif</td><td>go to hint screen</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
<tr><td>button_pause.gif</td><td>pause the dialogue presented by virtual agent</td></tr>
<tr><td colspan="2"></td><td>button_stop.gif</td><td>stop the dialogue presented by virtual agent</td></tr>
<tr><td colspan="4">Narration Script</td></tr>
<tr><td colspan="4">"Opsss…Sorry. Wrong answer! Try again!" or "No, something wrong, please try again!" or "Nope.. I disagree with your answer!"</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Screen 6</td><td colspan="2">Screen Name: Hint Screen- Hint event</td><td>Multimedia elements:</td></tr>
<tr><td colspan="2" rowspan="8">
</td><td>Text</td><td>Screen title</td></tr>
<tr><td>Image</td><td>button_back.gif
button_play.gif
button_pause.gif
button_stop.gif</td></tr>
<tr><td>Audio</td><td>H1.mp3 to H20.mp3</td></tr>
<tr><td>Music</td><td>none</td></tr>
<tr><td>Video</td><td>hint.flv</td></tr>
<tr><td></td><td>duration : 2 minutes</td></tr>
<tr><td>Animation</td><td>female_agent</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="2">In this screen, tips for each question will be displayed in textbox to give clues to the students. The back button in the hint screen enables the learners to redo again the same question.</td><td>button_back.gif</td><td>Link to same question</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
</table>

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Table 4.3 *(continued)*

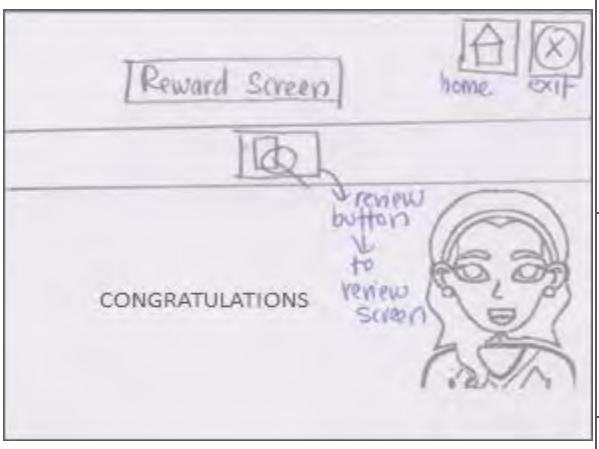
<table>
<tr><td>Screen 6</td><td>Screen Name: Hint Screen- Hint event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="2"></td><td>button_pause.gif</td><td>pause the dialogue presented by virtual agent</td></tr>
<tr><td>button_stop.gif</td><td>stop the dialogue presented by virtual agent</td></tr>
<tr><td colspan="4">Narration Script</td></tr>
<tr><td colspan="4">Reading hint for each question.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Screen 7</td><td>Screen Name: Interval support Screen- Interval support event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2" rowspan="7">
</td><td>Text</td><td>none</td></tr>
<tr><td>Image</td><td>button_go.gif
button_play.gif
button_pause.gif
button_stop.gif</td></tr>
<tr><td>Audio</td><td>D6.mp3</td></tr>
<tr><td>Music</td><td>music_support.mp3</td></tr>
<tr><td>Video</td><td>female_agent</td></tr>
<tr><td></td><td>duration : 1 minutes</td></tr>
<tr><td>Animation</td><td>female_agent
firework.gif</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="4">After the completion of 10 of the questions, interval support screen will be called upon for the specific interactions. The purpose of this screen is to deliver surprise elements to ensure student keep engaging in completing the Q-MLE. This will increase student's interest and motivate them to answer the questions.</td><td>button_go.gif</td><td>Link to screen of question 11</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
<tr><td>button_pause.gif</td><td>pause the dialogue presented by virtual agent</td></tr>
<tr><td>button_stop.gif</td><td>stop the dialogue presented by virtual agent</td></tr>
<tr><td colspan="4">Narration Script</td></tr>
<tr><td colspan="4">"Well done…you are rocking! Let's go on… you can do it!"</td></tr>
<tr><td colspan="4"></td></tr>
</table>

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Table 4.3 *(continued)*

<table>
<tr><td>Screen 8</td><td colspan="2">Screen Name: Reward Screen- Reward Event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="2" rowspan="8">
</td><td>Text</td><td>▪ Screen title
▪ Text line of “Congratulations ”
▪ Total score and time taken appear on the textbox</td></tr>
<tr><td>Image</td><td>button_reviw.gif
button_home.gif
button_exit.gif
button_play.gif
button_pause.gif
button_stop.gif</td></tr>
<tr><td>Audio</td><td>D7.mp3</td></tr>
<tr><td>Music</td><td>Reward_music.mp3</td></tr>
<tr><td>Video</td><td>reward.flv</td></tr>
<tr><td></td><td>duration : 1 minutes</td></tr>
<tr><td>Animation</td><td>female_agent</td></tr>
<tr><td colspan="2">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="2" rowspan="6">In the reward screen, students can check the total time taken and total score for all the questions. Reward button is available here to link to reward screen.

In the reward phase, students can check answers for all the questions. Thus, students improve their knowledge on the subject and at the same time prepare students for the exam.</td><td>button_review.gif</td><td>Link to review screen</td></tr>
<tr><td>button_home.gif</td><td>go to home screen</td></tr>
<tr><td>button_exit.gif</td><td>exit from the quiz</td></tr>
<tr><td>button_play.gif</td><td>dialogue presented by virtual agent</td></tr>
<tr><td>button_pause.gif</td><td>pause the dialogue presented by virtual agent</td></tr>
<tr><td>button_stop.gif</td><td>stop the dialogue presented by virtual agent</td></tr>
<tr><td colspan="5">Narration Script</td></tr>
<tr><td colspan="5">I am glad you are finally done. Congratulations on completing this quiz. Bye…</td></tr>
<tr><td colspan="5"></td></tr>
</table>

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Table 4.3 *(continued)*

<table>
<tr><td colspan="2">Screen 9</td><td colspan="2">Screen Name: Review Screen- Review Event</td><td colspan="2">Multimedia elements:</td></tr>
<tr><td colspan="3">REVIEW

1.Identify which one is a multimedia element?
A.Graphic
B.Slide show
C.Voice Script
D.Media

2.Multimedia is any combination of ..... .
A.Text, Graphic, Presentation, Audio and Source Code
B.Text, Graphic, Animation, Audio and Video
C.Transition, Animation, Design, and Slide Show
D.Transition, Animation, Design, and Smart Art</td><td>Text</td><td>▪ Screen title
Questions and Answers</td></tr>
<tr><td colspan="3" rowspan="6"></td><td>Image</td><td>button_home.gif
button_exit.gif</td></tr>
<tr><td>Audio</td><td>none</td></tr>
<tr><td>Music</td><td>none</td></tr>
<tr><td>Video</td><td>none</td></tr>
<tr><td></td><td>duration : none</td></tr>
<tr><td>Animation</td><td>none</td></tr>
<tr><td colspan="3">Screen Description:</td><td colspan="2">Navigation:</td></tr>
<tr><td colspan="3" rowspan="3">In the review screen, students can check answers for all the questions. Thus, students able to improve their knowledge on the chapter and at the same time prepare students for the exam.</td><td>button_home.gif</td><td>go to home screen</td></tr>
<tr><td>button_exit.gif</td><td>exit from the quiz</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="6">Narration Script</td></tr>
<tr><td colspan="3">None</td><td></td><td></td></tr>
</table>

4.4.7 Interface Design Prototypes

4.4.7.1 Home Screen

The Quiz based Multimedia Learning Environment (Q-MLE) enriched with attractive and standard interface design. A quite design does not seek attention for its own sake. Thus, it does not interrupt with pop-ups, advertisements, tangents or obstacles (Peters, 2014). In this Q-MLE, home screen is the first welcoming interface design. It is

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important to display all the important clickable buttons on the home screen (Leavitt & Shneiderman, 2006; Nielsen & Tahir, 2002). The home screen of the Q-MLE consists of title of quiz and clickable buttons such as play, pause, stop and start buttons. In addition, info and exit buttons also available at the top-right corner of the screen. In home screen, assessment event applied by providing start button. This start button enables the students to enter the linked question screen. At the same time, introduction event applied to the virtual agent in this home screen.

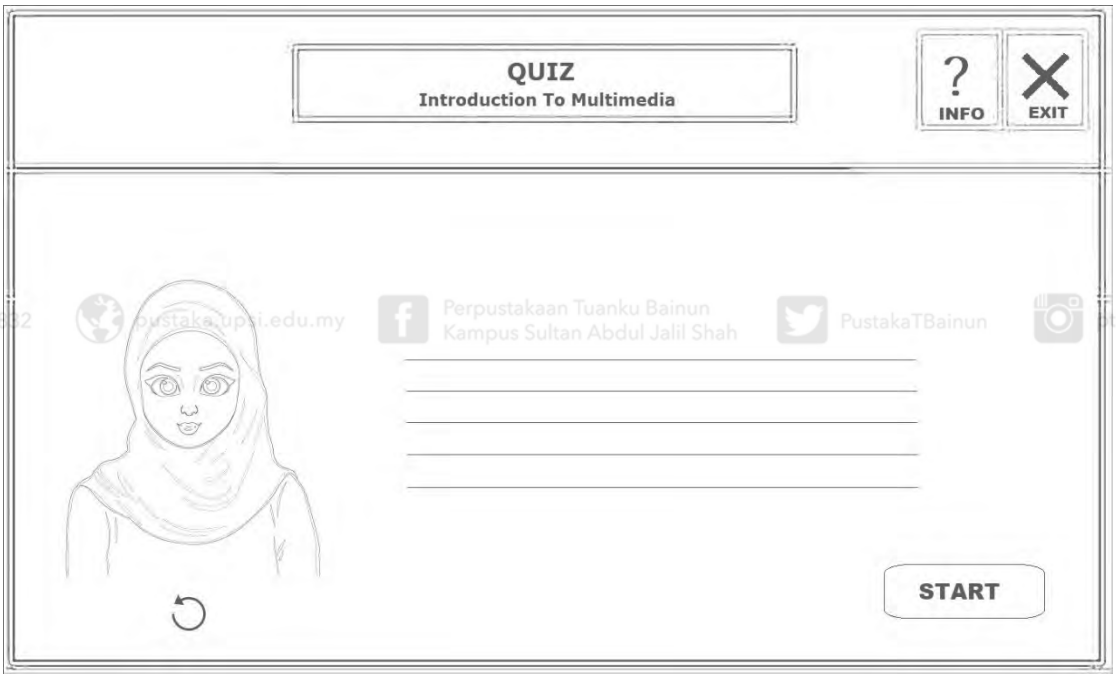


Figure 4.16. Sketched Home Screen

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4.4.7.2 Info Screen

Instructions should be provided as a guidance to answer questions by the students (Alessi & Trollip, 2001; Geetha, Buddhini & Uma, 2008;). Hence, the virtual agent in this info screen plays a role to read through on rules of the Quiz based Multimedia Learning Environmen (Q-MLE) based on guidance event before students start answer the questions. Consequently, this screen gives the overall picture of the Q-MLE to the students. This screen also consists of home, start, back and exit buttons. The start button that available here allows students to connect directly to questions without passing through the home screen. Still, back button is provided in this screen in case students prefer to go back to home screen.

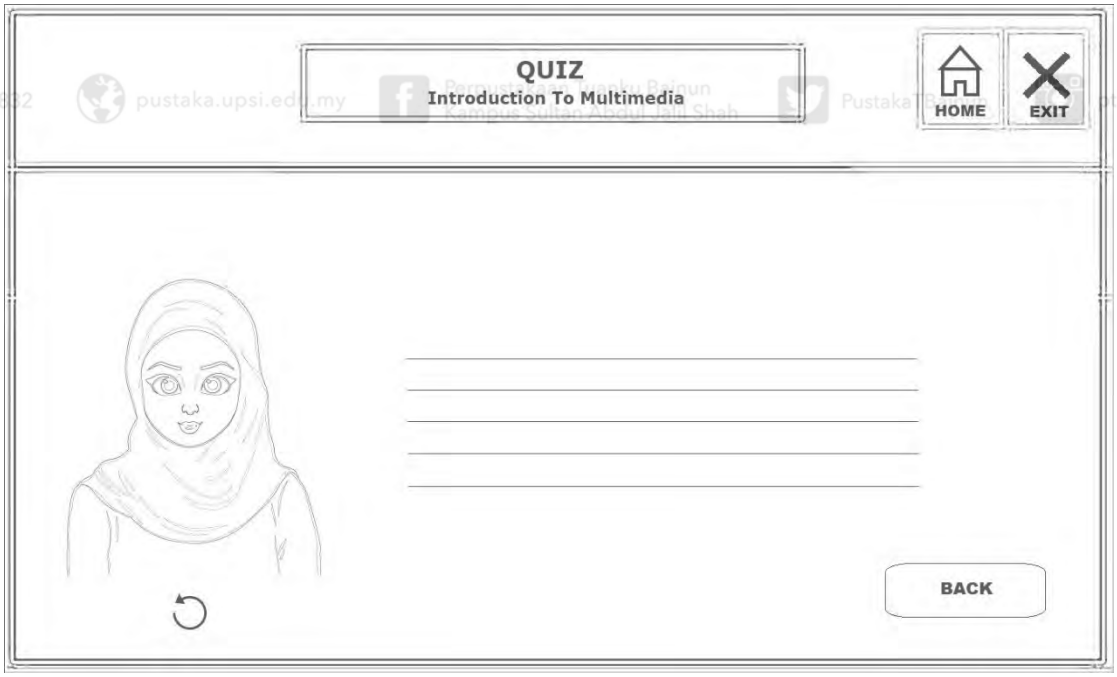


Figure 4.17. Sketched Info Screen

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4.4.7.3 Question Screen

A collection of 20 multiple-choice questions prepared from the first chapter of the Interactive Multimedia Applications subject. This screen designed according to question event. Virtual agent with narration presents in this screen to allow students listen to the question. In addition, play, pause and stop buttons are provided in this screen to enable the virtual agent to repeat again the question, pause or stop it. Three to five answer choices can provide for a multiple-choice question ("eLearning design guide", 2013). Thus, four answer choices are provided for each of the multiple-choice question in Quiz based Multimedia Learning Environment (Q-MLE). The answers are displayed as radio buttons in order to allow students select one of it as the answer. After the selection of answer, students need to click on submit button to check the answer. Besides that, a timer available in this screen in order to display time in seconds. This timer indicates the amount of time left for the students to answer questions. Timer will pause momentarily when the submit button is pressed and it will resume in the following question. Also, home and exit buttons are displayed at the top-right corner of the screen as in the other screens as well.

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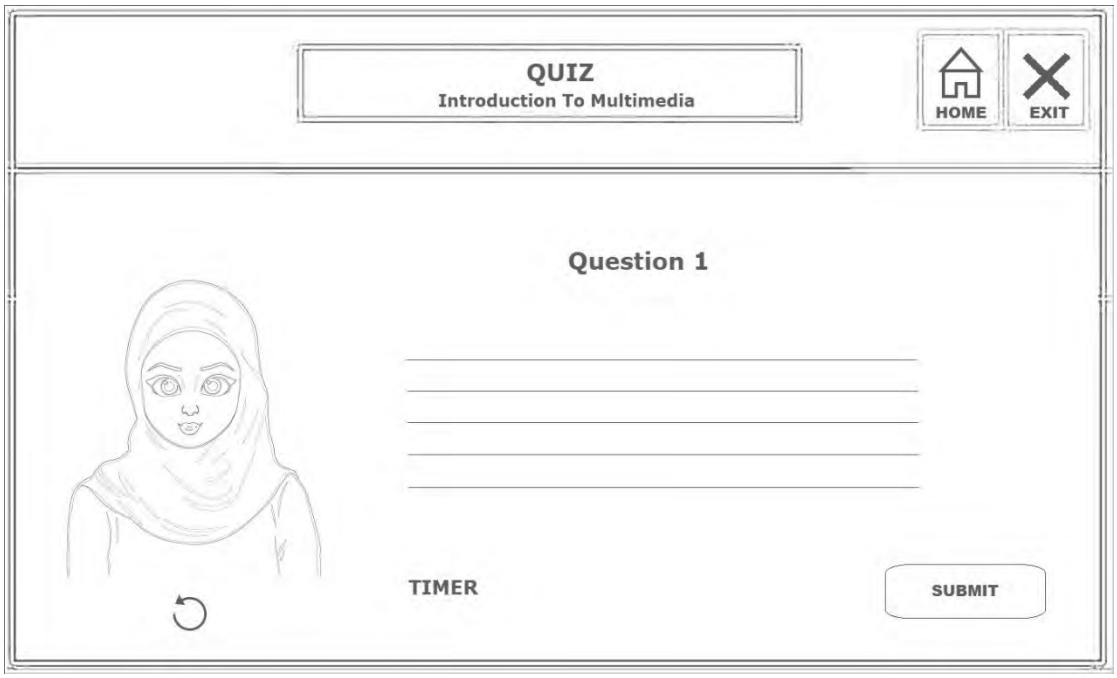


Figure 4.18. Sketched Question Screen

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4.4.7.4 Feedback Screen

The use of feedback can create communication space to tell the status of the given answer in effective and efficient way (Railean, 2016). Thus, the students' performance for each question is presented in the feedback screen. This screen uses feedback event which indicate whether the question has been answered correctly or incorrectly. Here, the correct answer enables students to proceed to the next question. A navigation plan or a relationship between screens can be generated with the existence of navigation buttons (Geetha et al., 2008; Usha & Sanjaya 2003). Thus, next button will be appeared automatically as the question answered correctly. This next button allows the students to go on with the following question as shown in Figure 4.19.

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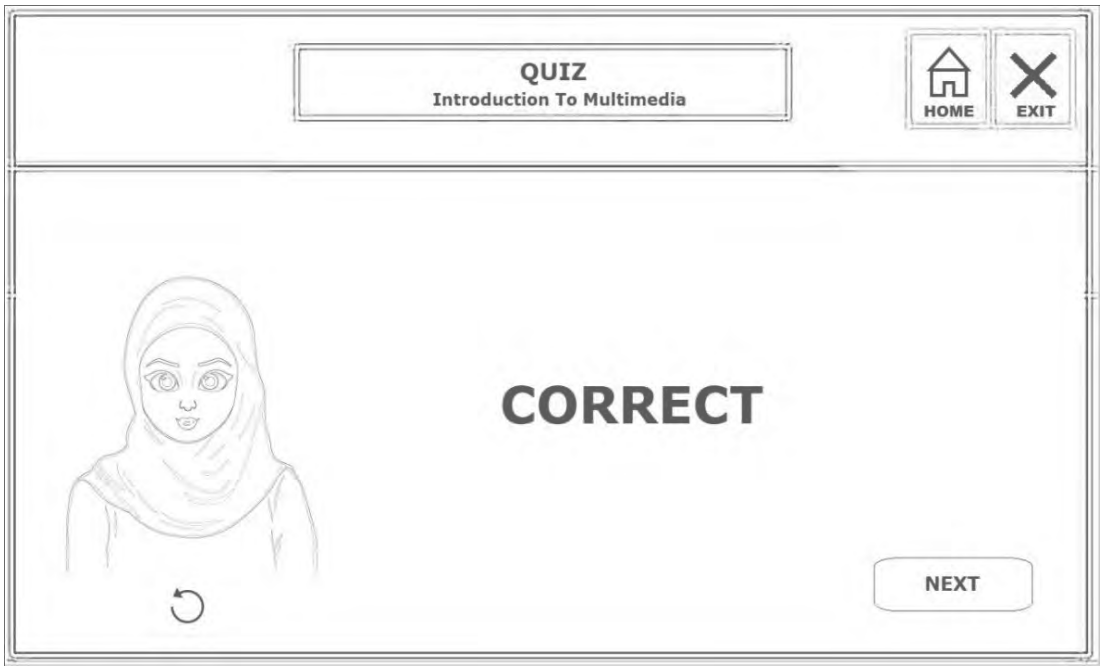


Figure 4.19. Sketched Feedback Screen of Correct Answer

However, if the answer is incorrect, the question is repeated in order to re-do it again. Chances will be given to answer an incorrect question and one can move on to the next question once get the right answer for it ("eLearning design guide", 2013). In this case, redo button exists to allow students re-do again the question. In addition, hint button also appears along with the wrong feedback for the provision of related supportive tips for the question as shown in Figure 4.20.

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Figure 4.20. Sketched Feedback Screen of Wrong Answer

After the completion of answering the question for second attempt, feedback screen is presented again corresponding to the given answer. If the students capable to answer it correcty, the feedback screen of correct answer will be shown as shown in Figure 4.19 and they can proceed to the next question by clicking on the next button. Conversely, if students' answer is still wrong, the feedback screen of wrong answer will be appeared again as shown in Figure 4.20. This allow students to re-do again the same question until successfully get the correct answer.

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4.4.7.5 Hint Screen

In case the attempt to answer a question is wrong and when students click on the hint button, a hint screen will be appeared. This screen activates based on hint event to provide related clues. The back button in the hint screen enables the students to redo again the same question.

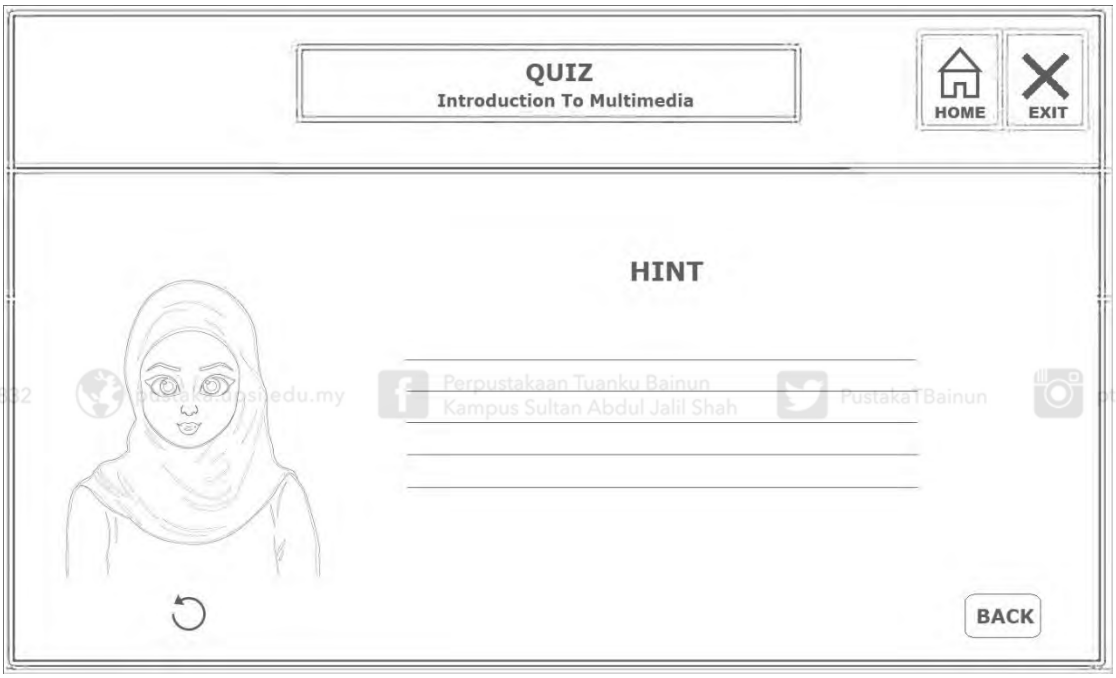


Figure 4.21. Sketched Hint Screen

4.4.7.6 Interval Support Screen

Besides that, interval support event can be seen in the interval support screen. This screen behaves as a pop-up screen which appears after the completion of ten questions in the Quiz based Multimedia Learning Environment (Q-MLE). Surprise elements are

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presented in this screen to attract students. Furthermore, concern-related dialogues are provided too by the virtual agent. The use of colour affects memory performance of students (Mariam & Muhammad, 2013). Anderson (2011) stated that a digital display is an important element to elicit motivation. Consequently, variety of colours used to provide the surprising elements in order to hold students' interest. When students click on continue button that available in this screen, they can proceed to answer the eleventh question of the Q-MLE.



Figure 4.22. Sketched Interval Support Screen

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4.4.7.7 Reward Screen

In the reward screen, total time taken and score have been shown by enabling reward event. Here, review button available to allow students enter the review screen. Home and exit buttons are available in this screen as well.



Figure 4.23. Sketched Reward Screen

4.4.7.8 Review Screen

The utility of review screen is based on review event. As the other screens, home and exit buttons available in this screen either to lead to home screen or exit the Quiz based Multimedia Learning Environment (Q-MLE).

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Figure 4.24. Sketched Review Screen

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4.4.8 Content

In the evaluation or analysis phase, the content of the Quiz based Multimedia Learning Environment (Q-MLE) had been decided. Therefore, 20 multiple-choice questions from first chapter of Interactive Multimedia Applications subject prepared for the Q-MLE. The questions were validated by the subject experts and linguistic experts from polytechnic. This is to ensure that the questions are prepared according to syllabus and up to the students' level.

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4.5 Develop Phase

Develop phase is more incorporated with design phase than subsequent to it. Sketches from the design phase were used for the development phase. Based on the sketches, virtual agents, Quiz based Multimedia Learning Environment (Q-MLE) and its content were developed using the chosen software. Thereafter, each design sent to the experts to validate it. Based on their feedback, the designs were amended. Subsequently, after each successive cycle of design and development, the emerging solution evaluated again to determine appropriateness and effectiveness of the developed design.

4.5.1 Virtual Agents' Prototypes

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4.5.1.1 Realistic Agent

First iteration

Usually, sketches are baseline for the actual design. In view of that, a realistic agent was designed based on the sketches. The texture of skin and facial features (eyebrows, eyelashes, eyes, nose and mouth) designed very detailed to look similar to human. It is a pixel-based design. The design features of realistic agent were extracted based on previous studies (Baylor & Kim, 2004; Beun, De Vos & Witteman, 2003; McDonnell, 2015; Ruhland, Zibrek, & Zell et al., 2015; Saidatul Maizura et al., 2010) and the references to commercial animation film. Then the designed realistic agent sent to experts for validation in order to identify whether it meets the requirement of realism.

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Consequently, the agent was accepted by the experts. Thus, second or thereafter iteration was not conducted for the realistic agent.



Figure 4.25. Realistic Agent

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4.5.1.2 Semi-Realistic Agent

First Iteration

Similarly, a semi-realistic agent was designed based on the sketches. By taking into consideration on previous studies (Saidatul Maizura et al., 2010; Zell et al., 2015), the agent was designed in order to look as semi-realistic. Accordingly, the texture of skin and facial features (eyebrows, eyelashes, eyes, nose and mouth) was designed with less details compared to realistic agent to ensure it looks like a medium realistic agent. It is also a pixel-based design. In the validation process, experts commented that the design of semi-realistic agent meets the requirement. Accordingly, the agent was accepted by the experts. Thus, second or thereafter iteration was not conducted for the semi-realistic agent as well.

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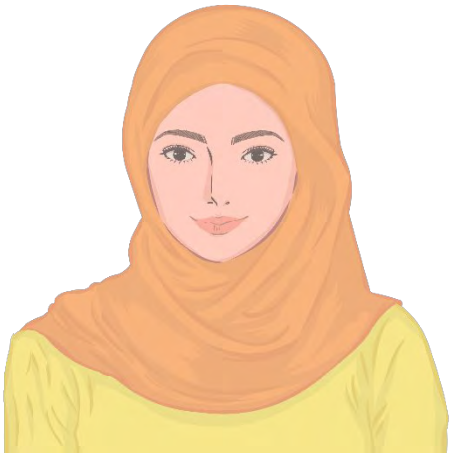


Figure 4.26. Semi-Realistic Agent

4.5.1.3 Stylized Agent

First Iteration

The stylized agent was designed based on past studies (Mohd Najib, 2015; Schwind et al., 2015; Zell et al., 2015). The intend to design stylized agent aroused from the character of Vanellope von Schweetz's in Wreck-It Ralph (Spencer & Moore, 2012) which is an animated feature film. Therefore, the stylized agent was designed with stylized features such as exaggerated eyes (enlarged to 150%), curled eyelashes, smaller nose and lips in order to look as unrealistic agent. In addition, these features capable to give some cuteness effect to the agent. Besides, additional stylize features such as glass and flower pin on hijab are included as well. It is a vector-based design. Then, the designed stylized agent sent to experts for validation process. This process is very important to determine whether the design meets the requirement of stylized agent. Eventually, changes had been done to the agent in the second iteration based on the feedbacks from experts.

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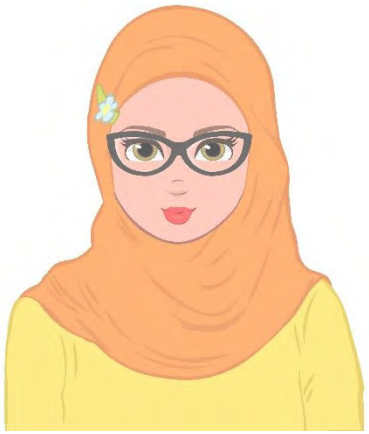


Figure 4.27. Stylized Agent (First Iteration)

Second iteration

Some of the features of stylized agent redesigned at second iteration. The changes had been done based on experts' feedback. From there, the glass and the flower pin on hijab removed from the agent as it can be considered as 'extraneous' factors that may potentially interfere with results of the study. Accordingly, the stylized agent redesigned with larger eyes and curled eyelashes. Besides that, the colour of eyeball and eyebrow changed from brown to black to match with other virtual agents. Finally, the redesigned stylized agent accepted by the experts after the second iteration.

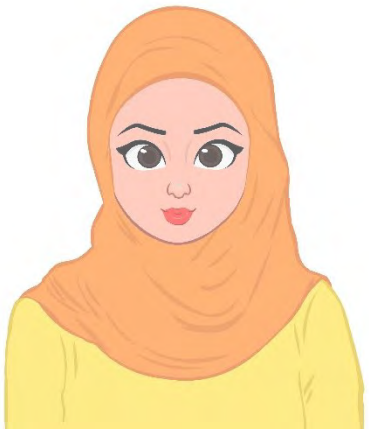


Figure 4.28. Stylized Agent (Second Iteration)

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4.5.1.4 Semi-Stylized Agent

First iteration

The semi-stylized agent was designed based on the sketches too. For the semi-stylized agent, it was designed in order to look as an agent with less stylized features compared to stylized agent. It is a vector-based design. Then, the designed agent sent to experts for validation.



Figure 4.29. Semi-Stylized Agent

Second iteration

In the second iteration, the semi-stylized agent was removed from the experiment. According to experts, the agent was very similar to semi-realistic agent and it was not recommended to include it in the study.

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4.5.1.5 Cartoon-like agent

First iteration

At the initial state, the cartoon-like agent was designed based on the sketches. The previous studies (Baylor & Kim, 2004; Gulz & Haake, 2006a; McDonnell et al., 2012; Ruhland et al., 2015; Saidatul Maizura et al., 2010) were used as basis for the design of cartoon like agent. Specifically, the eyes proportion increased to 100% with smaller nose and lips. It is a vector-based design. Then, it had been sent to experts for validation process.

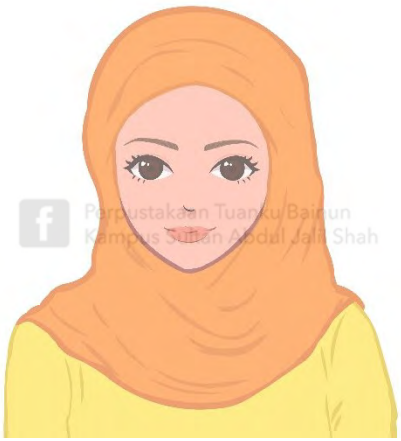


Figure 4.30. Cartoon-Like Agent (First Iteration)

Second Iteration

The design of cartoon-like agent had been modified in the second iteration in accordance with the feedbacks from experts. Since the initial design looks very similar to the stylized agent, it redesigned with more simplistic in order to look different from the stylized agent. Here, the eyebrow, eyes, nose and mouth were designed with very simple abstract look. Ultimately, the redesigned cartoon-like agent accepted by the experts after the second iteration.

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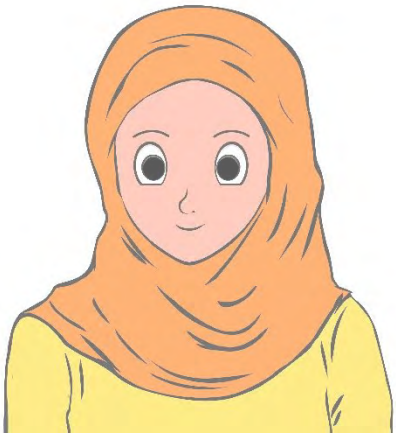


Figure 4.31. Cartoon-Like Agent (Second Iteration)

4.5.2 Interface Designs

4.5.2.1 Home Screen

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Figure 4.32. Home Screen of Cartoon-Like Agent

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4.5.2.2 Info Screen

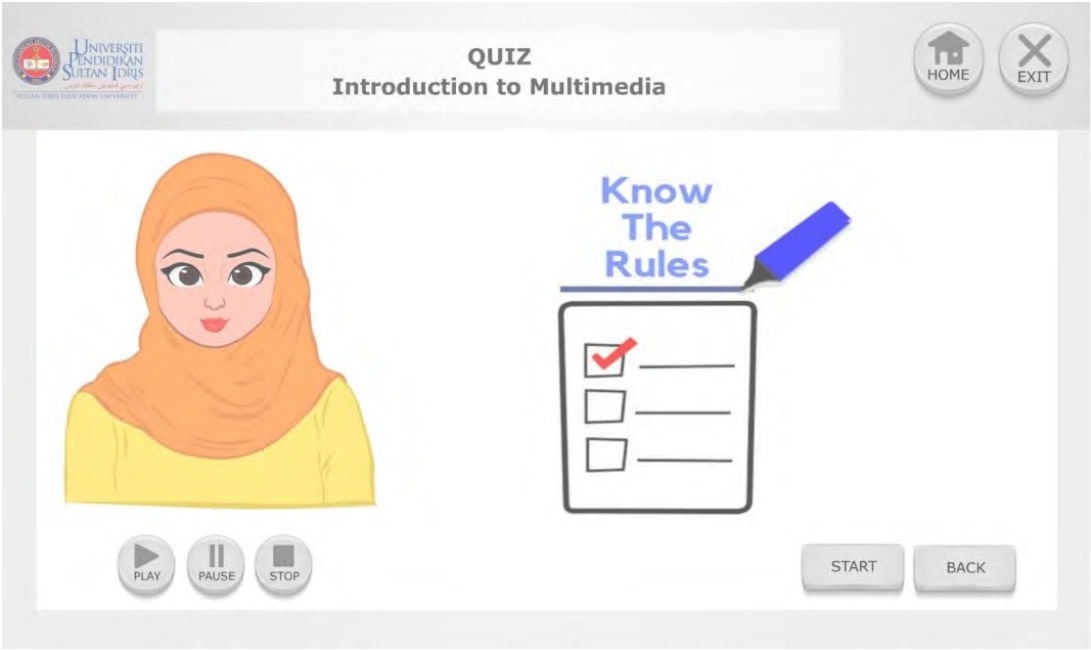


Figure 4.33. Info Screen of Stylized Agent

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4.5.2.3 Question Screen

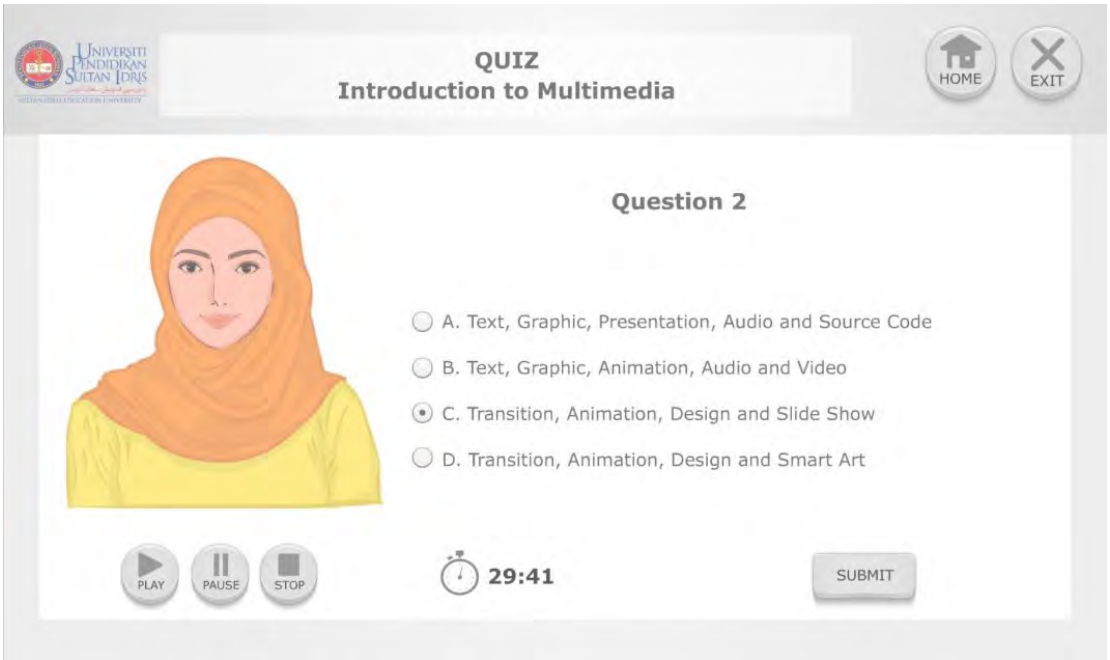


Figure 4.34. Question Screen of Semi-Realistic Agent

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4.5.2.4 Feedback Screen

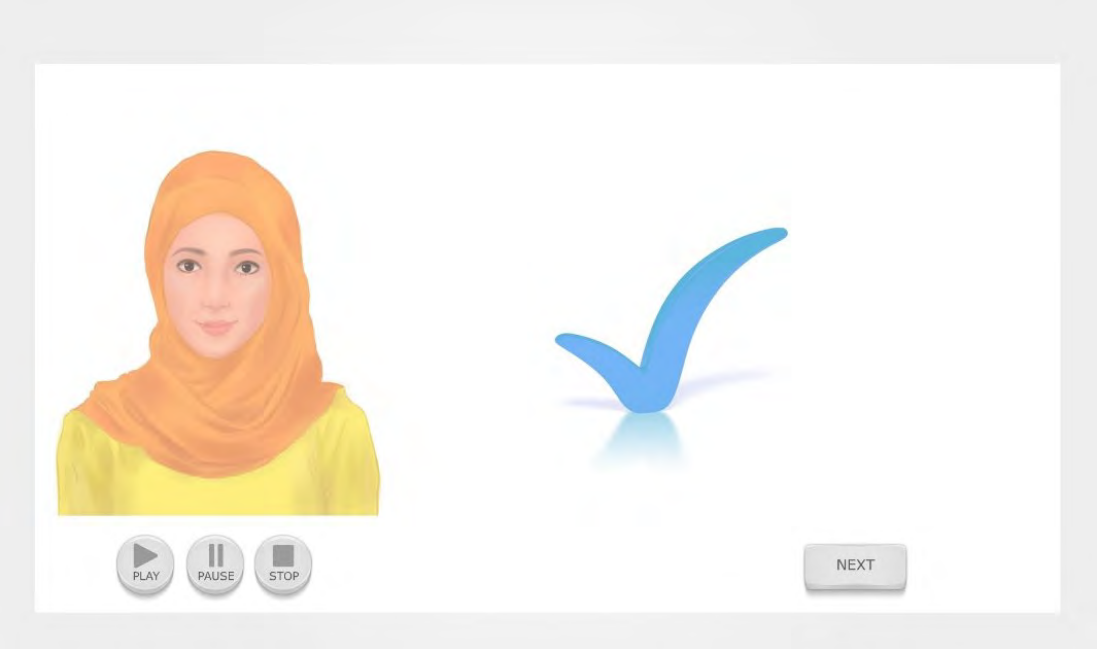


Figure 4.35. Correct-Feedback Screen of Realistic Agent

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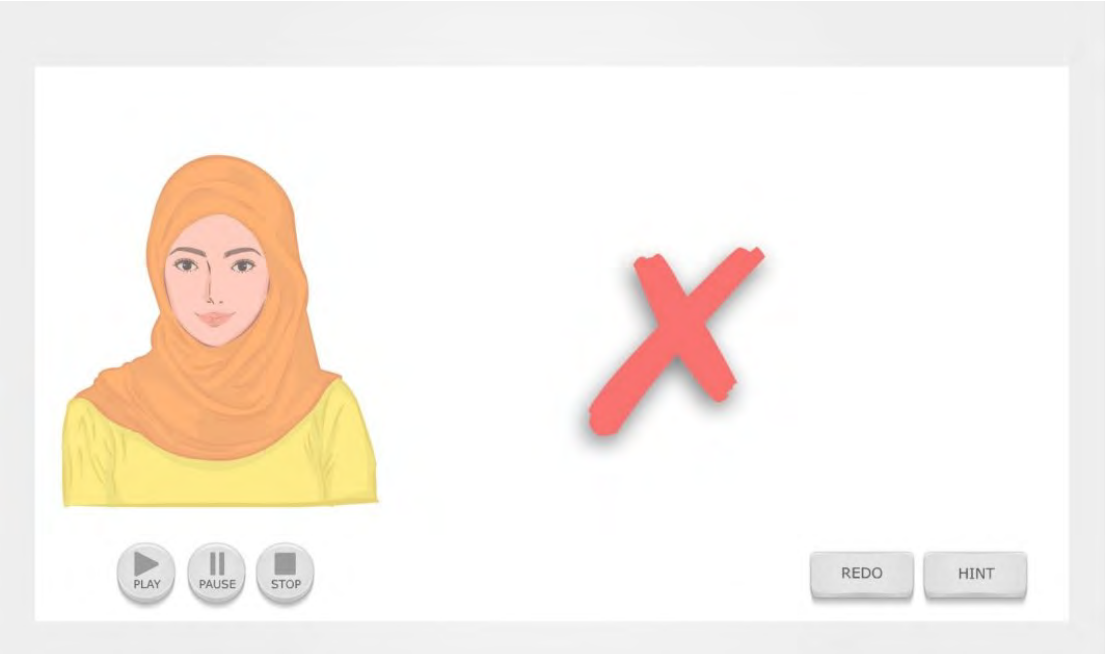


Figure 4.36. Wrong-Feedback Screen of Semi-Realistic Agent

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4.5.2.5 Hint Screen

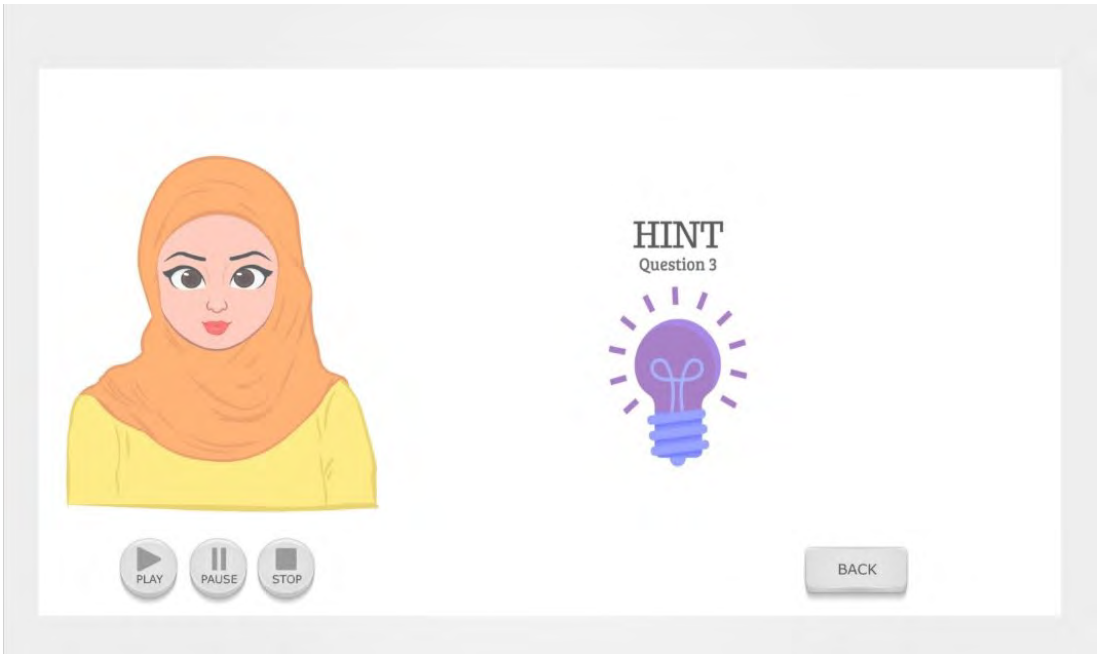


Figure 4.37. Hint Screen of Stylized Agent

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4.5.2.6 Interval Support Screen

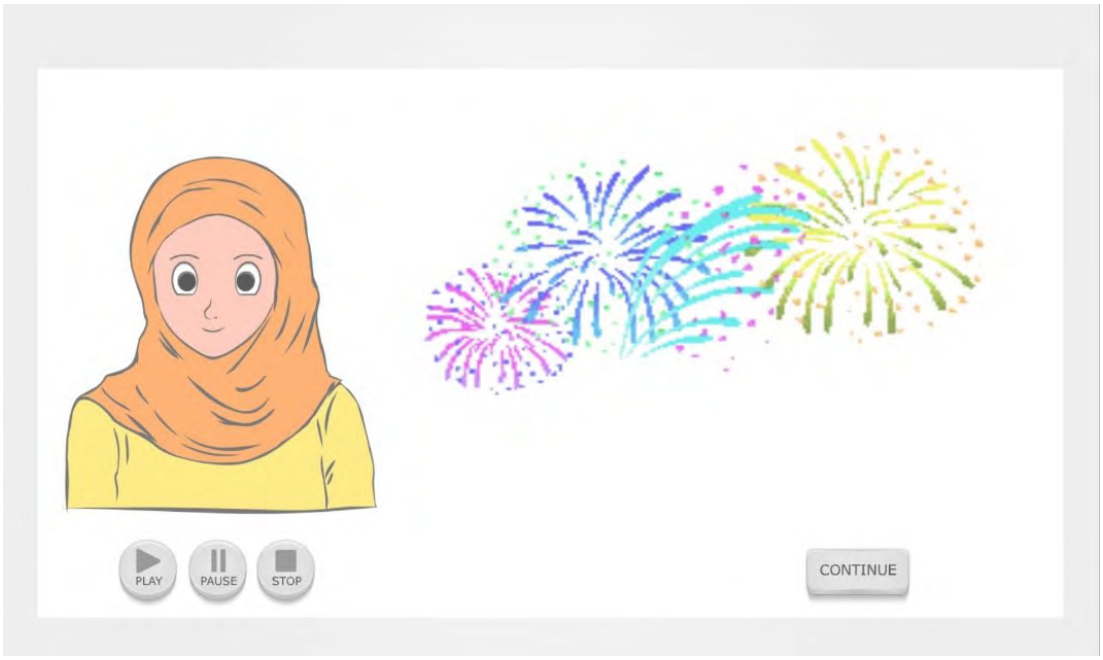


Figure 4.38. Interval Support Screen of Cartoon-Like Agent

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4.5.2.7 Reward Screen

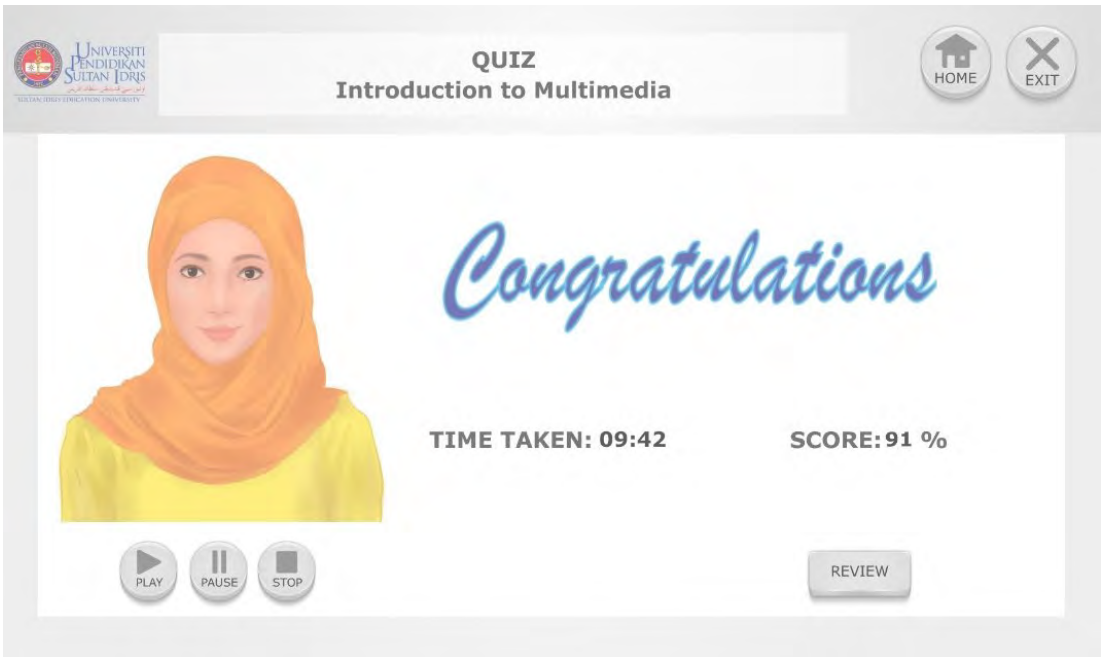


Figure 4.39. Reward Screen of Realistic Agent

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4.5.2.8 Review Screen

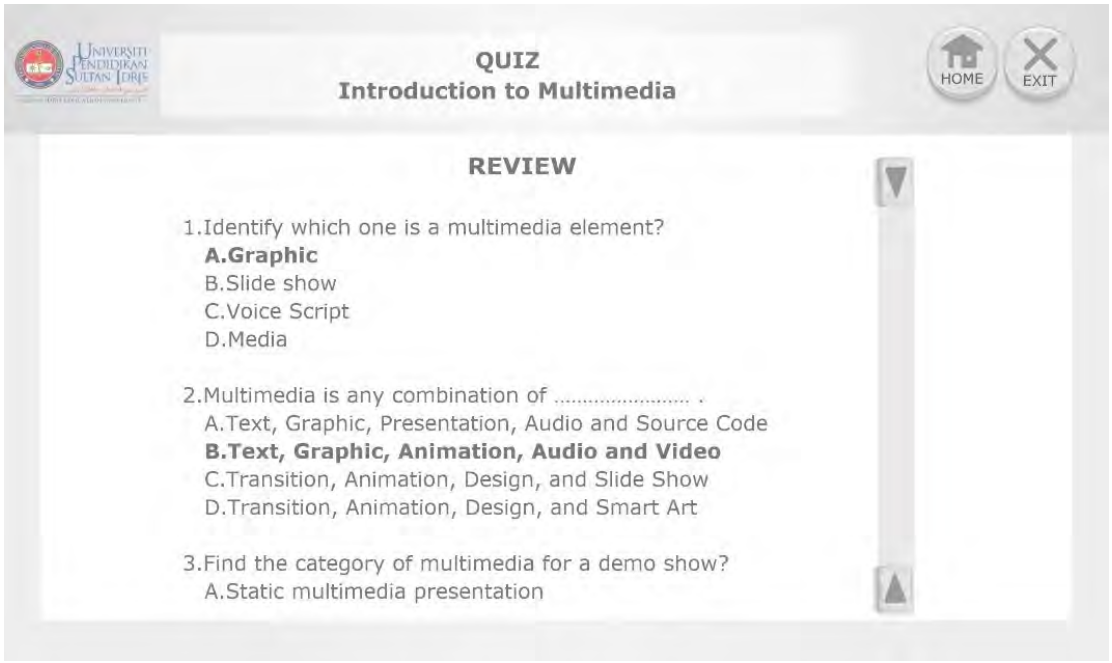


Figure 4.40. Review Screen

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4.5.3 Content

Introduction To Multimedia
Quiz 1

1. Identify which one is a multimedia element?
   - **A. Graphic**
   - B. Slide show
   - C. Voice Script
   - D. Media

HINT: Multimedia is computer information that can be represented through sound, video, and animation in addition to traditional media such as text and image.

2. Multimedia is any combination of .....
   - A. Text, Graphic, Presentation, Audio and Source Code
   - **B. Text, Graphic, Animation, Audio and Video**
   - C. Transition, Animation, Design, and Slide Show
   - D. Transition, Animation, Design, and Smart Art

HINT: A multimedia application may require five basic components consist of written words, still picture, motion picture, sound reproduction and digital motion

3. Find the category of multimedia for a demo show?
   - A. Static multimedia presentation
   - B. Animated multimedia presentation
   - C. **Linear multimedia presentation**
   - D. Non-linear multimedia presentation

HINT: Linear multimedia presentation does not allow the user to control the sequence and progress of multimedia content. Whereas, Non-linear multimedia presentation allow the user to control the sequence and progress of multimedia content.

Figure 4.41. Questions and Hints for the Quiz

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4.6 Usability and User Satisfaction Test

Usability test carried out after the completion of development process for Quiz based Multimedia Learning Environment (Q-MLE). The adapted Post-Study System Usability Questionnaire (PSSUQ) is used for evaluation purpose (Lewis, 2002). The PSSUQ is comprised of 21 items with seven-point Likert-scale (ranging from strongly disagree [1] to strongly agree [7]). In particular, the PSSUQ consists of seven subscales: design / layout (items 1–3); functionality (items 4–6); ease of use (items 7–10); learnability (items 11–13); satisfaction (items 14–16); outcome / future use (items 17–19) and errors / system Reliability (items 20–21).

The participants of this study are composed of 40 polytechnic students. This study was conducted for 30 minutes after students explored the Q-MLE. The basic function of the Q-MLE had been explained by the researcher prior to exploration. Thereafter, the participants explored the Q-MLE for about 20 minutes and then they answered the questionnaire. Cronbach's alpha is employed to calculate the reliability of the Q-MLE. As a result, the Cronbach Alpha value of the usability test and user satisfaction of the PSSUQ questionnaire is 0.93. This signified that the Q-MLE has high reliability. This followed by the measurement of mean values and standard deviations. The outcomes from the PSSUQ show that the participants were satisfied with the usability of the Q-MLE as whole (see Table 4.4).

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Table 4.4

Mean and Standard Deviation of PSSUQ Items

	Items of PSSUQ	Mean	SD
	Design / Layout		
1.	I liked using the interface of the quiz application	6.4	0.84
2.	The organization of information on the quiz application screens was clear	6.5	0.71
3.	The interface of this quiz application was pleasant	6.4	0.81
	Functionality		
4.	This quiz application has all the functions and capabilities that I expect to have	6.3	0.85
5.	The information provided in the quiz application was clear	6.4	0.67
6.	All the features in the quiz application functioned well	6.5	0.60
	Ease of use		
7.	It was simple to use the quiz application	6.6	0.54
8.	It was easy to find the information I needed	6.3	0.73
9.	The information provided in the quiz application was clear	6.6	0.59
10.	Overall, this quiz application was easy to use	6.7	0.62
	Learnability		
11.	It was easy to learn by using the quiz application	6.6	0.64
12.	There wasn't too much information to read before I can use the quiz application	6.4	0.74
13.	The information provided in the quiz application was easy to understand	6.5	0.68
	Satisfaction		
14.	I felt comfortable using the quiz application	6.6	0.59
15.	I enjoyed exploring the quiz application	6.5	0.64
16.	Overall, I am satisfied with this quiz application	6.6	0.59
	Outcome / Future use		
17.	I believe I could become productive quickly using this quiz application	6.4	0.64
18.	The quiz application was able to convince me on improving my skills	6.5	0.60
19.	From my current experience using the quiz application, I think I would use it regularly	6.2	0.77
	Errors / System Reliability		
20.	Whenever I made a mistake in the quiz application, I could recover easily and quickly	6.6	0.59
21.	The quiz application gave error messages that clearly told me how to solve the problem	6.5	0.64

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Table 4.5

Reliability Statistics of PSSUQ

Cronbach's Alpha	N of Items
0.93	21

4.7 Pilot Test

Pilot test is a test that conducted as a rehearsal for the main research study. This test carried out to a small number of test participants. This additional step essential to be conducted in order to significantly reduce flaws that may exist in the research study. The output from this approach enables the necessary improvements to be made to the research design based on the potential problems that might occur. Consequently, the researcher ensures the research is workable and capable to run smoothly during the actual execution phase of the research study.

In view of that, 40 polytechnic students are participated in the pilot test of this research. They were divided to four groups where each group assigned for the respective Quiz based Multimedia Learning Environment (Q-MLE). This study was conducted as the actual experiment. The basic function of the Q-MLE explained by the researcher prior to exploration.

The Cronbach Alpha value of the Self-Assessment Manikin (SAM) questionnaire for the two items is $\alpha = .86$ and the Cronbach Alpha value of the Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ) for the 24

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items is α = .87. Generally, the reliability coefficient of a scale should be above 0.7 (DeVellis, 2012). This indicated that the items have relatively high internal consistency. Therefore, the both instruments had high reliability as well.

Table 4.6

Reliability Statistics of Self-Assessment Manikin (SAM)

Cronbach's Alpha	N of Items
0.855	2

Table 4.7

Reliability Statistics of Short-Form Learning-related Achievement Emotions Questionnaire (SF-L-AEQ)

Cronbach's Alpha	N of Items
0.867	24

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4.8 Summary

Creating a multimedia-based learning material involving several steps in its workflow. Chapter four has broken down the basic steps based on Simple Successive Approximation (SAM) model that involving three phases in preparation of interesting multimedia-based learning material, namely evaluate or analysis, design and develop. In addition, it is important to consider about the objective, method, target audience and content to optimize the quality of the interactive learning material. Chapter four also covered about the recommended software that make it easier for the design purpose.

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Also, the settings of the psychical design are presented for the accurate and efficient creation of the Quiz based Multimedia Learning Environment (Q-MLE). These include text, audio, video, animation, graphic and screen design structure. At the same time, chapter four shows how to create an effective interface design with appropriate content for Q-MLE that consists of three reference planes containing flowchart, storyboard and interface design prototypes. Aside from that, chapter four also presented four different realism designs of virtual agents that exported and linked to each other in the Q-MLE. After all, this chapter reports the outcomes of usability and user satisfaction based on the tests conducted.

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CHAPTER 5

DATA ANALYSIS

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5.1 Introduction

In this chapter the data and the results of the analysis are presented and reported according to the requirements and techniques stated in chapter three. All data obtained were analyzed using Statistical Package for the Social Sciences (SPSS) software. Demographic analysis was carried out to obtain the frequency and percentage of distribution. ANOVA test was used to test whether there is any significant effect of different realism designs of virtual agents which are realistic, semi-realistic, stylized and cartoon-like on students' emotions in dimension of valence, arousal and emotions in learning. Moreover, mediation analysis (bootstrapping method) was used to test whether there was any significant mediator relationship between students' emotions in

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the dimension of valence or arousal caused by different realism designs of the virtual agents on students' emotions in learning. The results of the analysis that have been clarified on all the hypotheses are explained in detail in the next section.

5.2 Total Feedbacks from the Questionnaire

Paper based methods were chosen for data collection purposes. It suits well for the research and contributes a high rate of feedback. Table 5.1 shows response rate of the research questionnaires.

Table 5.1

Response Rate of the Research Questionnaires

Questionnaire feedback	**Total**
Distributed questionnaires	609
Returned questionnaires	609
Unreturned questionnaires	0
Incomplete questionnaires	9
Total questionnaires	**600**
Percentage of feedback	**98.5%**

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5.3 Background of Participants

Respondents' background information is important to carry out this research. Few essential details such as age, gender, participated polytechnics and program of study have been taken into account to ease with the proceeding.

5.3.1 Age and Gender

A total of 600 participants with mean age 20.27 (SD = 0.66) took part in this study. Table 5.2 shows the frequency and percentage of respondents' gender. It was found that male students are more than female students; a total of 353 male students with 58.8% and 247 female students with 41.2% was recorded.

Table 5.2

The Frequency and Percentage of the Respondents' Gender

	Male	**Female**
Group 1 (Realistic Agent)	87	63
Group 2 (Semi-Realistic Agent)	81	69
Group 3 (Stylized Agent)	106	44
Group 4 (Cartoon-like Agent)	79	71
Total	**353**	**247**
Percentage %	**58.8**	**41.2**

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5.3.2 Polytechnics

Table 5.3 presents the participants and percentage of polytechnics. It was discovered that the highest number of students are from Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA) with a frequency distribution of 172 and 28.7%, while Politeknik Merlimau (PMM) students with frequency 143 and 23.8%, followed by Politeknik Sultan Azlan Shah (PSAS) with frequency 113 students with 18.8% and a frequency of 75 students with 12.5% from Politeknik Sultan Idris Shah (PSIS). On the contrary, for Politeknik Seberang Perai (PSP), a frequency of 39 students with 6.5% whereas frequency of 37 students with a percentage of 6.2 from Politeknik Ungku Omar (PUO) were highlighted. In addition, the lowest number of students was from Politeknik Port Dickson (PPD) with a frequency distribution of 21 and a percentage of 6.2.

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Table 5.3

The Frequency and Percentage of the Participated Polytechnics

Polytechnics	**Frequency**	**Percentage%**
Politeknik Ungku Omar (PUO)	37	6.2
Politeknik Port Dickson (PPD)	21	3.5
Politeknik Sultan Salahuddin Abdul Aziz Shah (PSA)	172	28.7
Politeknik Seberang Perai (PSP)	39	6.5
Politeknik Merlimau (PMM)	143	23.8
Politeknik Sultan Azlan Shah (PSAS)	113	18.8
Politeknik Sultan Idris Shah (PSIS)	75	12.5
Total	**600**	**100**

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5.3.3 Program of Study

Table 5.4 highlights the frequency distribution and percentage of program of study. From the analysis, it was identified that the highest number of students are from the Diploma in Electronic Engineering (Communication) (DEP) program with 289 (48.2%), followed by Diploma in Electrical Engineering (DET) program with 101 students (16.8%), Diploma in Electronic Engineering (Computer) (DTK) program with 90 students (15%), Diploma in Electronic Engineering (Medical) (DEU) program with 47 students (7.8%), Diploma in Electrical & Electronic Engineering (DEE) program with 39 students (6.5%) and the lowest number students are from Diploma in Electronic Engineering (Control) (DJK) program with 34 students (5.7%).

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Table 5.4

The Frequency and Percentage of the Respondents' Program of Study

Program	**Frequency**	**Percentage%**
Diploma in Electrical Engineering (DET)	101	16.8
Diploma in Electronic Engineering (Communication) (DEP)	289	48.2
Diploma in Electronic Engineering (Control) (DJK)	34	5.7
Diploma in Electronic Engineering (Computer) (DTK)	90	15
Diploma in Electronic Engineering (Medical) (DEU)	47	7.8
Diploma in Electrical & Electronic Engineering (DEE)	39	6.5
Total	**600**	**100**

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5.4 Reliability Test

Reliability in research refers to the consistency of the scores obtained. Indeed, it is the ability of a test to produce the same results under the same conditions (Fraenkel, Wallen & Hyun, 2011). If similar values are obtained at second and subsequent measurements, studies are said to have high reliability. In this study, Cronbach's alpha test was performed to identify the reliability of each scales. The sensible compromise value upon lower limit for Cronbach's alpha is .70; has high reliability as a research instrument (Hair, Black, Babin & Anderson, 2014). The reliability value of each variables is as follow.

5.4.1 Valence and Arousal

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Table 5.5 shows the value of Cronbach alpha for the variables of valence and arousal. The valence and arousal have two items with Cronbach's alpha value of 0.86. The value shows the variables have high reliability.

Table 5.5

Reliability Analysis for Valence and Arousal

Variables	Total items	Cronbach's Alpha
Valence and arousal	2	.86

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5.4.2 Learning-Related Achievement Emotions Questionnaire

As shown in Table 5.6, the value of Cronbach alpha for the variable of emotions in learning is 0.84. The variable has 24 items. Hence, the value indicates that the reliability of the variable is high.

Table 5.6

Reliability Analysis for Emotions in Learning

Variables	Total items	Cronbach's Alpha
Emotions in learning	24	.84

5.5 Analysis of the First Research Question

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Research Question 1

Is there any significant effect of different realism designs of the 2D female virtual agents on students' valence?

ANOVA test was used to test whether there is any significant effect of different realism designs of the 2D female virtual agents which are realistic, semi-realistic, stylized and cartoon-like on students' emotions in dimension of valence.

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5.5.1 Homogeneity of Variance

Homogeneity of variance test aims to ensure the variance of the mean score for valence is equivalent for each virtual agent groups. Levene's test of equality of error variances shows no significant $F(3, 596) = 1.812$, $p = 0.14 > .05$ and therefore homogeneity assumption was not violated. Hence, ANOVA test can be executed. Table 5.7 presents the results of the Levene's test of equality of error variances on valence.

Table 5.7

Levene's Test for First Research Question

Levene's Test of Equality of Error Variances[a,b]					
		Levene Statistic	**df1**	**df1**	**Sig.**
Valence	Based on Mean	1.812	3	596	.144
	Based on Median	1.412	3	596	.238
	Based on Median and with adjusted df	1.412	3	584.381	.238
	Based on trimmed mean	1.840	3	596	.139

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: VALENCE

b. Design: Intercept + virtualagent

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5.5.2 One-Way ANOVA Test Analysis

The dependent variable (DV) for the ANOVA is valence and independent variable (IV) is the different realism designs of virtual agents. The analysis of ANOVA is shown in Table 5.8.

The result of the ANOVA test shows that there is a significant difference between valence and different realism designs of virtual agents with $F(3, 596) = 15.48$, $p < 0.05$, partial eta squared = 0.07 provided that the effect size is medium according to Cohen (1988) as shown in Table 5.9. Hence, first hypothesis of this study is acceptable. Subsequently, the Tukey's Honestly Significant Difference (HSD) post hoc test was performed to identify which group is significantly different from each other.

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Table 5.8

ANOVA One-Way Test Results for First Research Question

Tests of Between-Subjects Effects

Dependent Variable: VALENCE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	97.845[a]	3	32.615	15.475	.000	.072
Intercept	28635.042	1	28635.042	13586.740	.000	.958
virtualagent	97.845	3	32.615	15.475	.000	.072
Error	1256.113	596	2.108			
Total	29989.000	600				
Corrected Total	1353.958	599				

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Table 5.9

Effect Size Based on Cohen 1988

Effect Size	Use	Small	Medium	Large
η^2	ANOVA	0.01	0.06	0.14

5.5.3 Tukey's Honestly Significant Difference (HSD) Post Hoc Test

Moreover, in order to identify which virtual agent pairs show significant differences, Tukey's HSD post hoc comparison tests were performed. The details of descriptive statistics as in Table 5.10 shows that semi-realistic agent obtains the highest mean score for valence (M = 7.49, SD = 1.33, n = 150) followed by realistic agent (M = 6.93, SD = 1.52, n = 150), stylized agent (M = 6.87, SD = 1.45, n = 150) and cartoon-like agent (M = 6.35, SD = 1.50, n = 150).

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Table 5.10

Descriptive Statistics

Group	Mean	Standard Deviation	N
Realistic	6.93	1.52	150
Semi-Realistic	7.49	1.33	150
Stylized	6.87	1.45	150
Cartoon-like	6.35	1.50	150
Total	6.91	1.50	600

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Additionally, the results of the pairwise comparisons test using the Tukey's method as shown in Table 5.11 summarize that the mean difference of valence for realistic and cartoon-like agents (MD = 0.59, $p < 0.05$), semi-realistic and realistic agents (MD = 0.55, $p < 0.05$), semi-realistic and stylized agents (MD = 0.62, $p < 0.05$), semi-realistic and cartoon-like agents (MD = 1.14, $p < 0.05$) and stylized and cartoon-like agents (MD = 0.52, $p < 0.05$) are significantly different. However, realistic agent and stylized agent (MD = 0.07, $p > 0.05$) has no significant difference.

Table 5.11

Findings of Tukey's HSD Post Hoc Test for Valence Against Virtual Agents

Multiple Comparisons

Dependent Variable: Valence

Tukey HSD

(I) Virtual Agent	(J) Virtual Agent	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
realistic	semi-realistic	-.55*	.168	.006	-.99	-.12
	stylized	.07	.168	.979	-.37	.50
	cartoon	.59*	.168	.003	.15	1.02
semi-realistic	realistic	.55*	.168	.006	.12	.99
	stylized	.62*	.168	.001	.19	1.05
	cartoon	1.14*	.168	.000	.71	1.57
stylized	realistic	-.07	.168	.979	-.50	.37
	semi-realistic	-.62*	.168	.001	-1.05	-.19
	cartoon	.52*	.168	.011	.09	.95
cartoon	realistic	-.59*	.168	.003	-1.02	-.15
	semi-realistic	-1.14*	.168	.000	-1.57	-.71
	stylized	-.52*	.168	.011	-.95	-.09

Based on observed means.

The error term is Mean Square (Error) = 2.108.

*. The mean difference is significant at the .05 level.

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5.5.4 The Scatter Plots of Valence

A scatter plot, with x-axis indicating valence and y-axis respondent, was plotted (Figure 5.1). Results show that valence level for each agents is focused at more than five score value which means all the agents cause positive valence. For realistic agent, majority scores fall at 7 and 8 with a total 57 percentage. In addition, majority scores for semi-realistic agent also fall at 7 and 8 with total 60.6 of percentage. Furthermore, for stylized agent, majority scores falls at 6 and 7 with total 47.3 percentage. Lastly, majority scores for cartoon-like agent fall at 5 and 7 with total 49.3 percentage. Based on the mean score value, all the agents' valence level fall between 6 to 7.5.

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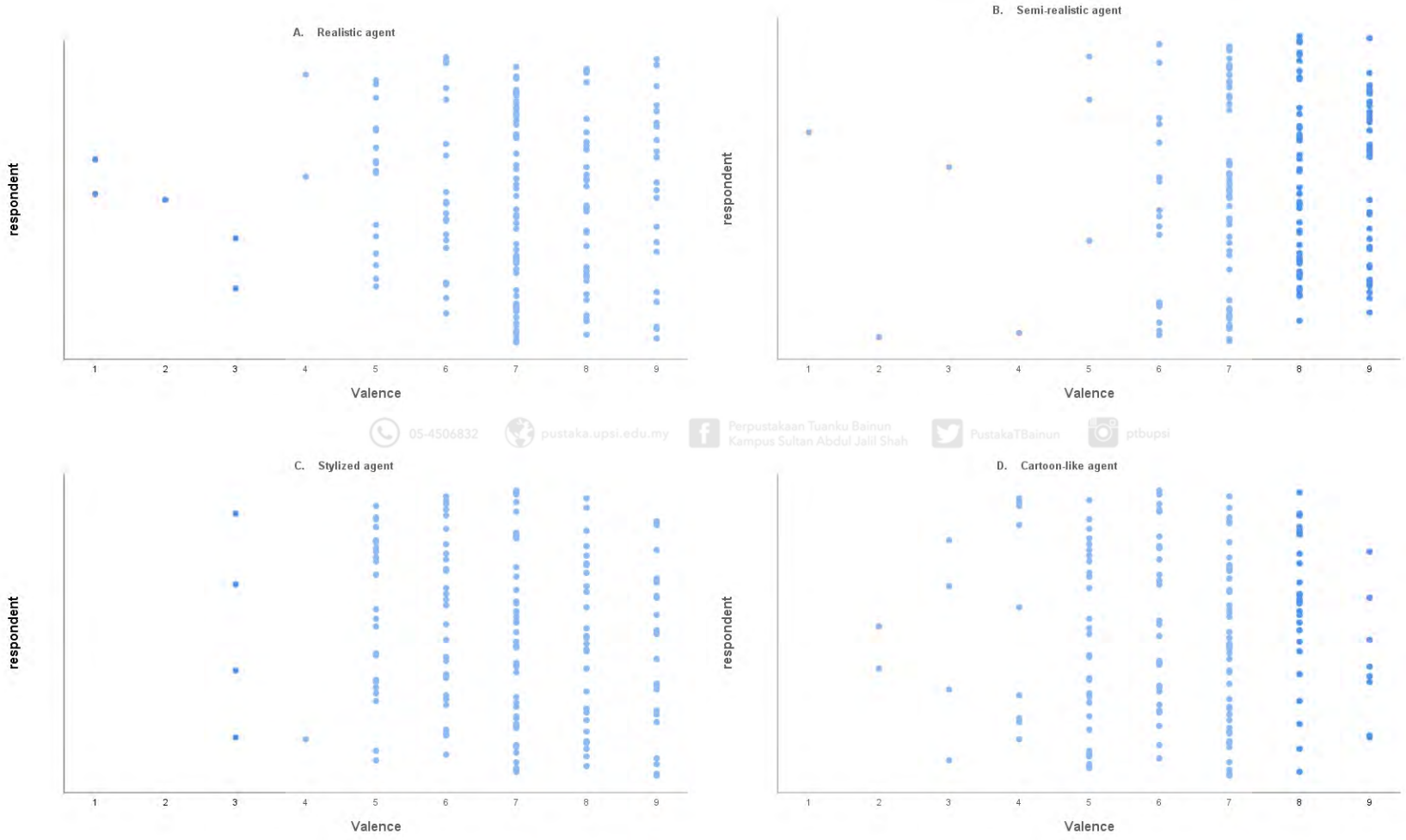


Figure 5.1. The Scatter Plots of Valence on Realistic Agent (A), Semi-Realistic Agent (B), Stylized Agent (C) and Cartoon-Like (D) with Respondents.

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5.5.5 Summary of First Research Question

Overall, ANOVA was used to test whether there is any significant difference in valence between student groups based on different realism designs of virtual agents which are realistic, semi-realistic, stylized and cartoon-like agents. The results of the ANOVA test show that there is a significant difference between valence and different realism designs of virtual agents with $F(3, 596) = 15.48$, $p < 0.05$, partial eta squared = 0.07 which the effect size is medium according to Cohen (1988). Therefore, first hypothesis of this study was accepted.

Table 5.12

Summary of ANOVA One-Way Test Results for First Research Question

Tests of Between-Subjects Effects

Dependent Variable: VALENCE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
virtualagent	97.845	3	32.615	15.475	.000	.072
Error	1256.113	596	2.108			
Corrected Total	1353.958	599				

a. R Squared = .072 (Adjusted R Squared = .068)

Subsequently, Tukey's HSD post hoc comparison tests were performed to identify which virtual agent pairs show significant difference. In sum, semi-realistic agent has the highest mean score, followed by realistic agent, stylized agent and the lowest mean score obtained by cartoon-like agent for valence. Table 5.13 shows the ranking order of student groups ranging from the best valence mean score.

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Table 5.13

Ranking Order of Mean Score Value for Valence

Ranking order	Group	Mean	Standard Deviation
1	Semi-Realistic	7.49	1.33
2	Realistic	6.93	1.52
3	Stylized	6.87	1.45
4	Cartoon-like	6.35	1.50

5.6 Analysis of the Second Research Question

Research Question 2

Is there any significant effect of different realism designs of the 2D female virtual agents on students' arousal?

ANOVA test was used to test whether there is any significant effect of different realism designs of the 2D female virtual agents which are realistic, semi-realistic, stylized and cartoon-like on students' emotions in dimension of arousal.

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5.6.1 Homogeneity of Variance

Homogeneity of variance test aims to ensure the variance of the mean score for arousal is equivalent for each virtual agent group. As viewed, Levene's test of equality of error variances was not significant F (3, 596) = 1.60, p = 0.19 > .05 and therefore homogeneity assumption was not violated. For this reason, ANOVA test can be executed. Table 5.14 presents the results of the Levene's test of equality of error variances on arousal.

Table 5.14

Levene's Test for Second Research Question

Levene's Test of Equality of Error Variances[a,b]					
		Levene Statistic	**df1**	**df1**	**Sig.**
Arousal	Based on Mean	1.601	3	596	.188
	Based on Median	1.437	3	596	.231
	Based on Median and with adjusted df	1.437	3	568.249	.231
	Based on trimmed mean	1.514	3	596	.210

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: AROUSAL

b. Design: Intercept + virtualagent

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5.6.2 One-Way ANOVA Test Analysis

The dependent variable (DV) for the ANOVA is arousal and independent variable (IV) is the different realism designs of virtual agents. The analysis of ANOVA is shown in Table 5.15.

The results of the ANOVA test show that there is a significant difference between arousal and different realism designs of virtual agents with $F(3, 596) = 15.79$, $p < 0.05$, partial eta squared = 0.07 understood that the effect size is medium according to Cohen (1988). Hence, the second hypothesis of this study is acceptable. Then, the Tukey's Honestly Significant Difference (HSD) post hoc test was performed to see which group is significantly different from each other.

Table 5.15

ANOVA One-Way Test Results for Second Research Question

Tests of Between-Subjects Effects

Dependent Variable: AROUSAL

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	140.378[a]	3	46.793	15.791	.000	.074
Intercept	23650.482	1	23650.482	7981.070	.000	.931
virtualagent	140.378	3	46.793	15.791	.000	.074
Error	1766.140	596	2.963			
Total	25557.000	600				
Corrected Total	1906.518	599				

a. R Squared = .074 (Adjusted R Squared = .069)

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5.6.3 Tukey's Honestly Significant Difference (HSD) Post Hoc Test

Alternatively, in order to find out which virtual agent pairs show significant difference, Tukey's post hoc comparison tests were performed. The details of descriptive statistics as shown in Table 5.16 concludes that semi-realistic agent obtains the highest mean score for arousal (M = 6.99, SD = 1.66, n = 150) followed by realistic agent (M = 6.35, SD = 1.74, n = 150), stylized agent (M = 6.13, SD = 1.64, n = 150) and cartoon-like agent (M = 5.64, SD = 1.84, n = 150).

Table 5.16

Descriptive Statistics

Group	Mean	Standard Deviation	N
Realistic	6.35	1.74	150
Semi-Realistic	6.99	1.66	150
Stylized	6.13	1.64	150
Cartoon-like	5.64	1.84	150
Total	6.28	1.78	600

Additionally, the results of the pairwise comparisons test using the Tukey's method as in Table 5.17 show that the mean difference of arousal for realistic and cartoon-like agents (MD = 0.71, $p < 0.05$), semi-realistic and realistic agents (MD = 0.63, $p < 0.05$), semi-realistic and stylized agents (MD = 0.85, $p < 0.05$) and semi-realistic and cartoon-like agents (MD = 1.35, $p < 0.05$) are significantly different. Besides that, the mean difference between realistic agent and stylized agent (MD = 0.22, $p > 0.05$) and stylized and cartoon-like agents (MD = 0.49, $p > 0.05$) is significantly no difference.

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Table 5.17

Findings of Tukey's HSD Post Hoc Test for Arousal Against Virtual Agents

Multiple Comparisons

Dependent Variable: Arousal

		Tukey HSD				
(I) Virtual Agent	(J) Virtual Agent	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
realistic	semi-realistic	-.63*	.199	.008	-1.15	-.12
	stylized	.22	.199	.685	-.29	.73
	cartoon	.71*	.199	.002	.20	1.23
semi-realistic	realistic	.63*	.199	.008	.12	1.15
	stylized	.85*	.199	.000	.34	1.37
	cartoon	1.35*	.199	.000	.83	1.86
stylized	realistic	-.22	.199	.685	-.73	.29
	semi-realistic	-.85*	.199	.000	-1.37	-.34
	cartoon	.49	.199	.064	-.02	1.01
cartoon	realistic	-.71*	.199	.002	-1.23	-.20
	semi-realistic	-1.35*	.199	.000	-1.86	-.83
	stylized	-.49	.199	.064	-1.01	.02

Based on observed means.

The error term is Mean Square(Error) = 2.963.

*. The mean difference is significant at the .05 level.

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5.6.4 The Scatter Plots of Arousal

A scatter plot, with x-axis indicating arousal and y-axis respondent, was plotted (Figure 5.2). Results show that arousal level for each agents is focused at more than five score value which means all the agents cause high arousal. For realistic agent, majority scores fall at 7 with total 32.7 percentage. In addition, majority scores for semi-realistic agent also fall between 7 and 8 with total 51.3 percentage whereas for stylized agent, majority scores fall between 5 to 7 with total 67.3 percentage. Finally, majority scores for cartoon-like agent fall between 4 to 7 with total 72.6 percentage. Based on the mean score values, all the agents' arousal level fall between 5.5 to 7.0.

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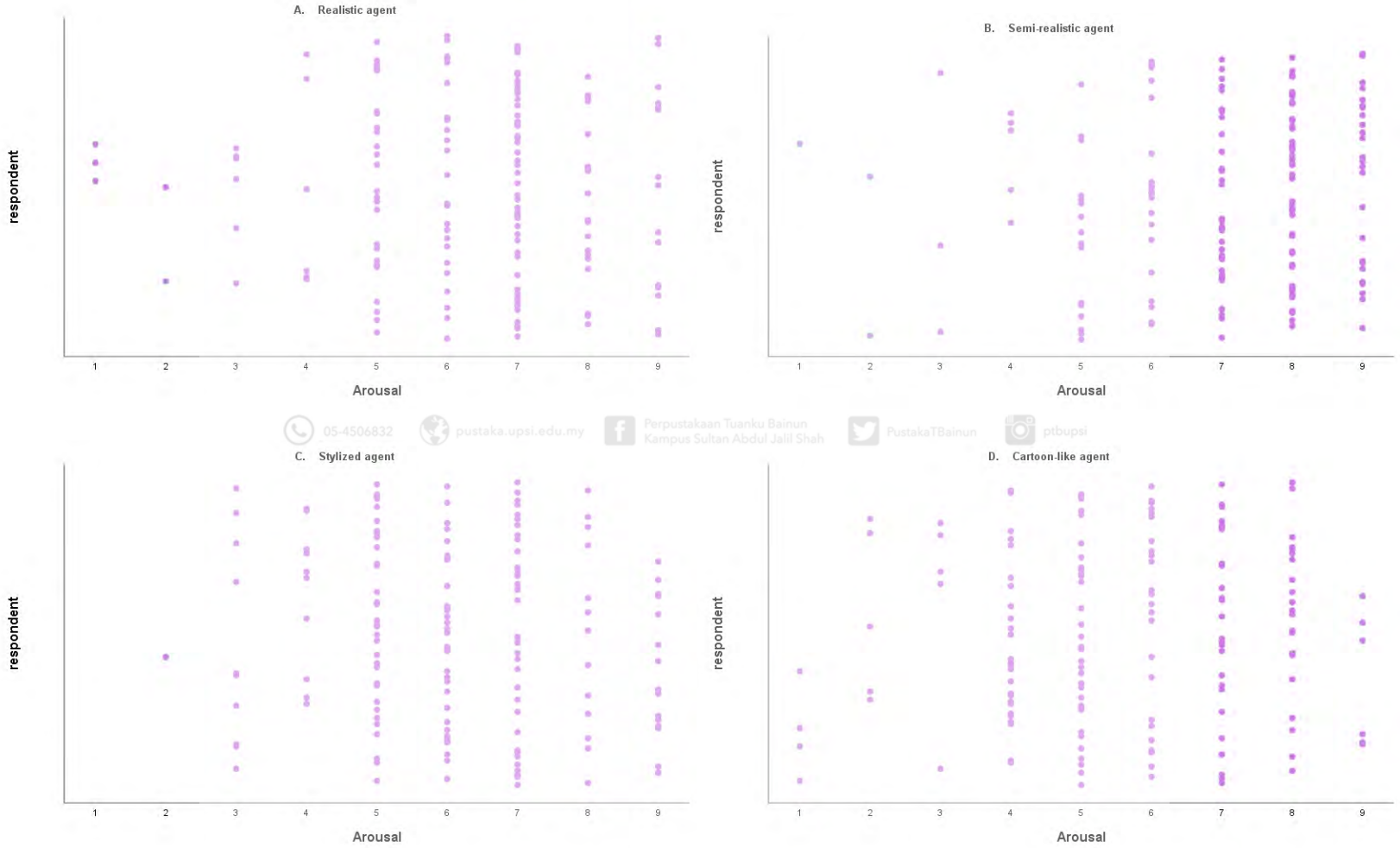


Figure 5.2. The Scatter Plots of Arousal on Realistic Agent (A), Semi-Realistic Agent (B), Stylized Agent (C) and Cartoon-Like (D) with Respondent.

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5.6.5 Summary of Second Research Question

Overall, ANOVA was used to test whether there is any significant difference in arousal between student groups based on different realistic designs of virtual agent which are realistic, semi-realistic, stylized and cartoon-like agents. The results of the ANOVA test show that there is a significant difference between arousal and different realism designs of virtual agents with $F(3, 596) = 15.79$, $p < 0.05$, partial eta squared = 0.07 of which the effect size is medium according to Cohen (1988). Hence, second hypothesis of this study was accepted.

Table 5.18

Summary of ANOVA One-Way Test Results for Second Research Question

Tests of Between-Subjects Effects

Dependent Variable: AROUSAL

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Virtual agent	140.378	3	46.793	15.791	.000	.074
Error	1766.140	596	2.963			
Corrected Total	1906.518	599				

a. R Squared = .074 (Adjusted R Squared = .069)

As well, Tukey's HSD post hoc comparison tests were performed to identify which virtual agent pairs show significant difference. Table 5.19 shows the ranking order of student groups ranging from the best arousal mean score.

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Table 5.19

Ranking Order of Mean Score Value for Arousal

Ranking order	Group	Mean	Standard Deviation
1	Semi-Realistic	6.99	1.66
2	Realistic	6.35	1.74
3	Stylized	6.13	1.64
4	Cartoon-like	5.64	1.84

5.7 Analysis of the Third Research Question

Research Question 3

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Is there any significant effect of quiz based MLE with different realism designs of the 2D female virtual agents on students' emotions in learning?

ANOVA test was used to test whether there is any significant effect of different realism designs of the virtual agents which are realistic, semi-realistic, stylized and cartoon-like on students' emotions in learning.

5.7.1 Homogeneity of Variance

Homogeneity of variance test aims to ensure the variance of the mean score for emotions in learning is equivalent for each virtual agent groups. Levene's test of equality of error variances is not significant $F(3, 596) = 1.73$, $p = 0.16 > .05$ and

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therefore homogeneity assumption is not violated. Therefore, ANOVA test can be executed. Table 5.20 presents the results of the Levene's test of equality of error variances on emotions in learning.

Table 5.20

Levene's Test for Third Research Question

Levene's Test of Equality of Error Variances[a,b]

		Levene Statistic	df1	df1	Sig.
Emotions	Based on Mean	1.730	3	596	.160
	Based on Median	1.741	3	596	.157
	Based on Median and with adjusted df	1.741	3	588.551	.157
	Based on trimmed mean	1.761	3	596	.154

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: emotions in learning

b. Design: Intercept + virtualagent

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5.7.2 One-Way ANOVA Test Analysis

The dependent variable (DV) for the ANOVA is emotions in learning and independent variable (IV) is the different realism designs of virtual agents. The analysis of ANOVA is shown in Table 5.21.

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The results of the ANOVA test show that there is a significant difference between emotions in learning and different realism designs of virtual agents with F (3, 596) = 2.89, $p < 0.05$, partial eta squared = 0.01 of which the effect size is small according to Cohen (1988). Hence, the third hypothesis of this study is acceptable. Then, the Tukey's Honestly Significant Difference (HSD) post hoc test was performed to see which group is significantly different from each other.

Table 5.21

ANOVA One-Way Test Results for Third Research Question

Tests of Between-Subjects Effects

Dependent Variable: emotions in learning

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	750.858[a]	3	250.286	2.892	.035	.014
Intercept	3400698.735	1	3400698.735	39290.500	.000	.985
virtualagent	750.858	3	250.286	2.892	.035	.014
Error	51585.407	596	86.553			
Total	3453035.000	600				
Corrected Total	52336.265	599				

a. R Squared = .014 (Adjusted R Squared = .009)

5.7.3 Tukey's Honestly Significant Difference (HSD) Post Hoc Test

Subsequently, to identify which virtual agent pairs show significant differences, Tukey's post hoc comparison tests were performed. The details of descriptive statistics as in Table 5.22 show that cartoon-like agent obtained the highest mean score for

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emotions in learning (M = 76.58, SD = 9.43, n = 150) followed by semi-realistic agent (M = 76.02, SD = 9.74, n = 150), realistic agent (M = 74.87, SD = 9.67, n = 150) and stylized agent (M = 73.67, SD = 8.63, n = 150).

Table 5.22

Descriptive Statistics

Group	Mean	Standard Deviation	N
Realistic	74.87	9.37	150
Semi-Realistic	76.02	9.74	150
Stylized	73.67	8.63	150
Cartoon-like	76.58	9.43	150
Total	75.29	9.35	600

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In contrast, the results of the pairwise comparisons test using the Tukey's method as in Table 5.23 show that the mean difference of emotions for cartoon-like and stylized agents (MD = 2.91, $p < 0.05$) are significantly different whereas realistic and stylized agents (MD = 1.21, $p > 0.05$), semi-realistic and realistic agents (MD = 1.15, $p > 0.05$), semi-realistic and stylized agents (MD = 2.35, $p > 0.05$), cartoon-like and realistic agents (MD = 1.71, $p > 0.05$) and cartoon-like and semi-realistic agents (MD = 0.56, $p > 0.05$) show no significant difference.

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Table 5.23

Findings of Tukey's HSD Post Hoc Test for Emotions in Learning Against Virtual Agents

Multiple Comparisons

Dependent Variable: Emotions in learning

Tukey HSD

(I) Virtual Agent	(J) Virtual Agent	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
realistic	semi-realistic	-1.15	1.07	.710	-3.91	1.62
	stylized	1.21	1.07	.675	-1.56	3.97
	cartoon	-1.71	1.07	.386	-4.47	1.06
semi-realistic	realistic	1.15	1.07	.710	-1.62	3.91
	stylized	2.35	1.07	.127	-.41	5.12
	cartoon	-.56	1.07	.954	-3.33	2.21
stylized	realistic	-1.21	1.07	.675	-3.97	1.56
	semi-realistic	-2.35	1.07	.127	-5.12	.41
	cartoon	-2.91*	1.07	.035	-5.68	-.15
cartoon	realistic	1.71	1.07	.386	-1.06	4.47
	semi-realistic	.56	1.07	.954	-2.21	3.33
	stylized	2.91*	1.07	.035	.15	5.68

Based on observed means.

The error term is Mean Square(Error) = 2.963.

*. The mean difference is significant at the .05 level.

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5.7.4 Summary of Third Research Question

ANOVA test was used to test whether there is any significant effect of different realism designs of the virtual agents which are realistic, semi-realistic, stylized and cartoon like on students' emotions in learning. The results of the ANOVA test show that there is a significant difference between emotions in learning and different realism designs of virtual agents with $F(3, 596) = 2.89$, $p < 0.05$, partial eta squared = 0.01 of which the effect size is small according to Cohen (1988). Hence, the third hypothesis of this study is acceptable.

Table 5.24

Summary of ANOVA One-Way Test Results for Third Research Question

Tests of Between-Subjects Effects

Dependent Variable: EMOTIONS IN LEARNING

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
virtualagent	750.858	3	250.286	2.892	.035	.014
Error	51585.407	596	86.553			
Corrected Total	52336.265	599				

a. R Squared = .014 (Adjusted R Squared = .009)

Furthermore, Tukey's HSD post hoc comparison tests were performed to identify which virtual agent pairs show significant differences. Table 5.25 shows the ranking order of student groups ranging from the best emotions in learning mean score.

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Table 5.25

Ranking Order of Mean Score Value for Emotions in Learning

Ranking order	Group	Mean	Standard Deviation
1	Cartoon-like	76.58	9.43
2	Semi-Realistic	76.02	9.74
3	Realistic	74.87	9.37
4	Stylized	73.67	8.63

5.8 Analysis of the Fourth Research Question

Research Question 4

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Are valence and arousal caused by realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning?

In order to answer the fourth research question, mediation analysis was tested using PROCESS macro (v3.3) for SPSS to test whether students' emotions in the dimension of valence and arousal are mediators to the relationship between different realism designs of the virtual agents and emotions in learning. The hypothesis was tested using mediation analysis based on Hayes (2018) as shown in the Figure 5.3. In addition, mediator 1 (M1; valence) and mediator 2 (M2; arousal) are proposed to explain the relationship between an independent variable (X; realistic, semi-realistic, stylized and cartoon-like agent or in other word high realistic level to lower realistic

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level) and dependent variable (Y; emotions in learning). This model is a parallel multiple mediator model.

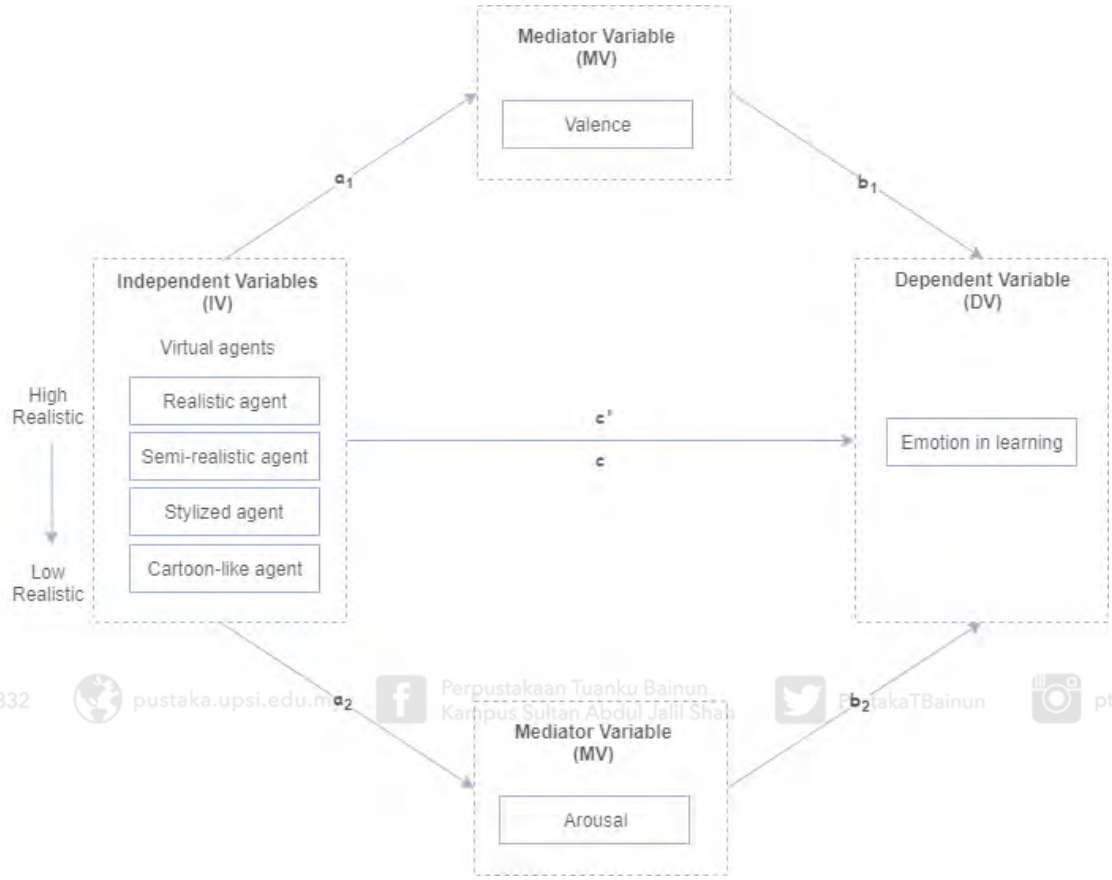


Figure 5.3. Parallel Multiple Mediator Model Showing the Direct Effect and Causal Paths Linking Different Realistic Designs of Virtual Agents to Emotions in Learning

5.8.1 Mediation analysis (Bootstrapping Method)

Mediation analysis was tested using the bootstrapping method with bias-corrected confidence estimates (Hayes, 2018; Preacher & Hayes, 2008). In the present study, the 95% confidence interval of the indirect effects was obtained with 5000 bootstrap

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resamples (Hayes, 2018; Preacher & Hayes, 2008). The summary of the results is shown in Table 5.26.

Firstly, it was found that the direct effect (c') high to low realistic level virtual agents (X) was positively associated with emotions in learning (Y) (ß = 0.597, t = 1.746, p = 0.081). It is indicated that other variables are controlled in the model; high realistic agents score 0.597 units higher on the emotions in learning scale (Figure 5.4). Hence, the effect is not statistically significant.



Figure 5.4. Virtual Agents Affects Emotion in Learning (Direct Effect)

Notes: The figure shows regression coefficients. The dashed line represents non-significant coefficients.
*p < .05, **p < .01, ***p < .001

In addition, the relationship between virtual agents is negatively related to valence ($a_{1)}$) (ß = -0.238, t (598) = - 4.40, p = 0.000). In other words, lower realistic agents (as opposed to high realistic level agents) decreases valence by -0.238 (because a_1 is negative); this effect is significant as shown in Figure 5.5.

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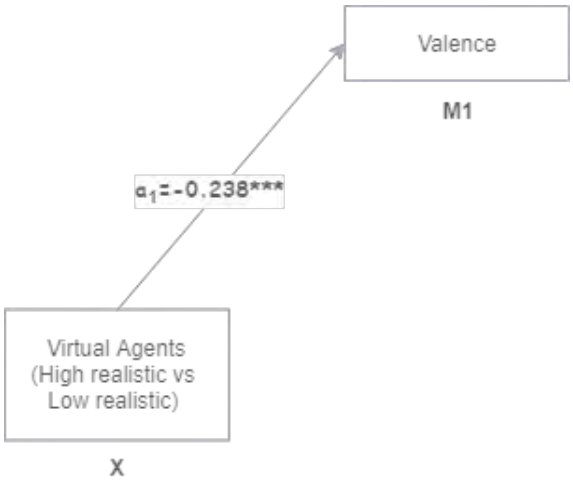


Figure 5.5. The Relationship between Virtual Agents and Valence (a_1)

Notes: The figure shows regression coefficients. p < .05, **p < .01, ***p < .001

On the other hand, the relationship between virtual agents is negatively related to arousal (a_2) (ß = -0.299, t (598) = - 4.67, p = 0.000). In brief, for path a_2, it is found that lower realistic agents (as opposed to high realistic level agents) decreases arousal by -0.299; this effect is significant as shown in Figure 5.6.

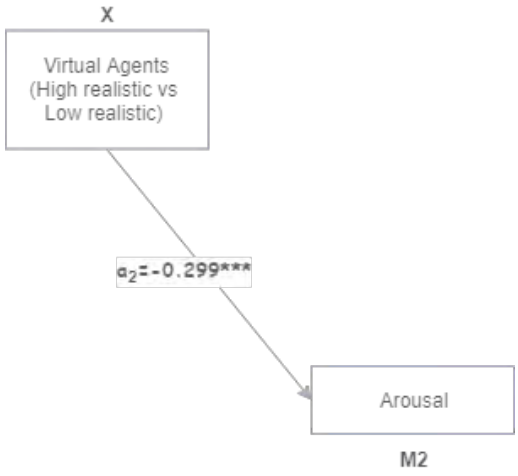


Figure 5.6. The Relationship between Virtual Agents and Arousal (a_2)

Notes: The figure shows regression coefficients. *p < .05, **p < .01, ***p < .001

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Secondly, results indicated that the first mediator, valence (b_1), is positively associated with emotions in learning (ß = 0.037, t (596) = 0.095, p = 0.925). In short, the impact of valence on emotions in learning (b_1) is 0.037; though the effect is insignificant (Figure 5.7).

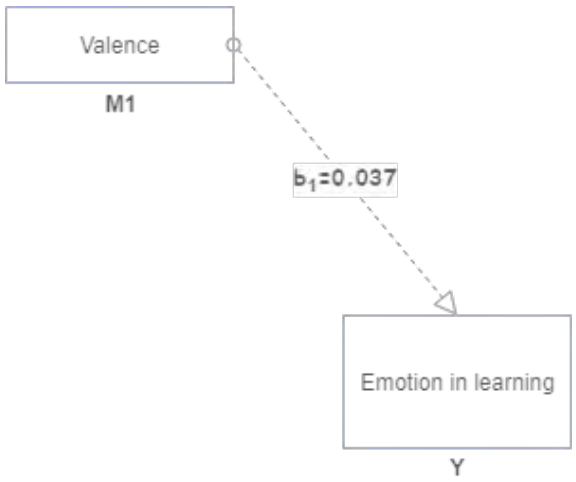


Figure 5.7. The Relationship between Valence and Emotions in Learning (b_1)

Notes: The figure shows regression coefficients. The dashed line represents non-significant coefficients. *p < .05, **p < .01, ***p < .001

Besides that, for the second mediator, arousal (b_2) is also positively associated with emotions in learning (ß = 1.039, t (596) = 3.14, p = 0.002). This concludes that the impact of arousal on emotions in learning is (b_2) 1.039; this effect is significant as shown in Figure 5.8.

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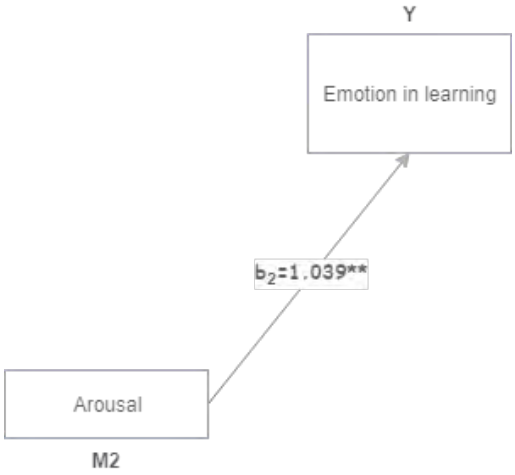


Figure 5.8. The Relationship between Arousal and Emotions in Learning (b_2)

Notes: The figure shows regression coefficients. *p < .05, **p < .01, ***p < .001

Consequently, the indirect effect of different realism designs of virtual agents on students' emotions in learning through valence (a_1b_1= - 0.009) is insignificant because this confidence interval does include zero (ß = -0.009, CI = -0.186 to 0.183) as shown in Figure 5.9. Therefore, valence does not have mediating relation between different realism designs of virtual agents and emotions in learning.

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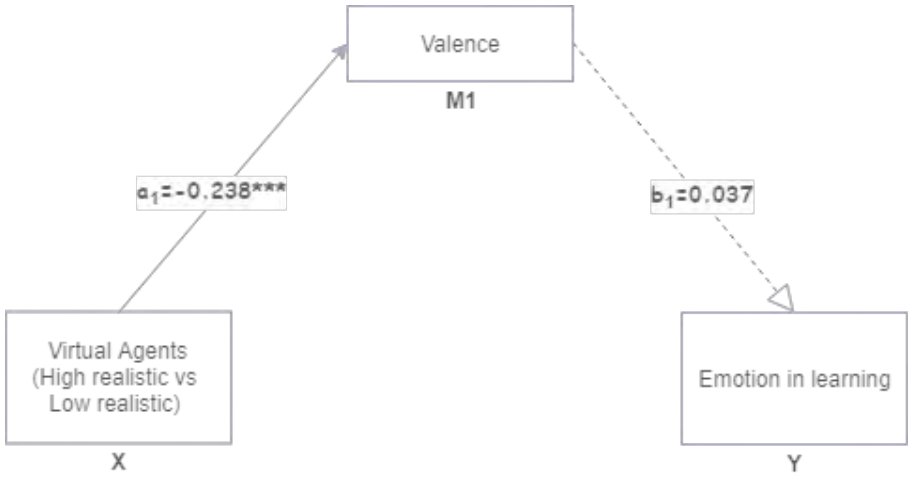


Figure 5.9. The Indirect Effect of Virtual Agent on Emotions Learning Through Valence (a_1b_1)

Notes: The figure shows regression coefficients. The dashed line represents non-significant coefficients. *p < .05, **p < .01, ***p < .001

However, for the indirect effect running only through arousal (a_2b_2 = -0.311) is significant because this confidence interval is below zero (ß = - 0.311, CI = -0.564 to -0.114) as shown in Figure 5.10. Hence, arousal has mediating relation between different realism designs of virtual agents and emotions in learning.

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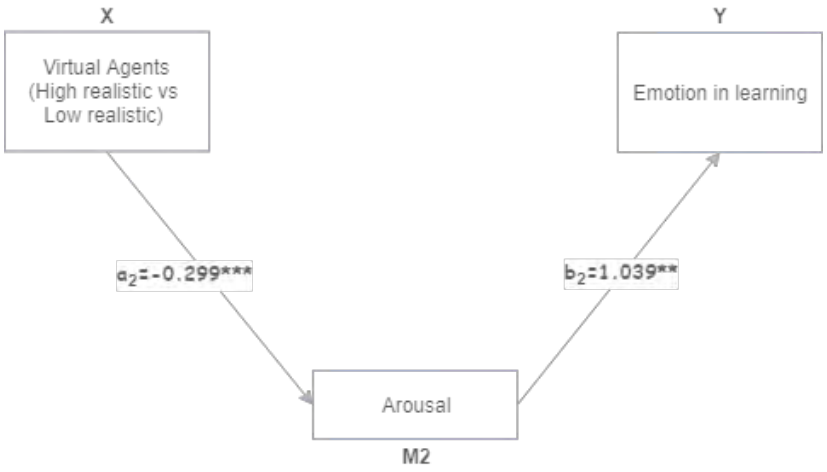


Figure 5.10. The Indirect Effect of Virtual Agent on Emotions Learning through Arousal (a_2b_2)

Notes: The figure shows regression coefficients. coefficients. *p < .05, **p < .01, ***p < .001

The total effect (c), of high to low realistic level virtual agents was positively associated on emotions in learning through valence and arousal (ß = 0.277, t (598) = 0.810, p = 0.418) meaning high realistic agent increases emotions in learning (because c is positive). However, this effect is insignificant.

Thus, the mediating effect of valence and arousal in the relationship between different realistic designs of virtual agents and emotion in learning shown are illustrated as in Figure 5.11.

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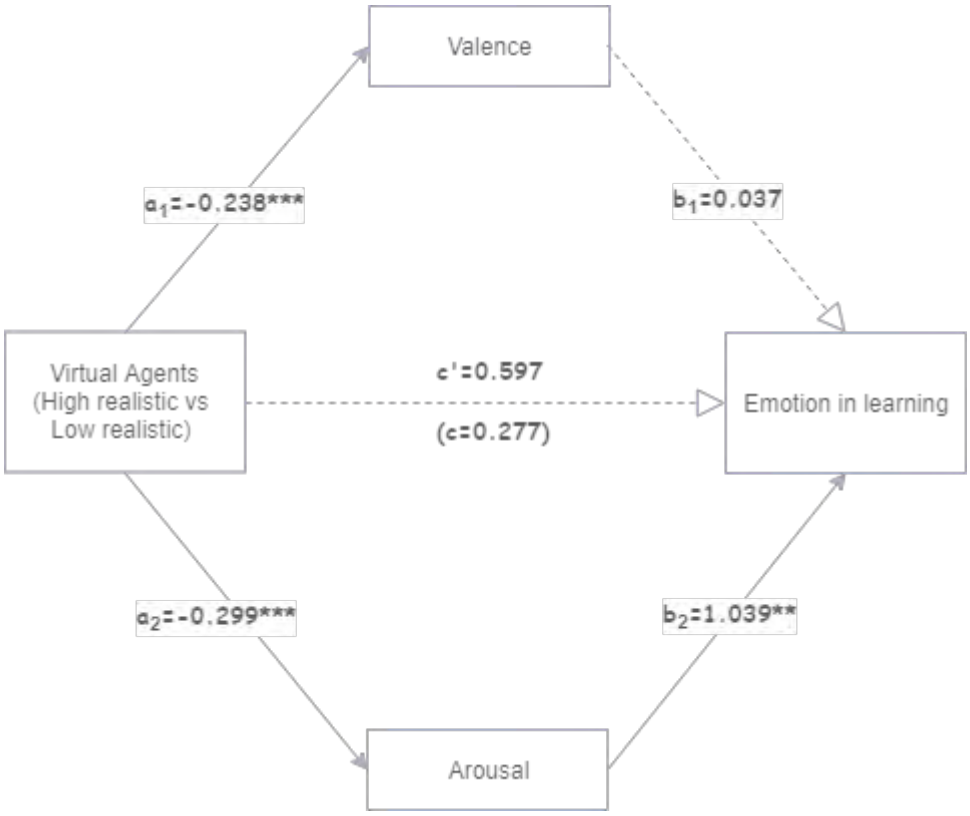


Figure 5.11. The Mediating Effect of Valence and Arousal in the Relationship between Different Realism Designs of Virtual Agents and Emotions in Learning.

Notes: The figure shows regression coefficients. The dashed line represents non-significant coefficients. *p < .05, **p < .01, ***p < .00

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Table 5.26

Regression Coefficients, Standard Errors and Model Summary Predicting Score on Emotions in Learning

Path	High realistic agent Versus Low realistic agent				
	Coeff.	SE	p	95% CI	
				Lower	Upper
Total effect (c)	0.277	0.341	.418	-0.394	0.947
Direct effect (c')	0.597	0.342	.081	-0.074	1.268
a_1	-0.238	0.054	.000	-0.344	-0.132
a_2	-0.299	0.064	.000	-0.425	-0.174
b_1	0.037	0.392	.925	-0.733	0.807
b_2	1.039	0.331	.002	0.389	1.689
Indirect effects					
a_1b_1	-0.009	0.091	-	-0.186	0.183
a_2b_2	-0.311	0.117	-	-0.564	-0.114

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5.8.2 Summary of Fourth Research Question

Mediation analysis was tested by using PROCESS macro (v3.3) for SPSS to test whether there is any significant relation between students' emotions in the dimension of valence and arousal as mediators to the relationship between different realism designs of virtual agents and emotions in learning. The hypothesis was tested by using mediation analysis using the bootstrapping method with bias-corrected confidence estimates (Hayes, 2018). In the recent study, the 95% confidence interval of the indirect

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effects was obtained with 5000 bootstrap resamples (Hayes, 2018). Results of the mediation analysis confirmed, arousal has mediating relation between different realism designs of agents and emotions in learning (ß = - 0.311, CI = -0.564 to -0.114). However, for the indirect effect running only through valence is insignificant because this confidence interval does include zero (ß = -0.009, CI = -0.186 to 0.183). In conclusion, only arousal acts as mediator in the relation between different realism designs of virtual agents and emotions in learning.

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CHAPTER 6

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

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6.1 Introduction

The research aims to evaluate on effects of different realism designs of virtual agents on students' emotions in the dimension of arousal and valence. In addition, the arousal and valence effects on emotions in learning were analysed as well. The research focused on a selected group of students as a sample in order to provide data related to their affective experiences. Many important insights are revealed in this chapter from the acquired quantitative data. These includes the discussion on each finding, implications and contributions of the study. The findings of the study are discussed in order to answer each research question of the study. Meanwhile, the implication of the study is focused to the teaching and learning, particularly lecturers and students. At the same time, the contribution of the study to instructional designer, character designer,

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animation industry and Ministry of Education Malaysia are also presented in this chapter. Additionally, conceptual framework is constructed based on the findings of this research. Aside from that, suggestions for future research are presented too in this chapter which will be useful recommendations for the future researchers.

6.2 Discussion of Research Findings

The findings of this study are described according to the research questions that had been developed earlier. There are four research questions that are analysed and discussed in detailed in the next section. The summary of the research findings as shown in table 6.1.

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Table 6.1

Summary of the Research Findings

Research Questions	Hypothesis	Findings
Is there any significant effect of different realism designs of the 2D female virtual agents on students' valence?	There will be significant effect of different realism designs of the 2D female virtual agents on students' valence.	**Accepted** - significant difference between valence and different realism designs of virtual agents with F (3, 596) = 15.48, $p<0.05$, partial eta squared =0.07
Is there any significant effect of different realism designs of the 2D female virtual agents on students' arousal?	There will be significant effect of different realism designs of the 2D female virtual agents on students' arousal.	**Accepted** - significant difference between arousal and different realism designs of virtual agents with F (3, 596) = 15.79, $p<0.05$, partial eta squared = 0.07

(continue)

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Table 6.1 *(continued)*

Research Questions	Hypothesis	Findings
Is there any significant effect of Quiz based Multimedia Learning Environment (Q-MLE) with different realism designs of the 2D female virtual agents on students' emotions in learning?	There will be significant effect of Quiz based Multimedia Learning Environment (Q-MLE) with different realism designs of the 2D female virtual agents on students' emotions in learning.	**Accepted** - significant difference between emotions in learning and different realism designs of virtual agents with $F(3, 596) = 2.89$, $p<0.05$, partial eta squared = 0.01
Are valence and arousal caused by different realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning?	Valence and arousal caused by different realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning.	**Partially Accepted** – only arousal played a mediating role between different realism designs of the virtual agents and students' emotions in learning.

6.2.1 The Importance of Virtual Agent's Design

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The selection of appropriate realism design is very essential for the design of virtual agent. Students keen to attract to an ideal virtual agent and accept it as learning partner in academic settings (Graesser & McNamara, 2010). Importantly, students' positive emotions towards the virtual agents' design lead to the acceptance of the virtual agent (Norman, 2007; Coates, 2003). With this in mind, emotional analysis on the different realism designs of virtual agents is very important in order to extract its effect on students' emotions in learning process.

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6.2.2 Measurement of Realism Level

Specifically, the emotional effect can be identified through the affective state that experienced by students. This affective state can be achieved through the expression of valence and arousal towards the different realism designs of virtual agents. The two dimensions, valence and arousal, are independent of each other.

6.3 First Research Question

Accordingly, the first research question for the present research is to study whether there is any significant effect of different realism designs of the 2D female virtual agents on students' valence.

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6.3.1 Valence

Valence is a basic psychological phenomenon which represents the affective experience from pleasant to unpleasant feeling or positive to negative state.

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6.3.2 Discussion

The findings showed that there is significant effect of different realism designs of the 2D female virtual agents on students' emotions in the dimension of valence. Valence represents the negative to positive affective state that rated on a nine-point scale from one (very negative) to five (neutral/objective) to nine (very positive) as shown in valence mean score graph.

As for emotions in the dimension of valence, the semi-realistic agent has significantly outperformed compared to other design by reaching the highest mean score value. The texture of the semi-realistic agent had been designed to push a further sense of realism and detail in order to display as life-like character. Thus, students were experienced highest pleasantness when viewing semi-realistic agent that seemed more real visually. Adding to this, even semi- realistic agent is not an objective image of reality but still it can be identified as real or close to real human-like character. Therefore, such perfectly fine human-like features in semi-realistic agent generate a sense of believe towards it and consequently provide a great aesthetic pleasure among students.

Conversely, valence was the lowest for cartoon-like agent compared to the other virtual agents. The design of cartoon-like agent is seemed as flat although it holds a sense personality through its' dark outline and colour choice. Besides that, the cartoon-like agent represents strangeness elements in terms of its design that caused it less likeable by the students. The research study by Kätsyri et al. (2017) also found that

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cartoonish characters were received the highest strangeness ratings and the lowest likability ratings.

The realistic agent has achieved the second highest score after the semi-realistic agent. The realistic agent is not always associated with perceived likability of the character, but its' likeability depends on the design of the character (Rosenthal & Krämer, 2014). It seems clear that when the realistic agent is resembled as a human, it has captured the students' attraction and the design highly likeable by them. Besides that, the texture of realistic agent is as realistic as human that led to look beautiful in the view of students and they were impressed to it.

At the same time, the mean score for stylized agent was higher than cartoon-like agent. Stylized agent is differed in terms of design features in a variety way. Different level of creativity was used in creating the stylized agent. When the features of stylized agent more exaggerated, it less seemed as real human-like character. Consequently, the stylized features on the design of stylized agent led to the moderate valence values.

6.3.3 Conclusion

Overall, valence was increased from cartoon-like agent to semi-realistic agent, confirming the realism positivity bias. Obviously, the four different realism designs of virtual agents fall on positive state of valence. This result indicated that students were happy and enjoyed with the interaction with the virtual agents as they viewed them

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more positively. The interaction with the virtual agents was pleasant for the students as well. Also, the positive valence among students capable to lead them towards the improvement of cognitive control relative.

6.4 Second Research Question

Taking this research to a step further, the second research question is focused on the presence of any significant effect of different realism designs of the 2D female virtual agents on students' arousal.

6.4.1 Arousal

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As discussed earlier, arousal is physiological mechanism that categories emotional experience into low or high state through the range that varies from being bored to highly excited or from being calm to tense (Russell, 2003).

6.4.2 Discussion

The findings of this research revealed that there is significant effect of different realism designs of the 2D female virtual agents on students' arousal. The rating values for arousal were tested using mean score values for each virtual agent. Generally, arousal signifies low to high affective state that rated on a nine-point scale from one (neutral/objective post) to nine (very high).

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Based on the findings, semi-realistic agent has achieved a higher rate of physiological arousal. The high level of arousal can only be experienced by a very high feeling of excitement. In view of that, students reached the heightened state of energy spontaneously at the first look of the semi-realistic agent on the screen. This is due to the excitement among students in seeing the semi-realistic agent which has the look that seems to be closely like them. Moreover, the features arrangements of the semi-realistic agent that represent more like real human affected the students. This is in consistent with the statement of Perkins et al. (2001) which showed that greater level of arousal is raised when individual felt excited and less serious when they are concerned with the process that they presently focused rather than its outcomes or consequences.

The created semi-realistic agent has the characteristics of skin colour of pinkish beige with look that closely portraying Malay native people. Malays are largest ethnic group in Malaysia where they are generally Muslim and practice Malay culture. Adding to this, the semi-realistic agent speaks standard and clear English language dialects with localized Malaysian's female voice which were recorded with real human voice. The mixture of nearly look of local people, attire and voice capable of providing an environment in where students felt that they were facing with people who are very recognizable by them. The presence of such elements on semi-realistic agent appearance offer high degree of excitement among students.

The high feeling of excitement was triggered from praiseworthy action by the students as a gratification towards the believable design of semi-realistic agent. This is supported in the study by Vogel et al. (2017) which revealed that the contact with

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familiar people motivates an individual's behaviour (Lang & Davis, 2006) and consequently increases his or her arousal. Here, the result may differ if a male agent or different ethnic is used.

On the other side of the coin, it is revealed that mean score was lowest when a virtual agent being portrayed with cartoon like features. This result showed that students' affective experience with the cartoon-like agent was less emotionally aroused compared to the other virtual agents. This is due to the design of cartoon-like agent that has used an abstract style with less visual detail. The visual style and shapes of the cartoon-like agent were expressed through silhouette edges. Thus, it was looked simple to the student although the look for the design come from real humans' appearance. This is in conjunction with the statement by Schneider et al. (2007) who found that even cartoon-like character clearly displayed human appearance but still its' abstract features strongly giving the impression that it is no identical to the real human. Thus, the flat looking 2D cartoon-like agent was less attractive to the students compared to other agents. This strengthens the argument by Wang and Rochat (2017) who stated that the unreal faces were significantly less attractive than the real faces. Consequently, students were less intense to the design of cartoon-like agent which caused lowest arousal rate among them.

When comes to realistic agent, its' concrete and detailed visual were evoked second highest mean score for the arousal. This result showed that students were more physiologically aroused when they encounter the realistic agent as it imitating like a human. The above finding is consistent with the study by Mitchell et al. (2011) which examined that the sense towards a realistic agent that resembles as a human is being

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highest due to the self-identification of the students. Basically, a successful realistic agent is designed with the illusion of reality. It seems clear that greater attention had been paid to the factor of realism in the design of realistic agent. As a result, all the facial features for the realistic agent fit together perfectly as a human. When the realistic agent is precisely developed, it became believable agent to the students as they can recognize it well. Consequently, they were attracted to the realistic agent that carried them to the state of high arousal. This is consistent with the statement of James et al. (2015) which showed that when an agent is realistic, it is seen to be credible and attractive to viewer.

Meanwhile, students were less physiologically aroused when the virtual agent design is represented in stylized form compared to realistic agent. This can be seen through the mean score for stylized agent which was lower than realistic agent. The findings from Wang and Rochat (2017) showed that unreal appearance of virtual agent is less attractive than the real human-like virtual agent. Generally, stylized agent is a non-realistic agent which is created with a greater appearance that mixed with many styles than an abstract cartoon-like agent. The very own style looking stylized agent has appropriate arrangement of the features in common which makes it recognizable as human by the students. Each features of stylized agent were exaggerated with a good abstraction of details that allow students easily perceived it as an agent with stylized look. This is supported by Zell et al. (2015) who stated that stylish look can be designed by increasing an agents' appeal or expressivity, exaggerating or softening specific features. Based on the research finding, the degree of stylization of the stylized agent had an effect on the students' interest by falling in high affective state. This is in line with statement by Adamo-Villani et al. (2016) which stated that the stylized agent is

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perceived as an appealing design. Still, with the enhanced style, stylized agent in this research unable to reach very high arousal effect among the students which is good in terms of producing appropriate design.

6.4.3 Conclusion

As a whole, it is concluded that cartoon-like agent has achieved the lowest arousal and it is followed by stylized agent, realistic agent and the highest arousal was achieved by semi-realistic agent. Nevertheless, the four different realism designs of virtual agents fall within the range of five to seven-point scale which called as high affective state for arousal. Of interest to the research questions, it had been found that the experience of emotions in dimension of arousal was influenced by the virtual agents' different realism designs. The increment in arousal among the students was due to the attractiveness and human-likeness of the virtual agents. It seems clear, they were excited to interact with the human-like virtual agents. Accordingly, the high affective state for arousal had a big impact on cognitive task performance which will be discussed later.

6.5 Does the Uncanny Valley Occurs Based on First and Second Research Questions?

Figure 6.1 shows the four different realism designs of virtual agents rated in circumplex model that has four quadrants with two independent nine point scales for valence and arousal. Specifically, the circumplex model holds the four virtual agents in the positive valence and high arousal. This highlighted that both dimensions obtained similar range

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of mean score that indicated as positive activating state. Basically, exciting feelings are elicited by a virtual agent at the positive activating state, annoying feeling at negative activating state, feeling of depression at negative deactivating state and sense of satisfaction exists at positive deactivating state. The result of positive activating state exhibited an interesting pattern across the two dimensions as it comprises the characteristics of happiness, delightfulness and excitement.

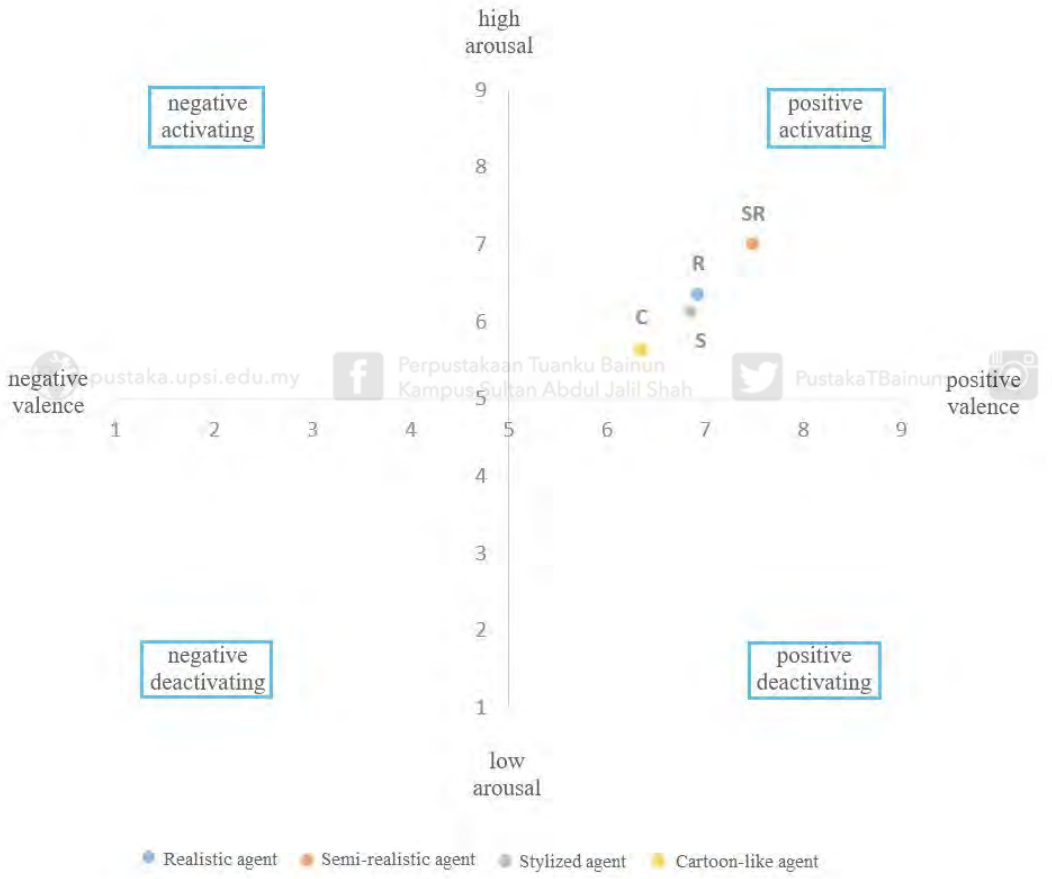


Figure 6.1 The Scatter Plots in the Circumplex Model of Arousal Versus Valence Based on Mean Score

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Based on the result, students found the virtual agents were familiar to them as they can recognize well the virtual agents due to the similar common elements as them. This is supported by Vogel et al., (2017) who discovered that individuals are attracted to close and highly familiar people that influenced them to feel excited and happy. The author also points out that the features of everyday social contexts influence the affective experience. In this research, the different realism designs of virtual agents were personalised with the combination of Malaysian native look, attire and appearance according to the needs, moods and preferences of students. The colour of cloth to the virtual agents are also a subtle indication of mood as the combination of orange and yellow are often associated with rich excitement. In addition, the virtual agents' visual elements and voice are matched perfectly as real humans' female voice is used for each virtual agent. With this in mind, the virtual agents were appeared to be attractive and pretty to students. Consequently, students were reported to experience pleasantness and excitement. According to Vogel et al., (2017), the interaction with highly familiar virtual agent is produced more positive affective valence and greater affective arousal. Similarly, the results of this graph implied that the four different realism designs of virtual agents fall at positive activating state.

Generally, Mori's robotics design theory which is called as uncanny valley is a common reference for the development of virtual agent (Schneider et al., 2007). According to the theory, when a virtual agent increasingly resembles more like a human, the sense of familiarity increases too until reach to a point where uncanny valley occurs. At this point, there will be inconsistence realism in the appearance of virtual agent. Hence, the agents appear to be unfamiliar and fake to viewers which cause eerie feelings and induce them to avoid it. This is similar to Schneider et al. (2007) who noted

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that characters such as Shark Tale (Damaschke et al., 2004) and Howdy Doody (Roger Muir, 1960) are reported to possess a clearly human appearance but the characters are low attractive and received scores that positioning them in the dip in correlation as described by Mori. On the face of it, uncanny valley occurrence depends on the degree of realism. This is in line with the statement of Seyama and Nagayama (2007) who has point out that the impressions of pleasantness increase monotonically with an increasing degree of realism, except for the uncanny valley.

However, based on the plot in the circumplex model, uncanny valley does not exist in this research as the four different realism designs of virtual agents are appeared to be attractive to the students. This is supported by Ciechanowski et al. (2019) who indicated that uncanny valley does not exist as there is a positive relationship between human likeness and familiarity in the design of virtual agents. Also, according to Mitchell et al. (2011), the feeling of eeriness occurred when there is a mismatch in the virtual agents' visual elements such as eyes, face and other treatments. Nonetheless, all the features of the different realism designs of virtual agents fit perfectly with appropriate arrangements.

Moreover, the graph shows that the four virtual agents escaped totally from falling in the range of negative valence. Generally, positive valence covers various positive emotions such as liking, pleasantness and attraction while negative valence is representing emotions such as unlikeness, unpleasantness and boredom. Students were assumed the virtual agents as attractive and beautiful virtual agents that induced pleasant impression among students. Hence, uncanny valley does not exist for the designed virtual agents. This finding is strengthened by the statement by Seyama and

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Nagayama (2007) which stated that pleasant impressions due to attractiveness, pretty and fascinating impressions will be represented within positive valence range and unpleasant impressions due to unattractive, ugly and uncanny impressions will be represented in negative valence range.

Aside from that, as the four different realism designs of virtual agents were designed in two-dimensional, students were experienced comfortability even the level of realism increased for each virtual agent. As a result, it has been noticed that each design of virtual agents has been escaped from the uncanny valley effect through the emotional feelings experienced by students. This is in line with the argument by Walker (2009) that the level of comfortability and positive emotion could also be raised with the use of 2Ds instead of three-dimensional characters.

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6.5.1 Conclusion

In sum, the results revealed that while the dimensions of valence and arousal are associated, the four virtual agents fall on positively activating state with a clear positive valence and high arousal. Clearly, it can be seen that the four different realism designs of virtual agents followed similar perception patterns within the valence-arousal space. This seems to indicate a more rapid development in the perception of positive stimuli along the arousal and valence dimension. In addition, the human-like female agents with Malaysian physical and cultural features in term of look, voice and skin colour are caused students to feel very familiar with it and it affected their affective experience in the dimension of arousal and valence. Consequently, the results did not indicate

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uncanny valley effect for the designs of virtual agents which varies from realistic, semi-realistic, stylized and cartoon-like. Adding to this, positive activating emotions capable to foster holistic and creative ways of thinking and subsequently provide a positive influence on learning as highligted by Scholae (2013). Interestingly, the four different realism designs of virtual agents: realistic, semi-realistic, stylized and cartoon-like character are best to be implemented for educational purpose as the four virtual agents are in the state of high arousing positive valence.

6.6 Third Research Question

The third research question for the present research is to study whether there is any significant effect of Quiz based Multimedia Learning Environment (Q-MLE) with different realism designs of the 2D female virtual agents on students' emotions in learning.

6.6.1 Emotions in Learning

From a pedagogical point of view, students experience a variety of emotions throughout the process of learning in academic settings (Scholae, 2013). Students' affective experience influences their perceptions and behaviour. Thus, it becomes an important goal for students to recognize and use their emotions on the content of learning and the circumstances of learning. Recently, Pekrun et al. (2011) and Ahmad Zamzuri and Mohd Najib (2016) highlighted the important of emotions in identifying cognition

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success in the learning process. According to the view of Ciechanowski et al. (2019), virtual agents play an important role as interactive mediate to distribute cognitive tasks to the students in interactive learning environment. Hence, an enhancing and suitable design of virtual agent would be more susceptible for emotions induction. In view of that, four different realism designs of virtual agents were designed to interact with user in Quiz based Multimedia Learning Environment (Q-MLE).

6.6.2 Discussion

In this case, research question of the present study focuses on identifying whether there is any significant effect of Quiz based Multimedia Learning Environment (Q-MLE) with different realism designs of the 2D female virtual agents on students' emotions in learning. The results revealed several interesting facts. Cartoon-like agent has scored the highest score in emotions in learning and it was significantly different with stylized agent. This is along with the lowest score that achieved by stylized agent among the four virtual agents. In the other way around, realistic and semi-realistic agents were not significantly different to any of the virtual agents. This is in line with the score obtained by realistic and semi-realistic agents in emotions in learning that not much difference.

Based on the result, the cartoon-like agent has demonstrated the highest score among the other virtual agents. This result indicated that the subtle design of cartoon-like virtual agent positivity bias in perceiving emotions in the process of learning. Besides that, there was a substantial increase in the emotions in learning when using cartoon-like agent compared to the emotions in the dimension of valence and arousal

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on cartoon-like agent in isolated. This finding showed there is a connection between the both analysis where the highest score demonstrated in emotions in learning is due to the arousal and valence effects. According to Lu et al. (2017), less arousing positively valenced emotional states lead to better overall cognitive-motor performance than highly arousing, negatively valenced emotional states. The cognitive-motor performance is very much associated with students' performance in learning process. According to Clark (2017), high engagement on the cognitive level is essential for students to perform well in learning process. Thus, arousal must be kept at moderate level to divert learners' full attention on the subject matter. Therefore, students with the lowest arousal score (yet positive) towards cartoon-like agent before learning process had high emotional state during the learning process.

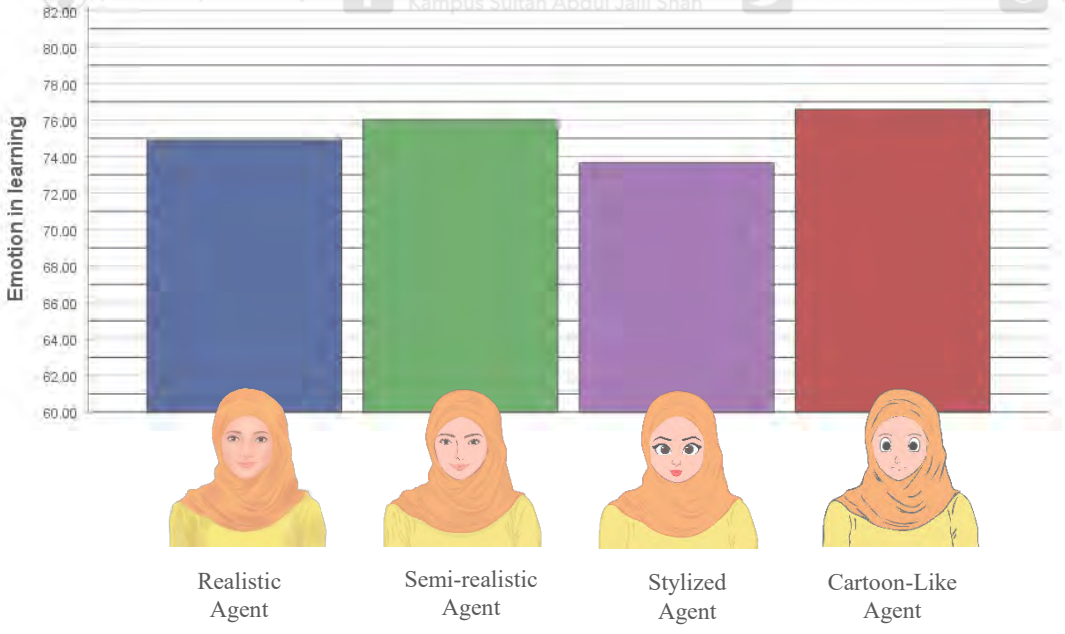


Figure 6.2. The Histogram of Emotions in Learning Based on Mean Score

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Basically, arousal is strongly connected to task performance as it affects an individuals' attention. This is in line with the statement by Vesker et al. (2018) that highlighted the capability of arousal in driving attention and visual processing priority. Attention can become either too narrow with too much arousal or too broad with too little arousal. This is supported by the statement by Clark (2017) which revealed that too high arousal decreases student's attention and motivation to learn. Revisiting to hypothesis one and two which showed that cartoon-like agent had lowest score for both valence and arousal meaning students were not too excited about the agent. The cartoon-like agent with mid-level point of arousal has provided the motivation to learn among students and allowed their attention on learning process as they have a sense of being in control of their learning environment. Thus, students became totally involved in the learning process. Conversely, further investigation needed whether this moderate arousal lead to student's better performance.

In between that, it is very common to use simple abstract style cartoon agents for games. Jin et al. (2016) added that the use of simple abstract style virtual agent in game capable to create large space for players to easily fill their self-image into it and generates more effects in their experience. Similarly, when cartoon-like agent used in Q-MLE, students able to identify themselves with the agent, accept it and engage fully in the learning process. In that manner, cartoon-like agent has greater impact on students' affinity towards learning. Also, Habib and Soliman (2015) had proven that cartoon agent has great influence over children where they attracted to the cartoon content and they prefer to watch cartoons for long hours. This is applicable to teenagers as well as proven in the research findings.

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In the present research, there were no significant differences between semi-realistic agent and any other agents. Same result has achieved by the realistic agent as the both virtual agents remained fairly similar with typical features as human face. Therefore, both virtual agents also produced higher emotional effect on learning.

As discussed earlier, the semi-realistic agent and realistic agent fall on positive activating state with high arousal and positive valence. Thus, both virtual agents were not affected by the uncanny valley effect. In the dimension of arousal, the increases in arousal will result in the increase of cognitive task performance, up to a point where very high arousal will affect it. It had been predicted that the high level of arousal during the earlier analysis did not go beyond the optimal arousal that allows students to experience pleasant excitement and focus well during the learning process.

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In addition, the study by Roxas et al. (2018) examined that emotions are an important element in order to create strong connection between human and virtual agent during learning process. Since, the semi-realistic and realistic agents are appeared to be same age group with the students, they were interacted easily by accepting the virtual agents as their friend. The finding was consistent with findings of past studies by Vogel et al. (2017) which supported that an individual seek for frequent interaction with close and highly familiar people.

Conversely, stylized agent has reached the mean score that indicating lowest emotions in learning. This may be caused by atypical features of the stylized agent that decreased students' emotions in learning. Many features exaggerated for stylized agent such as enlarged eyes, smaller nose and mouth. Similarly, Kätsyri et al. (2015)

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highlighted that faces with typical or average features are considered more attractive than atypical face in their study. Also, Kätsyri et al. (2015) added that some agents in the 'human' category would be viewed as creepy as they look like human yet contained features such as exaggerated eyes which is not 'entirely right'.

According to past researches, atypical features were also considered as factor for the existence of uncanny valley (Langlois & Roggman, 1990; MacDorman et al., 2009; Rhodes et al., 2001). However, interestingly, this is contrary to the present study where the stylized agent has attained lower valence and arousal value compared to realistic and semi-realistic agents which indicated the absent of uncanny valley for stylized agent. But still, the use of stylized agent in learning produced lowest emotions among students compared to other virtual agents. Therefore, further research regarding this needed in order to explain whether the atypical features on agent could cause the uncanny valley or affect students' emotions in learning.

6.6.3 Conclusion

As conclusion, cartoon-like agent seemed to be perceived as best suitable virtual agent to be use in educational settings in order to stimulate the overall emotions in learning. This followed by semi-realistic, realistic and stylized agent. Concerning the realism factor, virtual agent should be designed in a way as a cartoon to induce more positive emotions in learning process among student. Clearly, students' emotional state during the learning process is assumed to influence their learning outcome in multimedia learning environment. This is in line with the potential of positive emotions in

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facilitating learning and thereby promotes effective teaching and learning. Aside from that, the findings from the research indicated that the induction of students' emotions through the first look of the virtual agents were differed from the emotions that aroused during their interaction throughout the learning process. Adding to this, since the uncanny valley absent for the four different realism designs of virtual agents, students' emotions disrupted in a positive way for all the four designed virtual agents. As a result, the four virtual agents used in this research are ideal to be implemented in multimedia learning environment for fostering students' positive emotions.

6.7 Fourth Research Question

Subsequently, the fourth research question for the present research is to study whether valence and arousal caused by different realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning.

6.7.1 Discussion

After all, the fourth research question focuses on identifying whether valence and arousal caused by different realism designs of 2D female virtual agents are significant mediators in determining students' emotions in learning. From there, mediation analysis was performed to predict this relationship. The result showed that only arousal has played a mediating role between different realism designs of the virtual agents and students' emotions in learning.

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The role of arousal as mediator can be seen clearly through the existence of relationship between students' emotions in the dimension of arousal caused by different realism designs of the virtual agents and emotions in learning that demonstrated using PROCESS macro for SPSS (Hayes, 2018) as shown in Figure 6.3.

This result underlined that as the degree of realism level decreases, arousal decreases too and consequently lower arousal was associated with higher emotions in learning. In other words, students who were exposed to lower realism level of virtual agents had experienced lower arousal and thus their emotions in learning process increased significantly. Conversely, students who viewed higher realism level of virtual agents had experienced higher arousal and subsequently they had lower emotions in learning. In sum, the rise of arousal through the first look on the virtual agents influenced the overall affective experience in learning process. However, highly aroused emotions in this research did not produce very low emotional state during learning process. Interestingly, this is due to the achievement of arousal that did not go beyond the optimal level.

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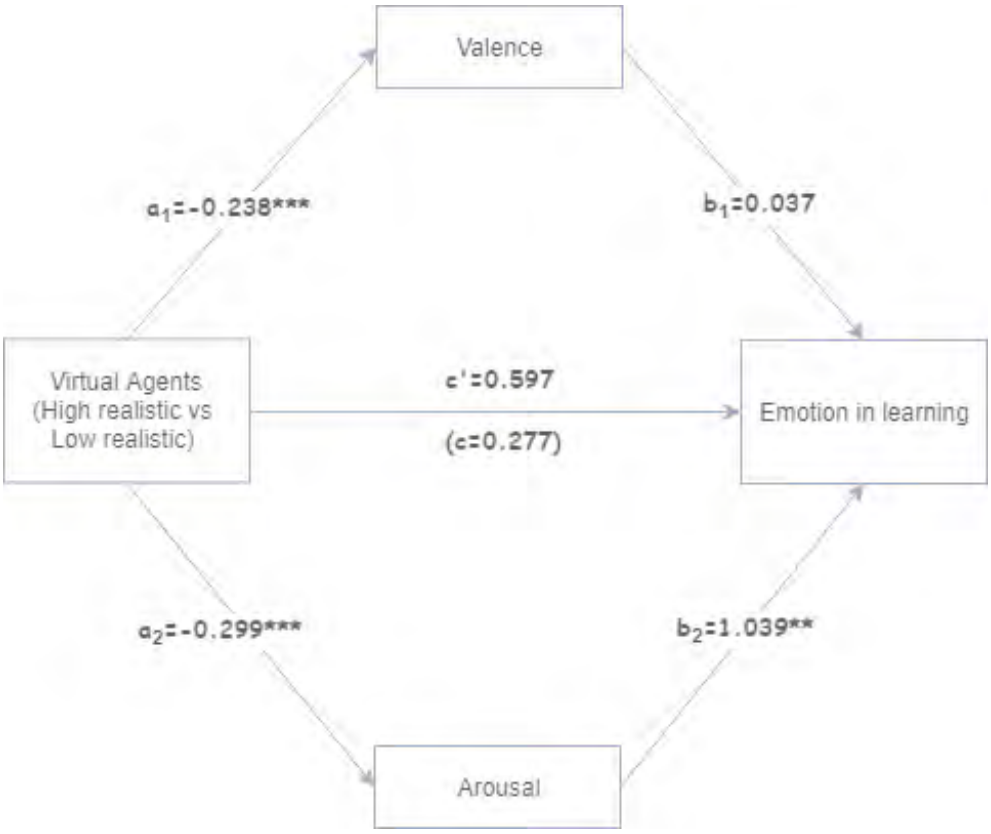


Figure 6.3. The Mediating Effect of Valence and Arousal in the Relationship Between Different Realism Designs of Virtual Agents and Emotions in Learning.

Notes: *p < .05, **p < .01, ***p < .001

On the other side of the coin, the indirect effect through valence was not different than zero. This indicated that there was no significant relationship between students' emotions in the dimension of valence caused by different realism designs of the virtual agents and emotions in learning. This is correspondingly due to the absence of uncanny valley effect on different realism designs of virtual agents as the four agents occupied on positive activate state by achieving positive valence.

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6.7.2 Conclusion

Overall, emotions play an important role in the interaction between human and computer. This is in line with the role of emotions in evoking the sense of believability on different realism designs of virtual agents that interact with human. The influence in the emotions can be demonstrated in the dimension of arousal and valence separately. However, regardless of valence, the rise of arousal on virtual agents plays a role as mediator in influencing affective experience in the cognitive learning process in multimedia learning environment. On face of it, the four virtual agents used in the present research were developed with appropriate realism designs that produce fruitful impact particularly in stimulating positive emotions in overall learning process. This is in accordance with the arousal factor stimulated by each virtual agent that being beneficial to learning without going into optimal arousal.

6.8 Implication of Study

The findings showed that the four virtual agents with different realism designs are suitable to use in learning in order to stimulate positive emotions among students. From there, it had been found that cartoon-like agent is the best agent to be implemented in education settings compared to other agents. The achievement of arousal and valence for cartoon-like agent were lowest among students that led them to devote more attention on learning. This had been proven through the results of emotional analysis among students during the learning process where cartoon-like agent has achieved the

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highest score. The findings of this study have specific impacts on students and lecturers as described in the next sub topic.

6.8.1 Implication to Multimedia Designer

Generally, multimedia designers need a strong information in multimedia to create a successful project. Accordingly, this research allows the identification of specific informations from the finished product of Quiz based Multimedia Learning Environment (Q-MLE) such as multimedia elements, special effects and attention-grabbing visuals and textual. Specifically, the organized information on the design specification of Q-MLE in the form of research writing can use as technical manual by the multimedia designer. Instead of viewing the writing as a stream of texts, multimedia designer can see the text as a collection of relevant information on the design specification that related to each other. By using this manual, the creative-minded multimedia designer capable to modify and make necessary changes to the multimedia material of Q-MLE to create informational and impactful content for other types of content such as advertisement, informational videos and so on. Consequently, multimedia designer can entice users in accordance to their needs and objectives. Besides that, the developed storyboard of the Q-MLE can be piece of baseline for the drawing of storyboard for other area such as video games, movies, advertisements and television shows. Additionally, the findings of this study determine the ideal realism design for virtual agent to stimulate emotions in the learning process. This enable multimedia designer to develop character with such design features for other purposes such as video games, tutorials, courseware to give the same emotional effects to the

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users. In addition, multimedia designer also can brainstorm and mock-up design ideas and computer-generated special effects of Q-MLE with other multimedia designers or cross functional teams including artists, animator, video game developer and programmers to decide upon the creative direction of other related project. This reduce a fair amount of time spend by them to research on the digital settings of multimedia materials before reach the deadline proximity. Adding to this, multimedia designer capable to handle more than one project simultaneously.

6.8.2 Implication to Students

The Quiz based Multimedia Learning Environment (Q-MLE) that developed for this research is believed to create student-centred learning environment that emphasizes three important elements of self-access, self-paced and self-directed through the ideal virtual agents as learning companion. Questions are presented by the virtual agent and students respond to it. Then, feedback is presented according to the students' response. Students also get results based on the answered questions. Here, the virtual agent serves as a motivator where students are very passionate to answer the questions when the virtual agent guides them throughout the Q-MLE. In addition, students' emotions positively stimulated when using different realism designs of virtual agents namely cartoon-like agent, semi-realistic agent, realistic agent and stylized agent. This is due to their attractiveness to the design of each agent. Adding to this, students are very much attracted to these agents and they feel very comfortable to accept these agents as learning companions in learning environment. These might lead students to stay focused and engaged throughout the learning process.

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6.8.3 Implication to Lecturers

Towards industry revolution 4.0 in education, all lecturers are advised to commit and cooperate in maximizing the use of interactive multimedia elements in preparing effective teaching tool for teaching and learning practices. According to cognitive theories, teaching and learning is easier through observation and recognition of objects such as visuals and sound that refer to interactive multimedia elements rather than relying on written material entirely. The current research reinforced this effort by producing Quiz based Multimedia Learning Environment (Q-MLE) as teaching tool with the implementation of virtual agent as learning companion for students. Interestingly, lecturers can request instructional designer to modify the Q-MLE according to their need of every subject in order to implement it in their teaching and learning process. This gives opportunity to lecturers to be passionate in changing the teaching methods that attract students and ultimately improve the quality of the students. Based on the research, each different realism designs of virtual agents have specific features to stimulate student's positive emotions throughout the learning process. In view of that, the different realism designs of virtual agents can be used by lecturers to deliver course material for other subject as well with the help of multimedia designer. Consequently, lecturers can enrich the learning materials in education settings. Besides that, the level of readiness of lecturers can be improve through the use of such teaching and learning approach. Lecturers can save their time, energy and save a lot of papers in delivering assessment without printing the questions in paper for each students. Lecturers can provide an easy access to the Q-MLE by embedding it into Learning Management System (LMS).

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6.9 Conceptual Framework of Virtual Agents based Multimedia Learning Environment (VA-MLE)

The main objective of this research is to overview the arousal and valence on different realism designs of virtual agents and its effect on overall emotions in learning. Mayer's multimedia learning cognitive theory, Mori's uncanny valley phenomenon and James Russell's Circumplex Model of Affect are the basis theories identified at the beginning of this study and these are further investigated throughout the study. The use of these theories is due to the needs of research that investigated on realism factor on virtual agents' design and its' effect on influencing students' emotions during learning in Quiz based Multimedia Learning Environment (Q-MLE). As a result of current research findings, a conceptual framework reformed as presented in Figure 6.4. The conceptual framework serves as useful tool to represent current research and it acts as a reference for further study by other researchers.

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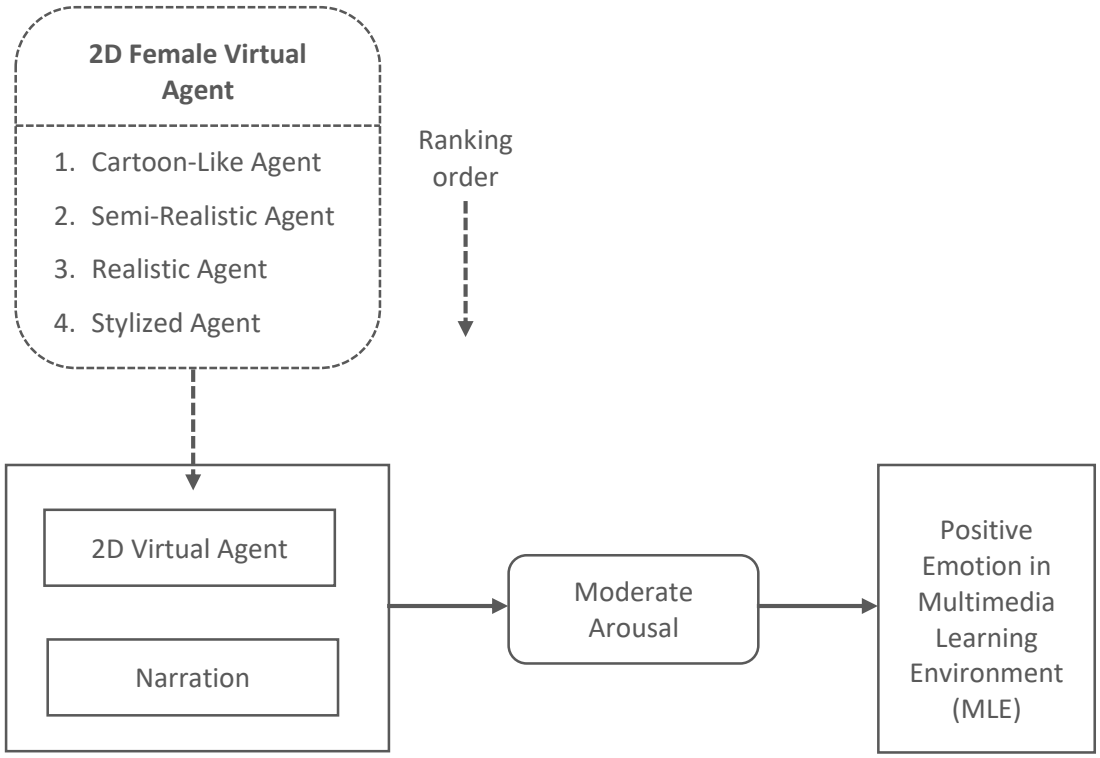


Figure 6.4. Conceptual Framework of Virtual Agents based Multimedia Learning Environment (VA-MLE)

The conceptual framework comprises different realism designs of 2D female virtual agents in Q-MLE, individual emotions in the dimension of arousal and overall emotions in learning that interconnected to each other. First, the research emphasized on the design of virtual agents by representing in four different realism designs. This includes realistic, semi-realistic, cartoon-like and stylized agents. Each virtual agent has its own features according to its respective realism levels. These include skin texture, colour, attire and Malay female native look. Along with these, the virtual agents presented with suitable Malaysian young female voice as narration that match well with the virtual agents. The role of realism in virtual agents with appropriate narration served

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as influence factors in order to stimulate students' emotional experience in the dimension of arousal. Arousal is important dimension of this research since it represents students' affective experience that influenced their overall emotion in learning through the interaction with virtual agent.

In fact, arousal play a mediator role between the different realism designs of virtual agents and overall emotions in learning the Q-MLE. In other words, there is significant relationship between virtual agents, arousal and emotions in learning. From there, it had been identified that cartoon-like agent is the best effective agent among the other virtual agents in inducing positive emotions in learning. This followed by semi-realistic agent, realistic agent and stylized agent respectively.

Although students' emotions in the dimension of valence proved the non-existence of uncanny valley on each designed virtual agents, but it does not contribute to provide any impact on the students' emotions in learning. Hence, valence ignored in the development of conceptual framework for this research.

As conclusion, the constructed conceptual framework for this research acts as a guideline for the development of virtual agents in any other MLE such as tutorial system, teaching aid and so on.

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6.10 Contribution of Study

The current study is an important contribution to create Quiz based Multimedia Learning Environment (Q-MLE) as a new pedagogical method to transform the teaching-learning environment in education settings. Also, the findings of this study provide an overview on determining the appropriate realism designs of virtual agents to stimulate emotions in learning process. This provides a great contribution to Instructional Designer, Character Designer, Animation Industry and Education Ministry of Malaysia as well.

6.10.1 Contribution to Instructional Multimedia Designer

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A high skill is required to combine various multimedia elements in a production of interesting and effective Multimedia Learning Environment (MLE). In the current research, the Quiz based Multimedia Learning Environment (Q-MLE) was developed in the combination of all the multimedia elements by using narration as audio, interaction of virtual agent as combination of video and animation, graphic user interface as graphic and rules and regulations as text as well. Moreover, the placement and alignment of each multimedia element such as button and text and the choice of colour for interface design prototype of the Q-MLE well-designed based on the previous studies. Adding to this, the content and structure of the Q-MLE are well-organized based on Gagne's Model. Besides that, the finding of the research contributed in the selection of appropriate virtual agent for Q-MLE that effective in inducing positive emotions among students in learning. Addressing these specific factors in the

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development of Q-MLE ease the instructional designer to quickly create a new MLE for any other course material without spending more time on it.

6.10.2 Contribution to Character Designer

In particular, the design of virtual agent plays an important role in determining the success of using it in educational settings. Thus, this research explored the experiences of pleasantness and excitement in students' emotion when watching Malaysian native look virtual agents with different realism designs. The results of the research had shown a strong evidence that the use of the four designed virtual agents for Quiz based Multimedia Learning Environment (Q-MLE) successfully stimulated positive emotions among students during learning process. Therefore, the four virtual agents can be useful guideline for character designer in developing such character for education purpose in order to elicit maximum effectiveness in learning.

6.10.3 Contribution to Animation Industry

Besides that, other commercial animation companies are likewise can turn animators to use the developed virtual agents as the choice of virtual agent for their products such as video games, animated film, intelligent tutorial system and so on. This is in accordance with the capability of the virtual agents in inducing positive emotions among students during learning process. Similarly, the same impact can be seen among viewer when implement the virtual agents for other products as well. Specifically, local animation

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film industry can use the native look virtual agents to attract local audience as followed by certain animation studio which can be seen in movies such as 'Upin & Ipin' (Burhanuddin et al. 2007) and 'BoBoiBoy' (Nizam et al. 2011).

6.10.4 Contribution to Education Ministry of Malaysia

Educational system in Malaysia is leading towards industry revolution through innovation-based education. Also, Ministry of Education Malaysia aspirated to enhance delivery mechanisms of educational material in innovative, creative and effective way. Interestingly, this research will propose to Ministry of Education Malaysia, an innovative and efficient way to deliver interactive multimedia design based educational materials using ideal virtual agents. At the same time, the finding of this research capable to result in a huge change in the way students acquire, use and distribute knowledge. This indirectly causes changes in the Education System of Malaysia and makes students more competitive towards education 4.0. Further, the developed Quiz based Multimedia Learning Environment (Q-MLE) can be widely used as teaching and learning material for Polytechnic and Community College. This is in accordance with its' 26th Key Performance Indicators (KPI) where it recommends to use innovative teaching and learning approaches (Department of Polytechnic and Community College Education [JPPKK], 2019).

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6.11 Future Directions

The findings showed that the four different realism designs of virtual agents fall on positive activating state that caused it to escape from uncanny valley effect. This is especially due to the design of 2D female virtual agents which emphasized on the Malaysian native look. Hence, it looks very familiar to students and subsequently highly likeable by them. However, the results may differ if virtual agents with male native look are used. Aside from that, the results may differ if the virtual agents are designed as different ethnics such as Chinese, Indian or other ethnics. Other than that, the present research is focused specifically about the emotions in learning. Thus, this research can be extended in order to investigate students' performance on the subject with different realism designs of virtual agents. In addition, the future researchers can include facial expressions to the virtual agents to explore the occurrence of uncanny valley effects. Besides the Quiz based Multimedia Learning Environment (Q-MLE), it is recommended to implement the same developed virtual agents for any other learning materials in order to investigate the existence of uncanny valley and its effect on learning. At certain point of view, question arises whether the uncanny valley only occurs at first look on the virtual agents. In this case, further investigation needed to identify whether similar result will be obtained when the same virtual agents are exposed to the same population repeatedly with different learning materials. Therefore, further research regarding this is needed in order to explain whether the atypical features on agent could cause the uncanny valley or affect students' emotions in learning.

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6.12 Conclusion

This research focused on the realism factor on designs of virtual agents and its effect on emotions among students. The emotions are comprised in the dimension of arousal, valence and emotions in learning process. The research discovered that the four different realism designs of virtual agents were in the positive activating state for both arousal and valence. The mean score value of semi-realistic agent was the highest for both valence and arousal followed by realistic agent, stylized agent and the lowest score for cartoon-like agent. It seems clear that the students score for the virtual agent depends on its design specifically the realism factor. Students felt excited and pleasant in viewing virtual agents in the same age range with them. Besides that, the virtual agents are appeared to be beautiful in the view of students with the Malaysian native look, attire and so on. On the face of uncanny valley effect on the virtual agents, first and second hypothesis prevailed that uncanny valley does not exist when students were exposed to the 2D female virtual agents.

In the other way around, when the virtual agents were implemented in Quiz based Multimedia Learning Environment (Q-MLE), the results were different where cartoon-like agent has scored highest mean value for emotions in learning. As the students' activation increased during the learning process, they were triggered by the repeated exposure of virtual agent that stimulated them to demonstrate different responses. Clearly, it had been found that low arousing cartoon-like agent increased students' attention in learning that led to achieve highest score as proven in third hypothesis.

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After all, the forth hypothesis revealed that arousal is perceived as significant mediators to the relationship between different realism designs of the virtual agents and emotions in learning. Here, there is no significant relationship between emotions in the dimension of valence and emotions in learning. In that matter, although valence allowed the virtual agents to fall on positive state with high pleasantness, it does not affect students' emotions during learning process. In overall, the present study had implication in determining the effect of realism designs of virtual agents on emotions in learning through the arousal as significant mediator for the research.

Finally, this thesis entitled as different realism designs of 2D female virtual agents and its' valence and arousal effects on overall emotions in learning had been completed by covering six chapters namely introduction, literature review, research methodology, design and development, research analysis, discussion, conclusion and recommendations. All findings of this study can be implemented by various related parties for future research purposes.

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APPENDIX A

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EXPERT'S VIEW OF THE CHARACTER'S DESIGN

Research Title: The Uncanny Impact on Different Realism Level of the virtual agent on Students' Emotions in Learning

Validation of the design of virtual agent. Please state whether this designs are according to the specified type of design. Please state yes or no. Then please comment on the space provided. Thank you.

1. The designed character meets the minimum 2-Dimensional of realistic design.

Yes/No (Yes)



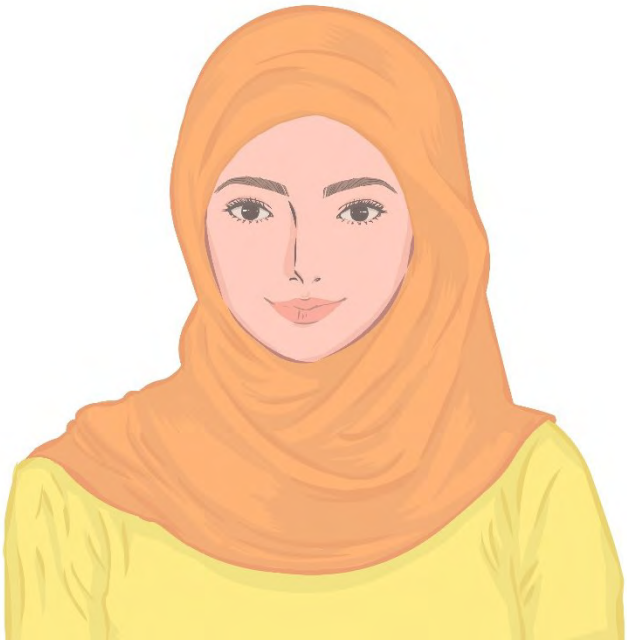
Comment: has X and Y values, and appropriate or realistic shading/skin toning

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2. The designed character meets the minimum 2-Dimensional of semi-realistic design.

Yes/No (Yes)



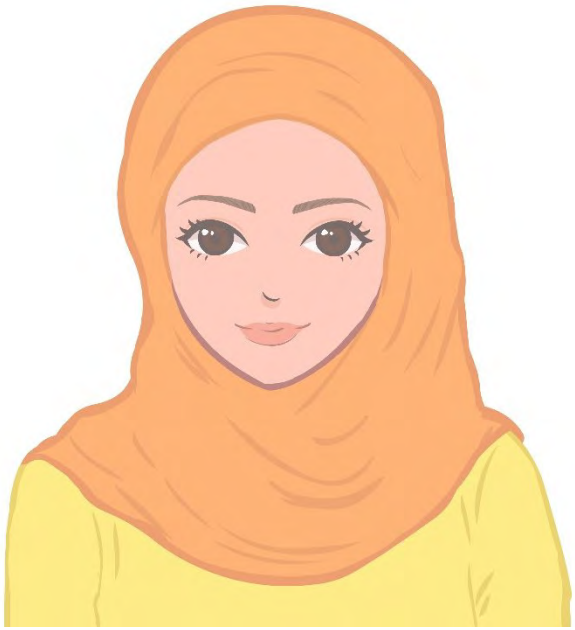
Comment: The eyes and lips look semi realistic

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3. The designed character meets the minimum 2-Dimensional of cartoon design.

Yes/No (Yes)



Comment: It has unrealistic representation (e.g. eyes and skin colour)

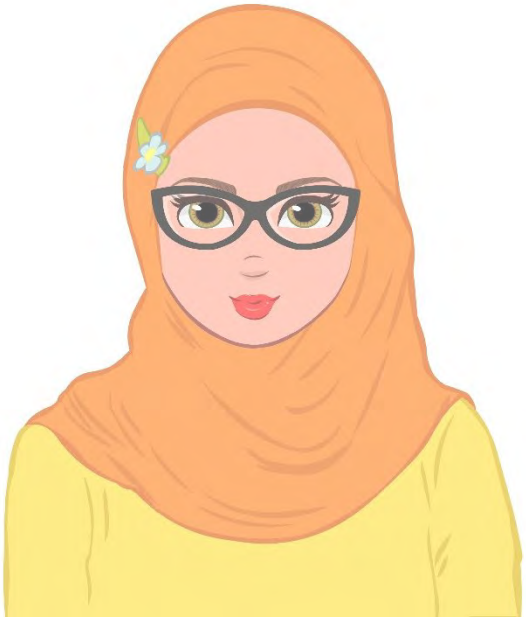
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4. The designed character meets the minimum 2-Dimensional of stylized design.

Yes/No (Yes)



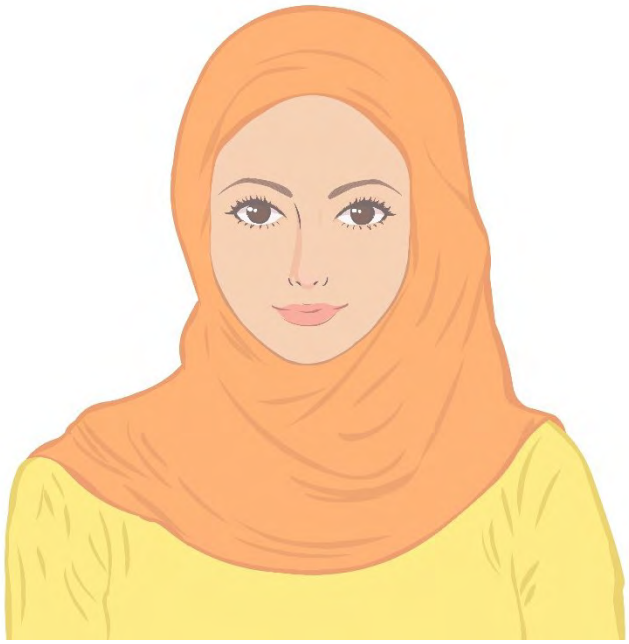
Comment: It has outstanding cartoon look

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5. The designed character meets the minimum 2-Dimensional of semi-stylized design.

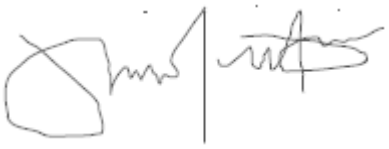
Yes/No (Yes)



Comment:

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Signature of the expert



Expert A

1st Round

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EXPERT'S VIEW OF THE CHARACTER'S DESIGN

Research Title: The Uncanny Impact on Different Realism Level of the virtual agent on Students' Emotions in Learning

Validation of the design of virtual agent. Please state whether this designs are according to the specified type of design. Please state yes or no. Then please comment on the space provided. Thank you.

1. The designed character meets the minimum 2-Dimensional of realistic design.
   [Animated character that are realistic (designed very detailed and it mimics like human)]
   Yes/No (Yes)



Comment:

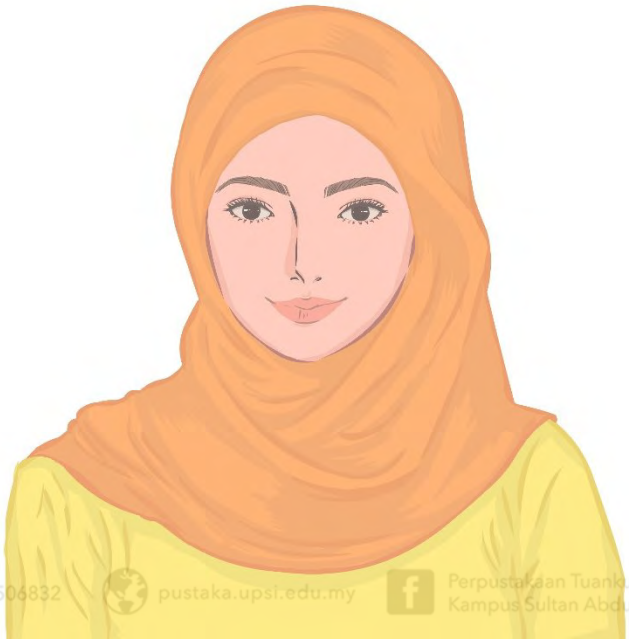
Yes, the design in terms of fidelity and naturalism mimics a real human being.

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2. The designed character meets the minimum 2-Dimensional of semi-realistic design.
   [Animated characters that are partially realistic (not as detailed as the realistic)]

   Yes/No (Yes)



Comment:

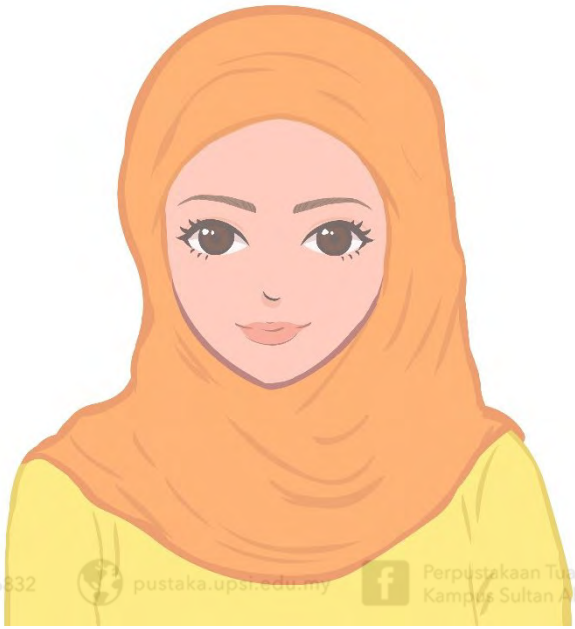
As compared to the Agent # 1, this agent has lower fidelity.

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3. The designed character meets the minimum 2-Dimensional of cartoon design.
   [Animated characters that are iconic match a typical cartoon model (simplified geometry of the face)]

   Yes/No (Yes)



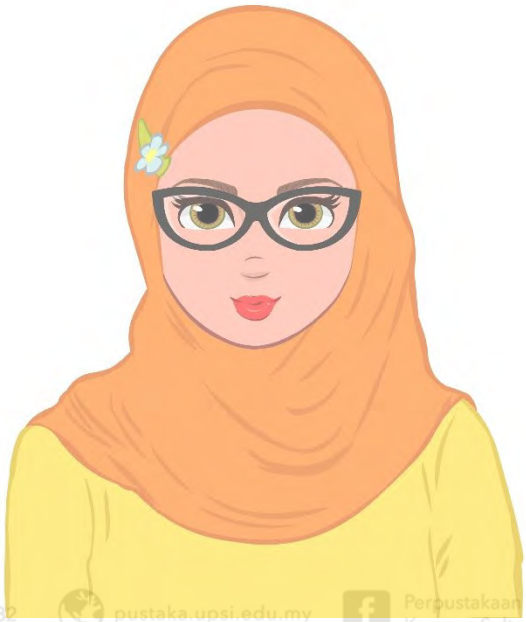
Comment:

Yes, this agent meets the criteria of being “iconic / cartoon” designed as it has a caricature / baby-face features (big eyes, small nose) that moves away from mimicking a real human-being. This *may* help alleviate the uncanny responses.

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4. The designed character meets the minimum 2-Dimensional of stylized design.
   [Animated characters that are stylized (cartoon character with exaggerated features)]
   Yes/No (Yes)



Comment:

In my opinion,

- I would suggest that the glasses (and flower-pin) to be removed as these cues can be considered as 'extraneous' factors that may potentially interfere with results of your experiment(s). Assuming that *realism level* is the primarily the independent variable of the experiment; thus, it is suggested that only realism level should be manipulated among the agents; while other design factors should be kept constant / controlled. This is to say that accessories (e.g., glasses and flower-pin) for this agent should be removed, to ensure constant design factors across the agents to strengthen the validity of experiment.

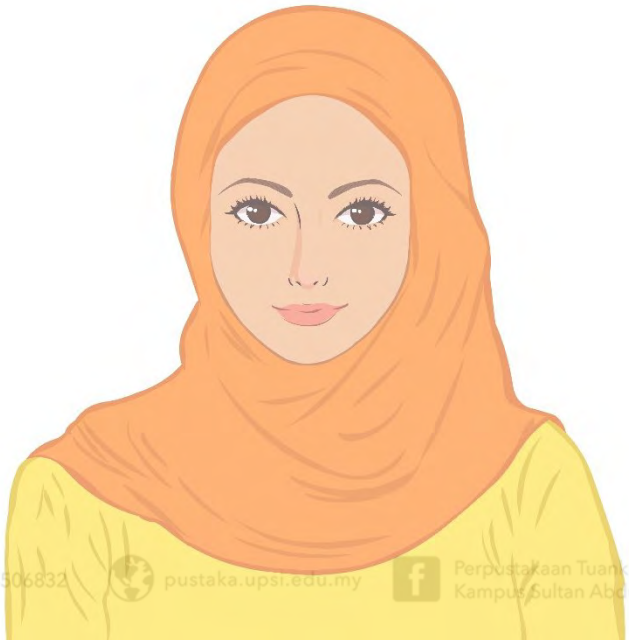
- In terms of operationalization of agent *realism*, this agent design can be considered equal to agent # 3. The reason is both agents share similar realism values such as being 'iconic', 'cartoonish', 'caricature design' and 'baby-face'.

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5. The designed character meets the minimum 2-Dimensional of semi-stylized design.
   [Animated characters that are partially stylized (cartoon character with lesser exaggerated features)]

   Yes/No (Yes)



Comment:

In my opinion, this agent design can be considered as equal to agent # 2, in terms of operationalization of realism factors, i.e., fidelity (detail). The slight difference that I can observe is the caricature (proportion) of the eyes, when compared to agent # 2. I am uncertain if this small variance would be 'strong' enough to justify the difference between these agents with respect to realism.

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General comments:

- The design of all agents are done very well and atheistically pleasing. Furthermore, I feel that there is strong novelty in the design of the agents as they are designed well to match the local culture of Malaysian settings.

- Assuming if the conceptual and operationalization framework of agent realism are based on 1) Fidelity (also known as 'detail' / 'texture') and 2) realism (also known as or overlapped to 'naturalism- stylization'); therefore, I suggest that that only agent #1, agent# 2, and agent #3 has significant differences in terms of realism design among the agents, and thus noteworthy to be examined. However, agents #4 and #5 seems too similar in realism design with agent #3 and agent # 2 respectively, and thus may be considered to be excluded in experiment.



Signature of the expert

Expert B

1st Round

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1. The designed character meets the minimum 2-Dimensional of realistic design.

Yes/No (yes)



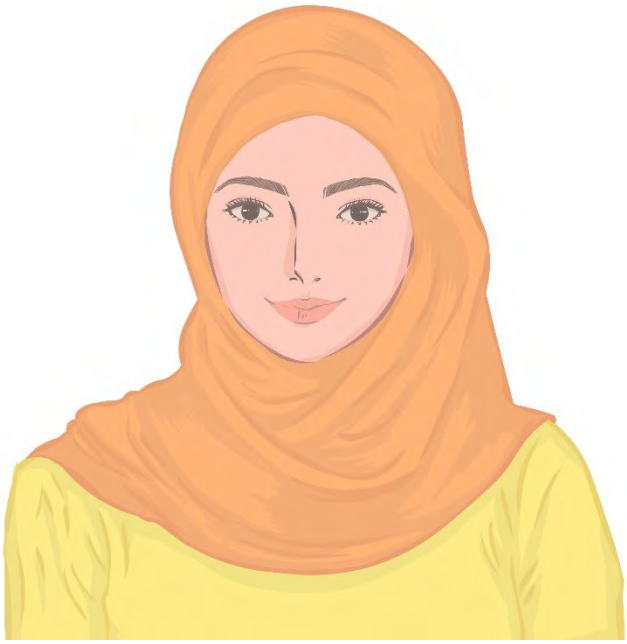
Comment:

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2. The designed character meets the minimum 2-Dimensional of semi-realistic design.

Yes/No (yes)



Comment:

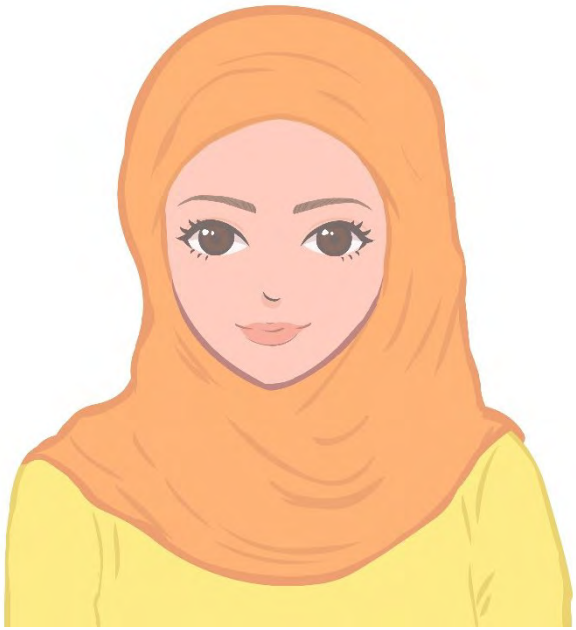
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3. The designed character meets the minimum 2-Dimensional of cartoon design.

Yes/No (yes)



Comment:

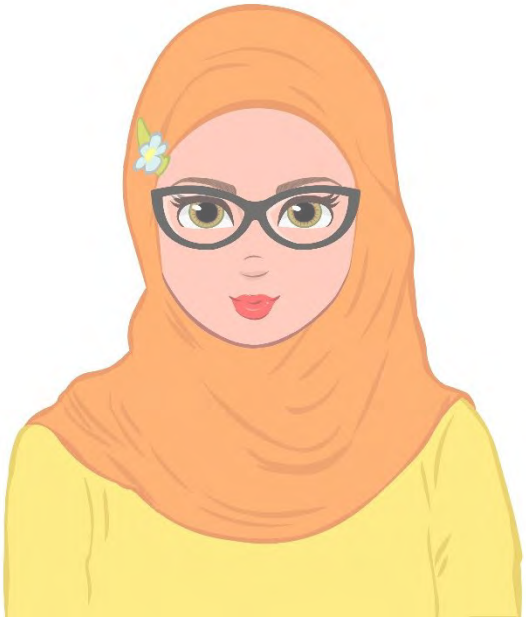
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4. The designed character meets the minimum 2-Dimensional of stylized design.

Yes/No (no)



Comment:

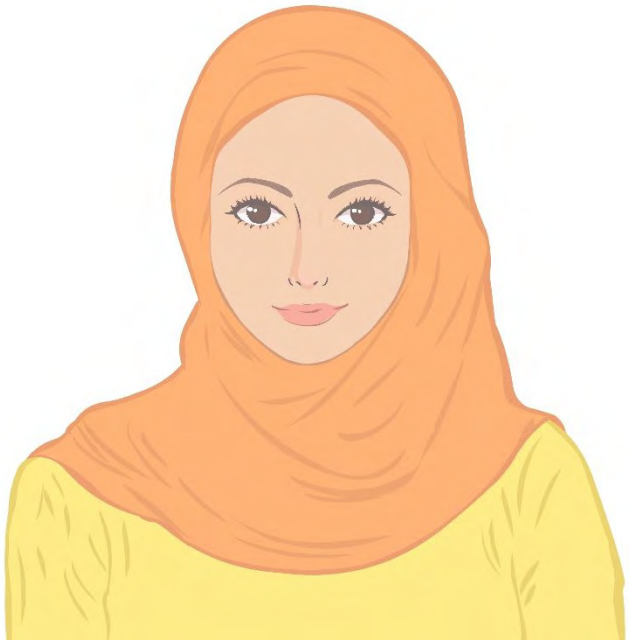
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5. The designed character meets the minimum 2-Dimensional of semi-stylized design.

Yes/No (yes)



Comment:

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Overall Comment

Dear Vicneas, I have reviewed the characters and I think they represent what you are intending except for #4- I don't understand the inclusion of glasses and a flower - that seems to distract from her features, not exaggerate them. I am not sure of your intention here.

While I understand your intention to get expert assessment of the characters, I think a better approach would be better to have the targeted users rate each character with Likert scales as to the extent that they match what you are trying to achieve. For example - the extent to which each character is: realistic, cartoon-like, has exaggerated features. Then you would be able to say that each character is (statistically) significantly more different than the other. Otherwise, how do you know that character 1 is significant more realistic than character 2?

Signature of the expert

Expert C

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1st Round

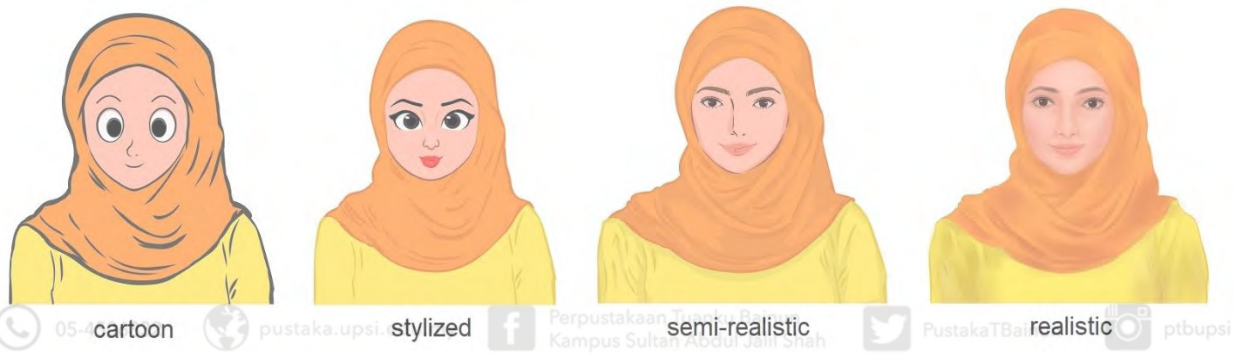
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EXPERT'S VIEW OF THE CHARACTER'S DESIGN

Research Title: The Uncanny Impact on Different Realism Level of the virtual agent on Students' Emotions in Learning

Validation of the design of virtual agent. Please state whether this designs are according to the specified type of design. Please state yes or no. Then please comment on the space provided. Thank you.



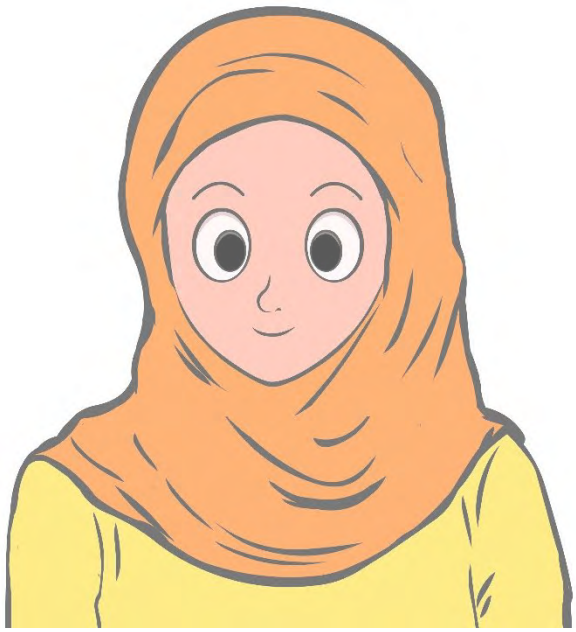
Different realism level of virtual agent ranging from cartoon to realistic

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1. The designed character meets the minimum 2-Dimensional of cartoon design.
   [It is a typical cartoon model]

   Yes/No (Yes)



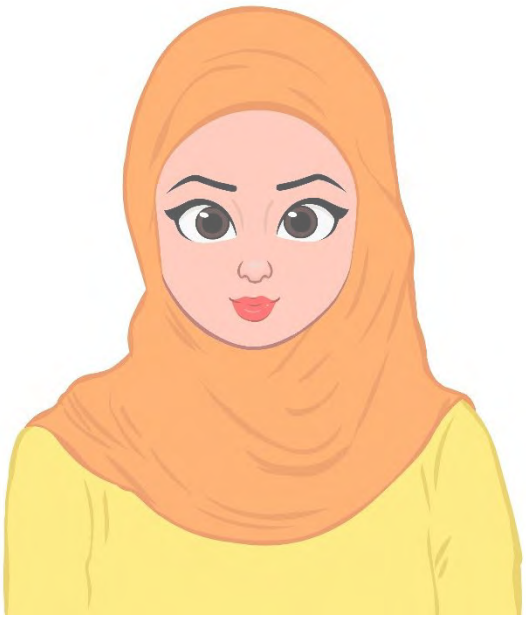
Comment: Contains basic features to represent cartoon character rather than human

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2. The designed character meets the minimum 2-Dimensional of stylized design.
   [Cartoon character with exaggerated features]

   Yes/No (Yes)



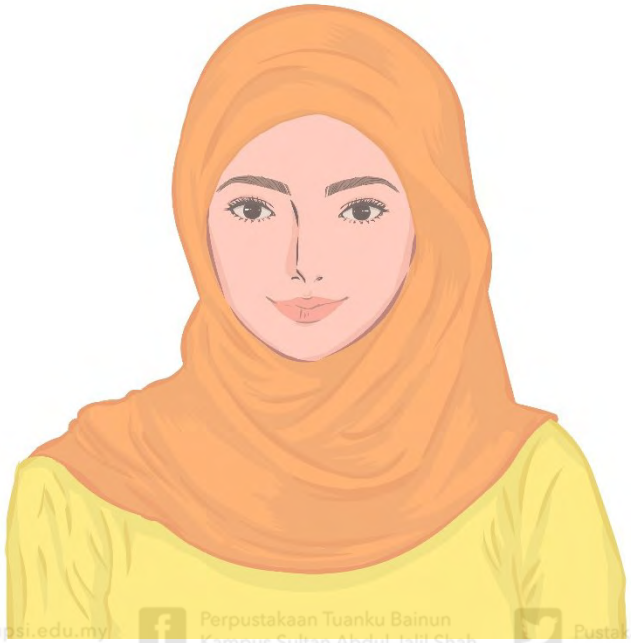
Comment: It has an improved look of cartoon with some styles of the cartoon basic features.

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3. The designed character meets the minimum 2-Dimensional of semi-realistic design.
   [It is partially realistic; not as detailed as the realistic]

   Yes/No (Yes)



Comment: It has some more refined look of cartoon, mimicking a human but doesn't look that realistic.

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4. The designed character meets the minimum 2-Dimensional of realistic design.
   [It is realistic; it mimics like human]

   Yes/No (Yes)



Comment: It has some shading/toning effects thus looks more realistic.



Signature of the expert

Expert A

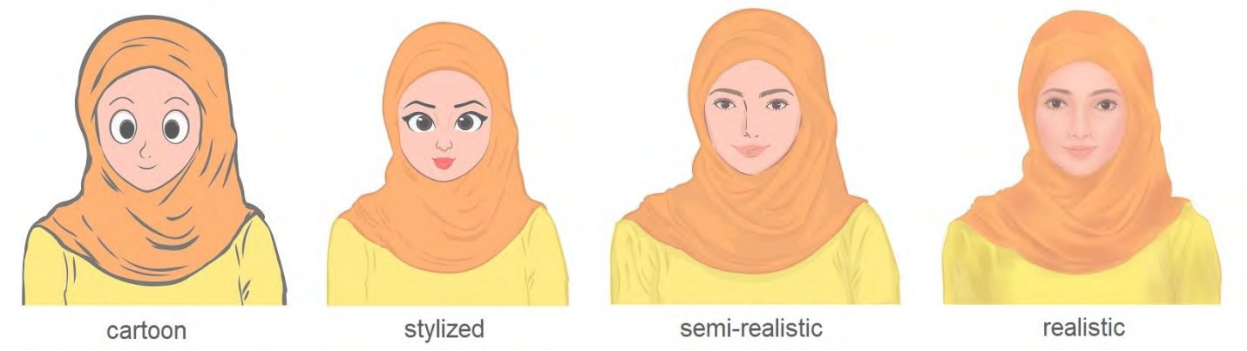
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Different realism level of virtual agent ranging from cartoon to realistic

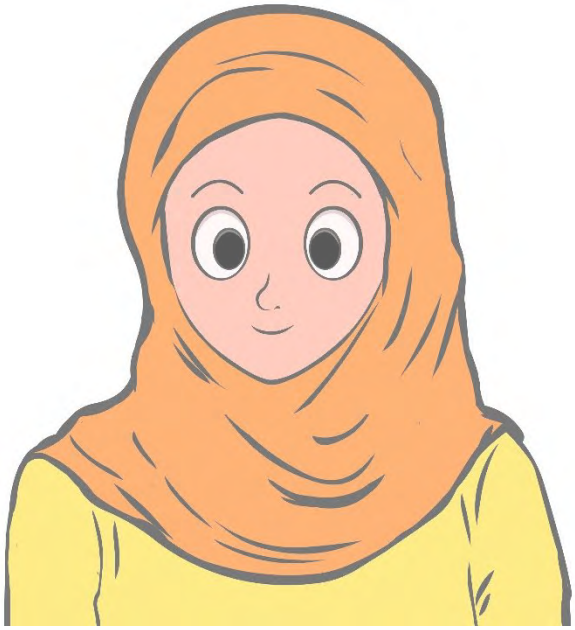
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1. The designed character meets the minimum 2-Dimensional of cartoon design.
   [It is a typical cartoon model]

   Yes/No (Yes)



Comment:
Just a comment:
I am uncertain how this design of agent #1 differs from agent design # 2 based on the realism framework. For a review, pedagogical agent realism framework in [1] [2] [3]. My suggestion is to include agent #2, 3, 4 only. However, you may have a different or an extended or modified framework, therefore, my suggestion is just a recommendation which you may consider and NOT taken as a strict rule.

1. Gulz, A., & Haake, M. (2005, July). Social and visual style in virtual pedagogical agents. In Workshop on Adapting the Interaction Style to Affective Factors associated with the 10th International Conference on User Modeling.

2. Gulz, A., & Haake, M. (2006). Virtual pedagogical agents–design guidelines regarding visual appearance and pedagogical roles. Current Developments in Technology-Assisted Education,© FORMATEX 2006.

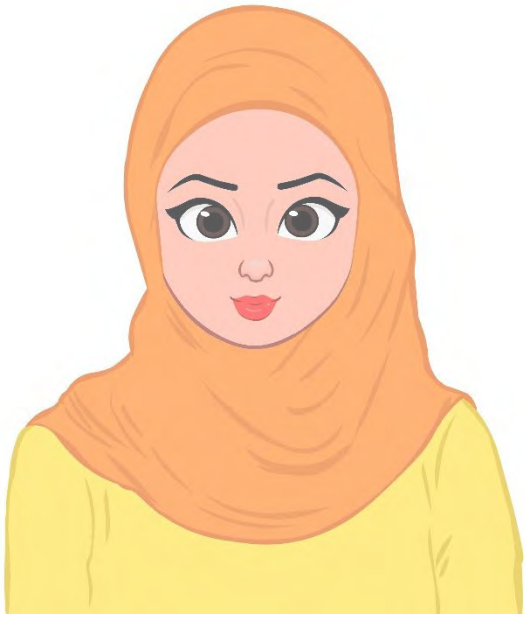
3. Haake, M., & Gulz, A. (2009). A look at the roles of look & roles in embodied pedagogical agents–a user preference perspective. International Journal of Artificial Intelligence in Education, 19(1), 39-71.

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2. The designed character meets the minimum 2-Dimensional of stylized design.
[Cartoon character with exaggerated features]

Yes/No (Yes)



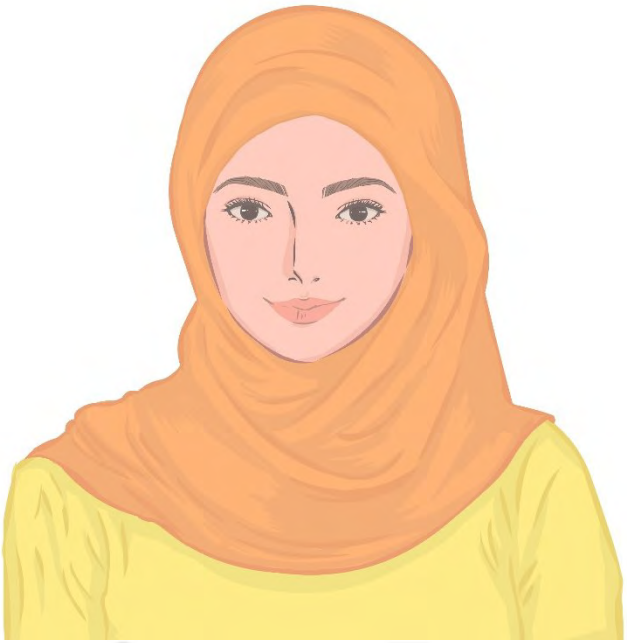
Comment: Yes, The design follows the 2D and stylization.

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3. The designed character meets the minimum 2-Dimensional of semi-realistic design.
[It is partially realistic; not as detailed as the realistic]

Yes/No (Yes)



Comment:

Yes, The design meets the specifications.

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4. The designed character meets the minimum 2-Dimensional of realistic design.
   [It is realistic; it mimics like human]

   Yes/No (Yes)



Comment:

Yes, the design meets the specifications.

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Signature of the expert

Name:
Designation:

Expert B

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2nd Round

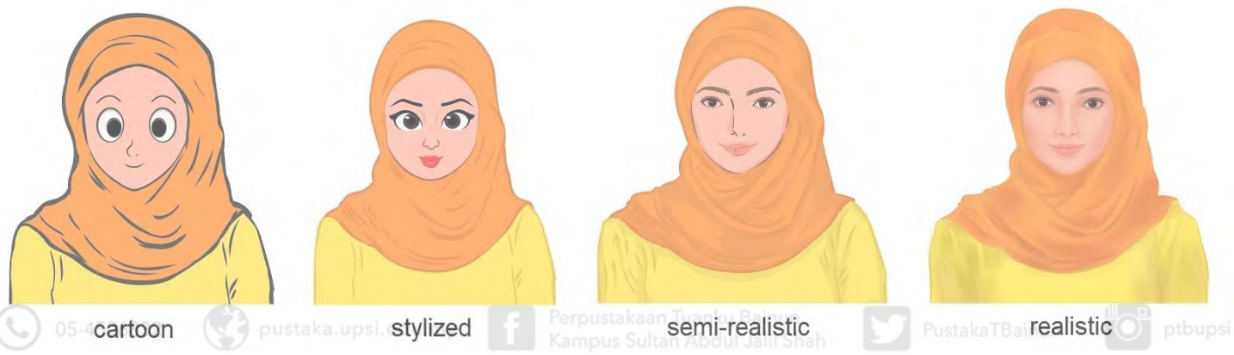
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Research Title: The Uncanny Impact on Different Realism Level of the virtual agent on Students' Emotions in Learning

Validation of the design of virtual agent. Please state whether this designs are according to the specified type of design. Please state yes or no. Then please comment on the space provided. Thank you.



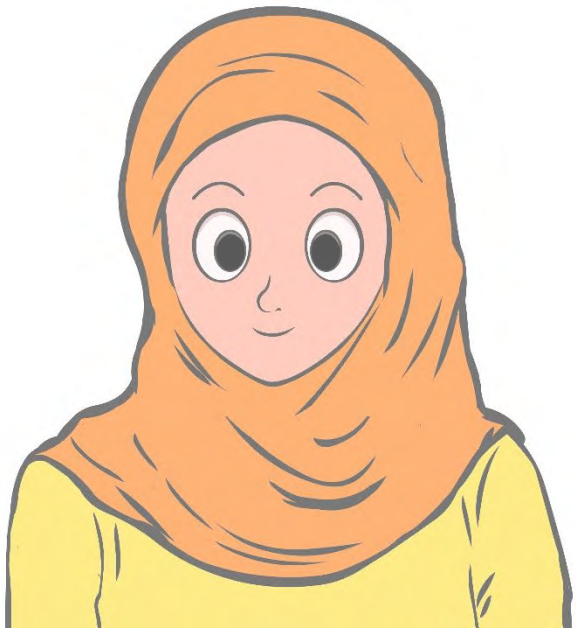
Different realism level of virtual agent ranging from cartoon to realistic

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1. The designed character meets the minimum 2-Dimensional of cartoon design.
   [It is a typical cartoon model]

   Yes/No (No)



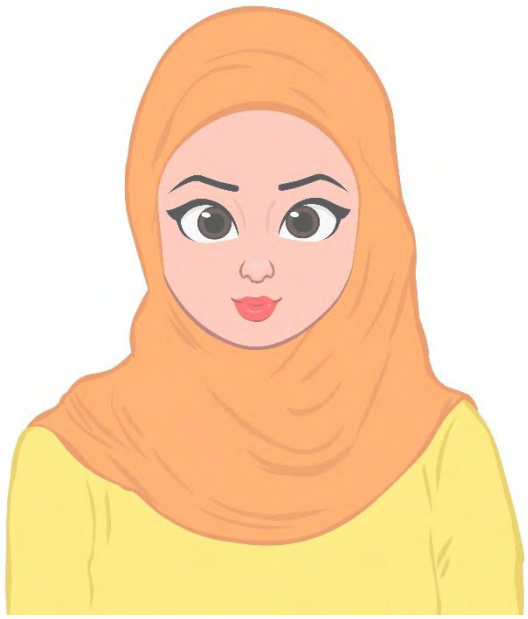
Comment:
This is a disturbing image- the eyes are strange and it is not clear that it looks female.

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2. The designed character meets the minimum 2-Dimensional of stylized design.
   [Cartoon character with exaggerated features]

Yes/No (yes)



Comment:

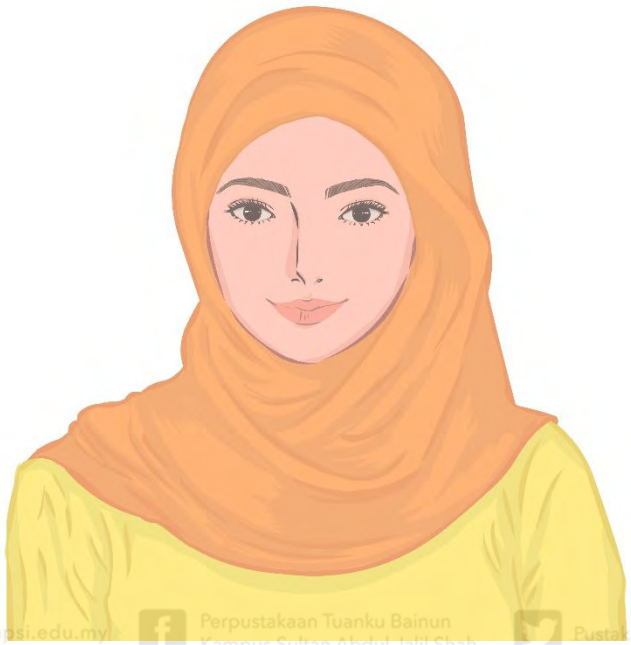
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3. The designed character meets the minimum 2-Dimensional of semi-realistic design.
   [It is partially realistic; not as detailed as the realistic]

Yes/No (yes)



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Comment:

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4. The designed character meets the minimum 2-Dimensional of realistic design.
   [It is realistic; it mimics like human]

   Yes/No (no)



Comment:
This does not look significantly different than the semi-realistic. You will not be able to get an effect of the treatment if the conditions are not significantly different.

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Signature of the expert

Expert C

2nd Round

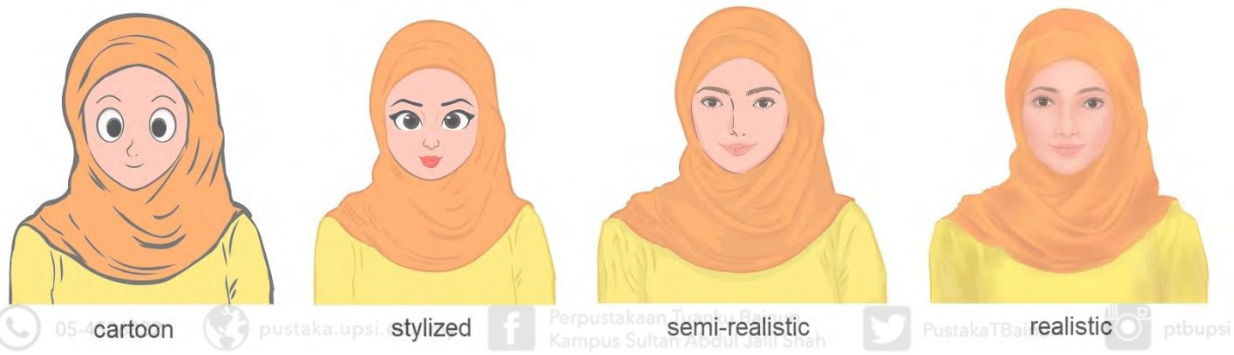
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EXPERT'S VIEW OF THE CHARACTER'S DESIGN

Research Title: The Uncanny Impact on Different Realism Level of the virtual agent on Students' Emotions in Learning

Validation of the design of virtual agent. Please state whether this designs are according to the specified type of design. Please state yes or no. Then please comment on the space provided. Thank you.



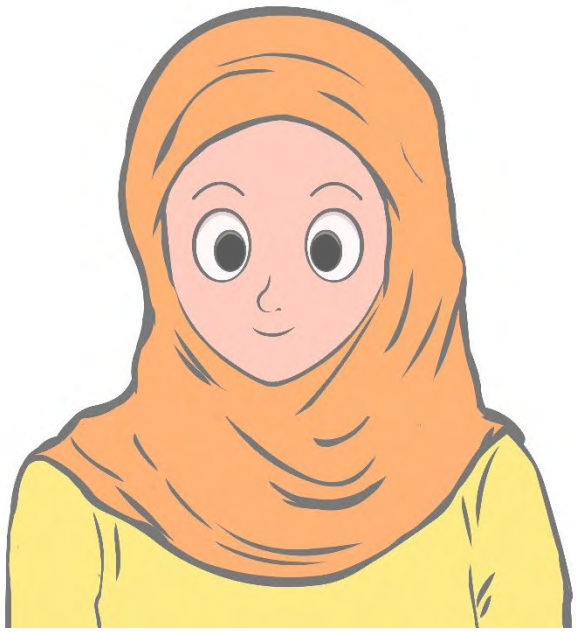
Different realism level of virtual agent ranging from cartoon to realistic

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1. The designed character meets the minimum 2-Dimensional of cartoon design.
   [It is a typical cartoon model]

   Yes/No (Yes)



Comment:

This character depicts a two-dimensional, simplistic, cartoon-like character.

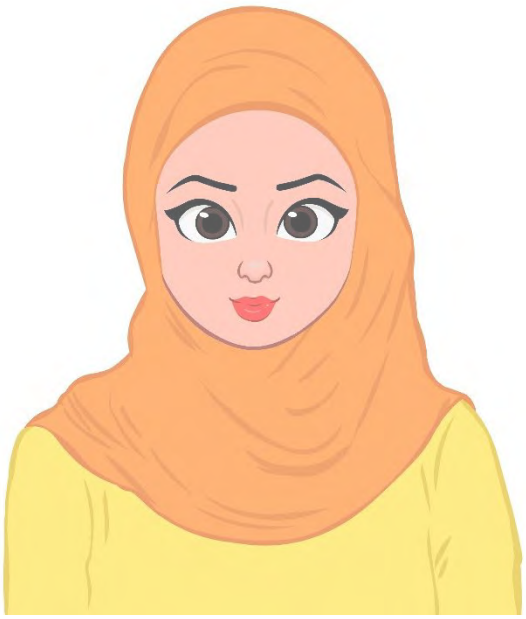
The character is likeable and appears friendly.

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2. The designed character meets the minimum 2-Dimensional of stylized design.
   [Cartoon character with exaggerated features]

   Yes/No (Yes)



Comment:

This character matches the description of a more stylized two-dimensional character design.

Again, the eyes are exaggerated and enlarged, to the extent that they are out of proportion with the rest of the character's features including the face shape, nose and mouth. However, this can increase how appealing and attractive a character is perceived to be.

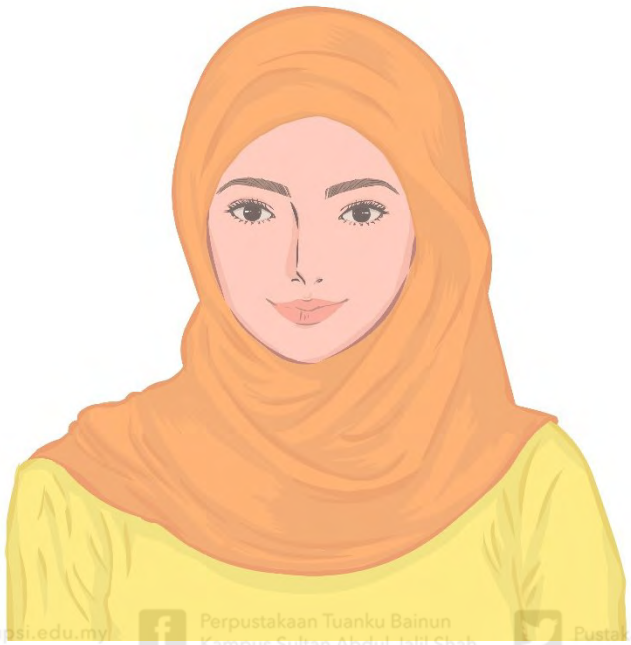
(Please see the previous study by Green et al., in 2008 ' Green, R.D., MacDorman, K.F., Ho, C. -C., Vasudevan, S.K. (2008) Sensitivity to the proportions of faces that vary in human likeness, *Computers in Human Behavior*, 24 (5), pp. 2456-2474.)

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3. The designed character meets the minimum 2-Dimensional of semi-realistic design.
   [It is partially realistic; not as detailed as the realistic]

   Yes/No (Yes)



Comment:

This character is an example of a two-dimensional, semi-realistic character.

This character appears more human-like, but it still depicts stylized features such as the eyes, nose, mouth, and skin tone. In keeping with the Uncanny Valley that Mori (1970) originally depicted, I perceive this as the most likeable and appealing character out of the four examples.

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4. The designed character meets the minimum 2-Dimensional of realistic design.
   [It is realistic; it mimics like human]

   Yes/No (Yes)



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Comment:

This character does depict an increased human-likeness compared to the other three characters. In this way, the character matches its description of a two-dimensional realistic, human-like character design.

The eyes, nose, mouth and skin tone in this character are more realistic than the other more cartoon-like and stylized features of the other three characters, however this increased realism does not guarantee an increased rapport toward this character.

I would rather interact with the semi-realistic, human-like character with a more stylized appearance. This is because the more abstract facial features and stylized design increases the attractiveness of the semi-realistic character. The more realistic, human-like character can seem more intimidating (i.e. more uncanny), more serious and less approachable than the other three characters due to this increased realism of the facial features and skin tone.

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Signature of the expert



Expert D

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2nd Round

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APPENDIX B

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EXPERT'S VIEW ON THE QUIZ QUESTIONS

Objectives of the expert view:

- To ensure the questions are relevant to the topic one of 'Fundamental of Multimedia' course.
- To ensure the questions are capable to test students' fundamental knowledge on 'Fundamental of Multimedia' course
- To ensure the questions are within the educational content area of 'Fundamental of Multimedia' course

FUNDAMENTAL OF MULTIMEDIA
QUIZ 1

1. Identify which one is a multimedia element?
   A. Graphic
   B. Slide show
   C. Voice Script
   D. Media

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HINT: Multimedia is computer information that can be represented through sound, video, and animation in addition to traditional media such as text and image.

2. Multimedia is any combination of …… .
   A. Text, Graphic, Presentation, Audio and Source Code
   B. Text, Graphic, Animation, Audio and Video
   C. Transition, Animation, Design, and Slide Show
   D. Transition, Animation, Design, and Smart Art

HINT: A multimedia application may require five basic components consist of written words, still picture, motion picture, sound reproduction and digital motion

3. Find the category of multimedia for a demo show?
   A. Static multimedia presentation
   B. Animated multimedia presentation
   C. **Linear multimedia presentation**
   D. Non-linear multimedia presentation

HINT: Linear multimedia presentation does not allow the user to control the sequence and progress of multimedia content. Whereas, Non-linear multimedia presentation allow the user to control the sequence and progress of multimedia content.

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4. Courseware and e-learning are examples of applications for multimedia in ……..... .
   A. Education
   B. Entertainment
   C. Home
   D. Public Places

HINT: Courseware is computer programs or other material designed for use in a training course as kits for teachers or as tutorials for students. While, E-learning is a learning system based on formalised teaching but with the help of electronic resources.

5. Select the examples of multimedia application areas?
   A. Video, text, sound, animation, and graphics
   B. Linear Presentation and Non-linear Presentation
   C. Creative industry, Commercial, Entertainment and fine arts, Education, Journalism and Engineering
   D. Proposal, Storyboard, Gantt Chart, Source code and References

HINT: Multimedia can be used or apply in different environment that provide a benefit over other forms of information presentation. For example, school, business, home, health and public places.

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6. Name the process of organizing graphics sequentially in the form of illustrations or images for the purpose of pre-visualizing a motion picture?
   A. Desktop publishing
   B. Storyboarding
   C. Template arranging
   D. Layout drawing

HINT: It is a process consist of a panel or series of panels on which a set of sketches is arranged depicting consecutively the important changes of scene and action in a series of shots for a film, television show, or commercial.

7. In preparing a multimedia presentation, we use TEXT as …….
   A. An element to generate mood to the presentation.
   B. An element to control over the special effects of the content.
   C. An element to stand alone without combine with other multimedia elements
   D. An element to deliver message effectively through explanation or discussion of a topic.

HINT: In multimedia, text is used as headlines, subtitles, and slogan. Text is also used to give directions and communicate information through text-based menus and buttons.

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8. Which technology enables a still image to look as though it is alive, able to move, act and talk.?
    A. Narration
    B. Animation
    C. Bitmap Image
    D. Vector Image

HINT: In this technology, a series of images put together to give the effect of movement.

9. Which of the following is **NOT** a use of sound in multimedia?
    A. Volume Control
    B. Narration
    C. Attention Grabber
    D. Sound Effect

HINT: Sound can enhance a website design and social media platforms. It is a multimedia application that uses dialogue, recorded narration, music and sound effects.

10. Below are examples of linear multimedia presentation **EXCEPT** ……..... .
    A. Movie
    B. Non-interactive lecture
    C. Games
    D. Power point Show

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HINT: Linear multimedia presentation is an active content that often progresses without any navigational control for the viewer such as a cinema presentation.

11. A multimedia presentation is identified as NON LINEAR when …….....
    A. it is not interactive
    B. users are not given navigational control
    C. users have control over the content that is being showed to them.
    D. users have no control over the content that is being showed to them.

HINT: Non-linear uses interactivity to control progress as with a video game or self-paced computer-based training.

12. Which of these is **NOT** a input devices?
    A. Scanner
    B. Printer
    C. Keyboard
    D. Joystick

HINT: An input device is any hardware device that sends data to a computer, allowing user to interact with and control it.

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13. The TITANIC was an example of movie presentation because of the characteristic of.....
    A. Linear
    B. Non-linear
    C. Animation
    D. Video

HINT: TITANIC movie is a cinema presentation often progresses without any navigational control for the viewer.

14. Below are example softwares for the development of multimedia application, **EXCEPT** ……..... .
    A. Adobe Photoshop
    B. C++ Compiler
    C. Adobe Premier Pro
    D. Adobe Flash

HINT: Multimedia presentation software that helps to create wonderful presentation such as movie, animation and graphic.

15. What is the purpose of Testing and Debugging stage for a multimedia project?
    A. To ensure the product free from navigation control.
    B. To ensure the product free from bugs.
    C. To deliver the completed project to end user.
    D. To implement the completed project by end user

HINT: Testing and debugging are the process of finding and removing a specific error from a multimedia project.

16. The steps involved in the process of Planning and Costing in developing multimedia project as below, **EXCEPT** ……
    A. Begin with an idea or objective.
    B. Develop scope and content.
    C. Estimate time and cost.
    D. Create a finished product.

HINT: Planning and Costing are the process of assembling needs, goals and costs for the successful completion of multimedia project.

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17. CIDOS e-learning is the use of electronic media, educational technology and information and communication technologies (ICT) in education. This statement refer to.....
    A. Cinema presentation
    B. Hypermedia presentation
    C. Computer game presentation
    D. Computer-based training presentation

HINT: The delivery of a learning material, training or education program involves the use of a computer or electronic device.

18. Choose an example environment that uses multimedia in public places?
    A. Simulations
    B. Courseware
    C. Information Kiosk
    D. SMS services

HINT: The use of multimedia in public places are to communicate or provide customers with information.

19. What is the advantage of multimedia presentation?
    A. Presenting information in various digital formats
    B. Support authoring tools.
    C. Store more data on single side.
    D. Use components of social media.

HINT: Multimedia presentation is a way to foster meaningful learning through the combination of multimedia elements.

20. If you wish to attract the audience's attention, you can use fast rhythmic music as the music setting for your presentation. This refer to ……..... .

    A. Warnings and Reminders
    B. Background Music
    C. Sound Effects
    D. Narration

HINT: Music that played while some other activity is going on in order to fill silence and create an atmosphere to attract the audience.

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Comment:

All question are good and well designed. Covered all items ~~fo~~ from chapter 1 in Interactive Multimedia Application (DEC5082) courses.

Signature of the expert

Name: AZHANI BINTI HASHIM
Designation: Pensyarah
Jabatan Kejuruteraan Elektrik
Politeknik Sultan Azlan Shah

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Comment:

Overall, the quiz questions is sufficient for Fundamental of Multimedia course.

Suggestion:

- The questions should put CLO (CLO2, C2) for references. (refer to syllabus DRE1023)

Signature of the expert

Name: ASMA ASDAYANA BINTI IBRAHIM
Pegawai Pendidikan Pengajian Tinggi
Designation: Jabatan Matematik, Sains Dan Komputer
Politeknik Sultan Azlan Shah

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Comment:

The questions are relevant to the topic. based on my experience.

Signature of the expert

Name: DARNI BT DARMIN
Designation: PENSYARAH
JABATAN KEJURUTERAAN ELEKTRIK
POLITEKNIK SULTAN AZLAN SHAH

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APPENDIX C

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EXPERT'S VIEW ON THE QUIZ QUESTIONS

Objectives of the expert view:

- To ensure the accuracy and consistence of each question used.
- To find and correct spelling, grammar, and punctuation errors in order to produce well written, precise and easy to read questions.
- To ensure each question gives the right impression and capable to deliver appropriate messages.

1. Identify which one is a multimedia element?
   A. Graphic
   B. Slide show
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   D. Media

HINT: Multimedia is computer information that can be represented through sound, video, and animation in addition to traditional media such as text and image.

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HINT: A multimedia application may require five basic components consist of written words, still picture, motion picture, sound reproduction and digital motion

3. Find the category of multimedia for a demo show?
   A. Static multimedia presentation
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   C. **Linear multimedia presentation**
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HINT: Linear multimedia presentation does not allow the user to control the sequence and progress of multimedia content. Whereas, Non-linear multimedia presentation allows the user to control the sequence and progress of multimedia content.

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4. Courseware and e-learning are examples of applications for multimedia in ……..

   A. Education
   B. Entertainment
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   D. Public Places

HINT: Courseware is computer programs or other material designed for use in a training course as kits for teachers or as tutorials for students. While, e-learning is a learning system based on formalised teaching but with the help of electronic resources.

5. Select the examples of multimedia application areas?

   A. Video, text, sound, animation, and graphics
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HINT: Multimedia can be used or ~~apply~~ applied in different environments that provide a benefit over other forms of information presentation. For example, school, business, home, health and public places.

6. Name the process of organizing graphics sequentially in the form of illustrations or images for the purpose of pre-visualizing a motion picture?

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   D. An element to deliver message effectively through explanation or discussion of a topic.

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8. Which technology enables a still image to look as though it is alive, able to move, act and talk?
   A. Narration
   B. Animation
   C. Bitmap Image
   D. Vector Image

HINT: In this technology, a series of images put together to give the effect of movement.

9. Which of the following is **NOT** a use of sound in multimedia?
   A. Volume Control
   B. Narration
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HINT: Sound can enhance a website design and social media platforms. It is a multimedia application that uses dialogue, recorded narration, music and sound effects.

10. Below are examples of linear multimedia presentation **EXCEPT** .....
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HINT: Linear multimedia presentation is an active content that often progresses without any navigational control for the viewer such as a cinema presentation.

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    D. Joystick

HINT: An input device is any hardware device that sends data to a computer, allowing user to interact with and control it.

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13. The TITANIC was an example of movie presentation because of the characteristic of.....
    A. Linear
    B. Non-linear
    C. Animation
    D. Video

HINT: Cinema presentation often progresses without any navigational control for the viewer.

14. Below are example softwares for the development of multimedia application, **EXCEPT** ..... .
    A. Adobe Photoshop
    B. C++ Compiler
    C. Adobe Premier Pro
    D. Adobe Flash

HINT: Multimedia presentation software that helps to create wonderful presentation such as movie, animation and graphic.

15. What is the purpose of Testing and Debugging stage for a multimedia project?
    A. To ensure the product free from navigation control.
    B. To ensure the product free from bugs.
    C. To deliver the completed project to end user.
    D. To implement the completed project by end user

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HINT: Testing and debugging are the process of finding and removing a specific error from a multimedia project.

16. The steps involved in the process of Planning and Costing in developing multimedia project as below, **EXCEPT** .....
    A. Begin with an idea or objective.
    B. Develop scope and content.
    C. Estimate time and cost.
    D. Create a finished product.

HINT: Planning and Costing are the process of assembling needs, goals and costs for the successful completion of multimedia project.

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17. CIDOS e-learning is the use of electronic media, educational technology and information and communication technologies (ICT) in education. This statement refers to.....
    A. Cinema presentation
    B. Hypermedia presentation
    C. Computer game presentation
    D. Computer-based training presentation

HINT: The delivery of a learning material, training or education program involves the use of a computer or electronic device.

18. Choose an example environment that uses multimedia in public places?
    A. Simulations
    B. Courseware
    C. Information Kiosk
    D. SMS services

HINT: The use of multimedia in public places are to communicate or provide customers with information.

19. What is the advantage of multimedia presentation?
    A. Presenting information in various digital formats
    B. Support authoring tools.
    C. Store more data on single side.
    D. Use components of social media.

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HINT: Multimedia presentation is a way to foster meaningful learning through the combination of multimedia elements.

20. If you wish to attract the audience's attention, you can use fast rhythmic music as the music setting for your presentation. This refer to ..... .
    A. Warnings and Reminders
    B. Background Music
    C. Sound Effects
    D. Narration

HINT: Music that played while some other activity is going on in order to fill silence and create an atmosphere to attract the audience.

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Comment:

Overall a very good piece of work. Very motivating for the participants to take part.

Signature of the expert Fathima

Name: FATHIMAH PATHMA BT ABDULLAH

Designation: *Pensyarah*
Jabatan Pengajian Am
Politeknik Sultan Azlan Shah

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APPENDIX D

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EXPERT'S VIEW ON THE DIALOGUES

Objectives of the expert view:

- To ensure the accuracy and consistence of each dialogue used.
- To find and correct spelling, grammar, and punctuation errors in order to produce well written, precise and easy to read dialogues.
- To ensure each dialogue gives the right impression and capable to deliver appropriate messages.

Dialogue 1.1: (introduction screen)

"Hello, how are you? Welcome. I am Shamira.

You are now with me in quiz-based multimedia learning environment for Interactive Multimedia Applications course.

It is a time to test your knowledge!

Click on the chapter one and challenge yourself.

You also can click on the info button to know the rules and regulations of the quiz …good luck!!! "

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Dialogue 2.1: (info screen)

"Dear students, there are three chapters in this multimedia learning environment (MLE);

Chapter 1-Introduction to ~~m~~Multimedia;

Chapter 2-Multimedia Hardware; and

Chapter 3-Media Elements.

Each chapter is provided with 20 questions with four multiple choices of answers.

It is important to achieve the correct answer for each question.

Mouse over the answers and select a correct answer for every question in order to proceed to the next question.

For the incorrect answer, participant need to repeat the question until managed to answer it correctly.

Participant ~~also~~ can also click the ~~hint~~ 'HINT' button to get hint related to the question.

Dialogue 3: (feedback screen-A)

Dialogue 3.1: "Correct! You ~~give it~~ have given the best!"

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Dialogue 3.2: "Wow!! Absolutely you are right!"

Dialogue 3.3: "Congratulations! Excellent Job!"

Dialogue 4: (feedback screen-B)

Dialogue 4.1: "Opsss…Sorry. Wrong answer! Try again!"

Dialogue 4.2: "No, something is wrong, please try again!"

Dialogue 4.3: "Nope.. I disagree with your answer!"

Dialogue 6: (interval support)

"Well done…you are rocking! Let's go on… you can do it!"

Dialogue 7: (reward screen)

"I am glad you are finally done. Congratulations on completing this multimedia learning environment (MLE)" Bye….

Comment:

Very interesting game. Good.

Signature of the expert Fathima

Name: FATHIMAH PATHMA BT ABDULLAH

Designation: *Pensyarah*
Jabatan Pengajian Am
Politeknik Sultan Azlan Shah

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UNIVERSITI PENDIDIKAN SULTAN IDRIS
SULTAN IDRIS EDUCATION UNIVERSITY

BORANG SOAL SELIDIK
QUESTIONNAIRE
Self-Assesment Manikin (SAM)

PROF. MADYA DR. NORLIZA BINTI JAMALUDDIN
Ketua Jabatan Bahasa dan Kesusasteraan Melayu
Fakulti Bahasa dan Komunikasi
Universiti Pendidikan Sultan Idris
35900 Tanjong Malim, Perak D. R.

Nama *(Name)* :

Umur *(Age)* :

Jantina (Gender) : Lelaki/Perempuan *(Male/Female)*

Bangsa (Race) : Melayu/Cina/India/Lain-lain *(Malay/Chinese/Indian/Others)*

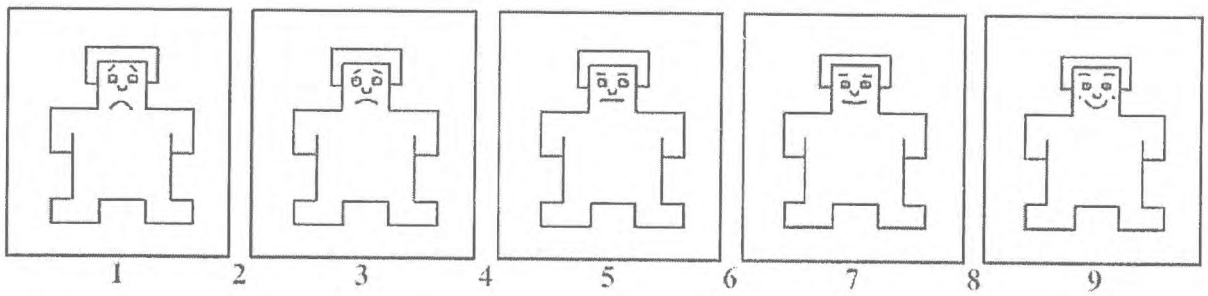
Politeknik (Polytechnic):

Sila bulatkan jawapan anda untuk setiap kenyataan dengan menggunakan skala 1 hingga 9.
Please circle your answers for each statement using a scale of 1 to 9.

Keseronokan *(Valence)*

Sila pilih manikin (karakter) di bawah yang mewakili mood semasa anda.
(Plese select from the manikins below the one that represents your current mood best.)

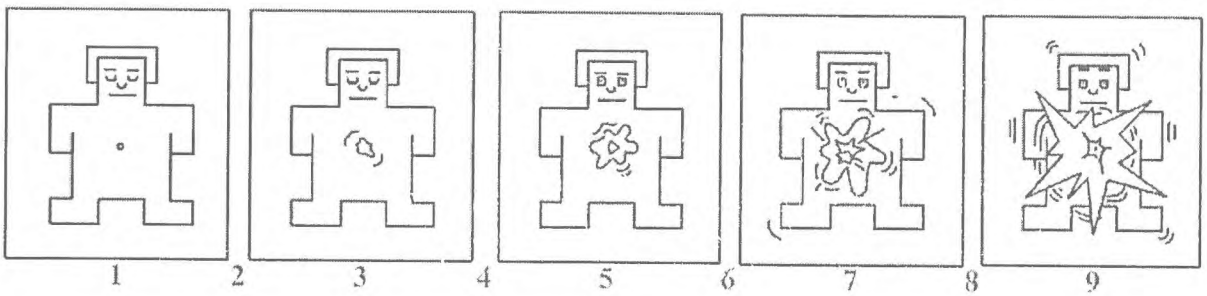
Marah *(Angry)* **Gembira *(Happy)***



Rangsangan *(Arousal)*

Sila pilih manikin (karakter) di bawah yang mewakili tahap rangsangan semasa anda.
(Plese select from the manikins below the one that represents your current arousal best.)

Mengantuk *(Sleepy)* **Teruja *(Excited)***



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UNIVERSITI PENDIDIKAN SULTAN IDRIS
SULTAN IDRIS EDUCATION UNIVERSITY

BORANG SOAL SELIDIK
QUESTIONNAIRE
Self-Assesment Manikin (SAM)

Disemak

Dr. Alizah Binti Lambri
Pensyarah Kanan
Jabatan Bahasa dan Kesusasteraan Melayu
Fakulti Bahasa dan Komunikasi
Universiti Pendidikan Sultan Idris

4/7/2

Nama *(Name)* :

Umur *(Age)* :

Jantina (Gender) : Lelaki/Perempuan *(Male/Female)*

Bangsa (Race) : Melayu/Cina/India/Lain-lain *(Malay/Chinese/Indian/Others)*

Politeknik (Polytechnic):

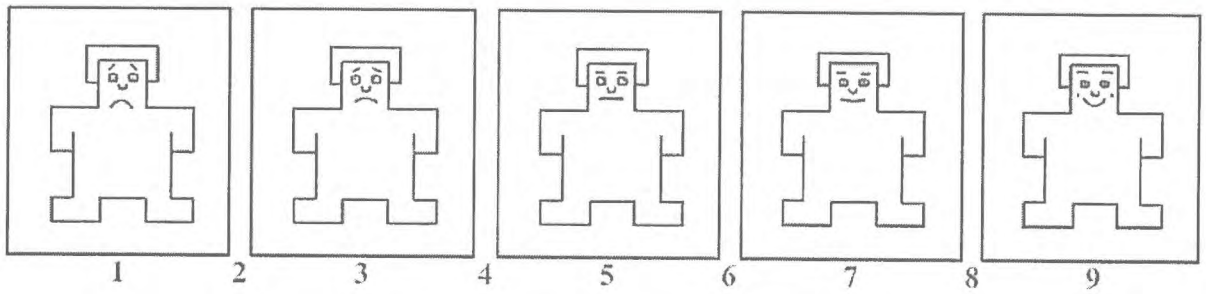
Sila bulatkan jawapan anda untuk setiap kenyataan dengan menggunakan skala 1 hingga 9.
Please circle your answers for each statement using a scale of 1 to 9.

Keseronokan *(Valence)*

Sila pilih manikin (karakter) di bawah yang mewakili mood semasa anda.
(Plese select from the manikins below the one that represents your current mood best.)

perasaan anda sekarang

Marah *(Angry)* — **Gembira *(Happy)***

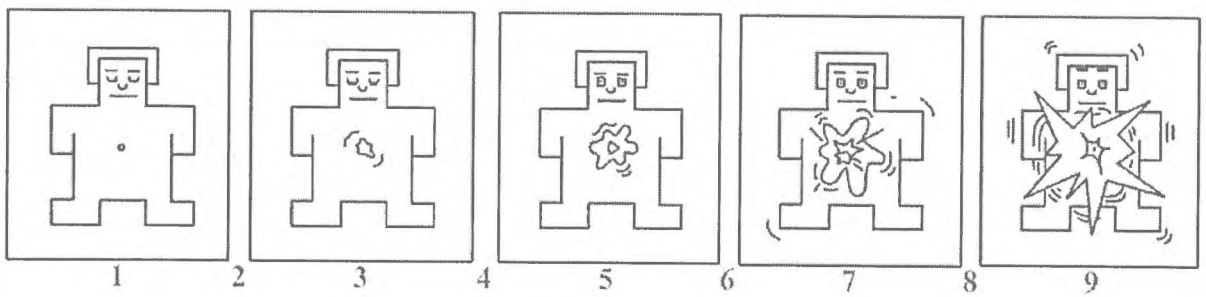


Rangsangan *(Arousal)*

Sila pilih manikin (karakter) di bawah yang mewakili tahap rangsangan ~~semasa~~ anda.
(Plese select from the manikins below the one that represents your current arousal best.)

sekarang

Mengantuk *(Sleepy)* — **Teruja *(Excited)***



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Re: Short AEQ

YANG, Lan [C&I] <yanglan@eduhk.hk>

Tue 5/22/2018 7:12 PM

To: Vicneas A/L. Muniady <vicneas@psas.edu.my>;

Cc: vicneasm@gmail.com <vicneasm@gmail.com>;

Categories: PHD

1 attachments (88 KB)

(Dr. YANG Lan) 24-item SF LAEQ.docx;

Hi Vicneas,
Thanks for your interest in a short form of AEQ.
So far, I tested a short form of Learning-related achievement emotions. See the attached file for this short scale and related statistics for your information.
I am developing three users' manuals with Prof. Pekrun's support for learning-, class-, test-related AEQ with their full scales and short scales. But they remain in preparation.
For an English version of the complete AEQ instrument (232 items), please contact Prof. Pekrun at pekrun@lmu.de

Best wishes to your research,

Joy

From: Vicneas A/L. Muniady <vicneas@psas.edu.my>
Sent: Tuesday, May 22, 2018 2:14 PM
To: YANG, Lan [C&I]
Cc: vicneasm@gmail.com
Subject: Short AEQ

Dear, Dr. Joy Yang Lan

I'm Vicneas Muniady, phd student frm Sultan Idris Education University, Malaysia (UPSI). My research is about realism level of virtual agent and its effect on students' emotion in learning. Therefore, i'm developing a courseware.

I would like to use the Short Version of the Academic Emotions Questionnaire to measure students' emotions in learning. Dr King suggested to use yours upon your approval.

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So, It will be very helpful if dr share the AEQ questionnaire and the manual.

Looking forward to hearing from you. Thank you in advance.

Regards,

Thank You,

Vicneas Muniady,
PhD Candidate,
Sultan Idris Education University,
Malaysia.

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2nd in Asia and 9th in the world in Education
(QS World University Rankings by Subject 2018)

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FW: Requesting for Achievement Emotions Questionnaire (AEQ)

Vicneas A/L. Muniady

Wed 9/13/2017 5:19 PM

Sent Items

To:vicneasm@yahoo.com <vicneasm@yahoo.com>;

2 attachments (2 MB)

AEQ Manual 2005.pdf; Pekrun et al AEQ 2011.pdf;

-----Original Message-----
From: Reinhard Pekrun [mailto:pekrun@lmu.de]
Sent: Friday, February 03, 2017 4:11 PM
To: Vicneas A/L. Muniady
Subject: RE: Requesting for Achievement Emotions Questionnaire (AEQ)

Dear Vicneas Muniady,

thank you for your interest in the AEQ. Please see enclosed for this instrument.

Best wishes,

Reinhard Pekrun

Dr. Reinhard Pekrun
Professor of Psychology
Dpt. of Psychology, University of Munich
80802 Munich, Germany
Phone: +49 89 2180 5149
Email: pekrun@lmu.de

Honorary Professor
Institute for Positive Psychology and Education Australian Catholic University Strathfield, NSW 2135, Australia
---

>>> "Vicneas A/L. Muniady" <vicneas@psas.edu.my> 02.02.2017 15:27 >>>
Dear Dr Reinhard Pekrun,

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05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

I'm Vicneas Muniady, phd student frm Sultan Idris Education University, Malaysia (UPSI). For my research i would like to use Achievement Emotions Questionnaire (AEQ) to measure students' emotions in learning. it will be very helpful if dr share AEQ and give permission to use the AEQ for my research.

Looking forward to hearing from you. Thank you in advance.

Regards,

Thank You,

Vicneas Muniady,

PhD Candidate,

Sultan Idris Education University,

Malaysia.

To report this email as SPAM, please attach the original email as an attachment to spam@1govuc.gov.my by holding Ctrl + Alt + F keys concurrently (for Outlook client) or right click on the email and forward as Attachment (for OWA).

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BORANG SOAL SELIDIK
QUESTIONNAIRE

Learning-related Achievement Emotions Questionnaire (SF-L-AEQ)

Nama *(Name)* :

Umur *(Age)* :

Jantina (Gender) : Lelaki/Perempuan *(Male/Female)*

Bangsa (Race) : Melayu/Cina/India/Lain-lain *(Malay/Chinese/Indian/Others)*

Politeknik (Polytechnic):

Sila bulatkan jawapan anda untuk setiap kenyataan dengan menggunakan skala 1 hingga 4.
Please circle your answers for each statement using a scale of 1 to 4.

Petunjuk: [1] Sangat Tidak Setuju [2] Tidak Setuju [3] Setuju [4] Sangat Setuju
Guide: ***[1]*** *Strongly Disagree* ***[2]*** *Disagree* ***[3]*** *Agree* ***[4]*** *Strongly Agree*

Keseronokan (Enjoyment)		***Sangat tidak setuju (1) hingga sangat setuju (4)*** *Strongly disagree (1) to strongly agree" (4)*			
1	Saya seronok memperoleh ilmu baru. *I enjoy acquiring new knowledge.*	**1**	**2**	**3**	**4**
2	Saya begitu gembira tentang kemajuan saya yang membuatkan saya bersemangat untuk terus belajar. *I am so happy about the progress I made that I am motivated to continue studying.*	**1**	**2**	**3**	**4**
3	Saya menjadi teruja dari segi fizikal apabila pembelajaran saya berjalan lancar. *I get physically excited when my studies are going well.*	**1**	**2**	**3**	**4**
Harapan *(Hope)*					
4	Berfikir tentang pencapaian objektif pembelajaran telah menginspirasi saya. *The thought of achieving my learning objectives inspires me.*	**1**	**2**	**3**	**4**
5	Saya berasa optimistik saya akan terus bertambah baik dalam pembelajaran saya. *I feel optimistic that I will make good progress at studying.*	**1**	**2**	**3**	**4**
6	Perasaan keyakinan saya mendorong saya. *My sense of confidence motivates me.*	**1**	**2**	**3**	**4**

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	Bangga *(Pride)*	***Sangat tidak setuju (1) hingga sangat setuju (4)*** *Strongly disagree (1) to strongly agree" (4)*			
7	Saya ingin berasa bangga atas pencapaian saya, saya sangat bermotivasi. *I want to be proud of my accomplishments, I am very motivated.*	**1**	**2**	**3**	**4**
8	Saya fikir saya boleh berasa bangga atas pencapaian pembelajaran saya. *I think I can be proud of my accomplishments at studying.*	**1**	**2**	**3**	**4**
9	Apabila saya menyelesaikan sesuatu masalah semasa belajar, jantung saya berdenyut dengan perasaan bangga. *When I solve a difficult problem in my studying, my heart beats with pride.*	**1**	**2**	**3**	**4**
Rasa Putus Asa *(Hopelessness)*					
10	Kekurangan keyakinan memenatkan saya walaupun belum memulakannya. *My lack of confidence makes me exhausted before I even start.*	**1**	**2**	**3**	**4**
11	Saya putus harapan apabila berfikir tentang pelajaran. *I feel hopeless when I think about studying.*	**1**	**2**	**3**	**4**
12	Perasaan putus asa saya melemahkan segala tenaga saya. *My hopelessness undermines all my energy.*	**1**	**2**	**3**	**4**
Kebosanan *(Boredom)*					
13	Oleh kerana saya bosan saya menjadi letih duduk di tempat saya. *Because I'm bored I get tired sitting at my desk.*	**1**	**2**	**3**	**4**
14	Bahan pembelajaran itu begitu membosankan menyebabkan saya rasa letih. *The material bores me so much that I feel depleted.*	**1**	**2**	**3**	**4**
15	Semasa mempelajari bahan pembelajaran yang membosankan ini, saya meluangkan masa saya untuk memikirkan bagaimana masa tidak berganjak. *While studying this boring material, I spend my time thinking of how time stands still.*	**1**	**2**	**3**	**4**
Marah *(Anger)*					
16	Saya berasa jengkel apabila belajar. *Studying makes me irritated.*	**1**	**2**	**3**	**4**
17	*Saya berasa begitu marah hingga hendak melontar buku teks saya ke luar tingkap.* I get so angry I feel like throwing the textbook out of the window.	**1**	**2**	**3**	**4**
18	Saya berasa marah apabila saya terpaksa belajar. *I get angry when I have to study.*	**1**	**2**	**3**	**4**

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Kebimbangan *(Anxiety)*		***Sangat tidak setuju (1) hingga sangat setuju (4)*** *Strongly disagree (1) to strongly agree" (4)*			
19	Apabila saya melihat buku-buku yang masih perlu dibaca, saya berasa cemas. *When I look at the books I still have to read, I get anxious.*	**1**	**2**	**3**	**4**
20	Apabila saya terpaksa belajar, saya akan mula merasa tidak sedap hati. *When I have to study I start to feel queasy.*	**1**	**2**	**3**	**4**
21	Saya berasa begitu gementar sehingga menyebabkan saya tidak mahu memulakan pembelajaran. *I get so nervous that I don't even want to begin to study.*	**1**	**2**	**3**	**4**
Malu *(Shame)*					
22	Oleh sebab saya menghadapi banyak masalah dengan bahan pembelajaran itu, saya mengelak daripada membincangkannya. *Because I have had so much troubles with the course material, I avoid discussing it.*	**1**	**2**	**3**	**4**
23	Apabila seseorang perasan betapa ceteknya kefahaman saya, saya akan mengelak bertentangan mata dengannya. *When somebody notices how little I understand I avoid eye contact.*	**1**	**2**	**3**	**4**
24	Saya berasa amat malu kerana tidak semahir seperti orang lain dalam pembelajaran. *I feel ashamed because I am not as adept as others in studying.*	**1**	**2**	**3**	**4**

TERIMA KASIH DI ATAS KERJASAMA ANDA

THANK YOU VERY MUCH FOR YOUR PARTICIPATION

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Self-Assessment Manikin

CSEAMedia <media@cseamedia.org>

Fri 1/11/2019 12:07 AM

To: Vicneas A/L. Muniady <vicneas@psas.edu.my>;

Categories: PHD

1 attachments (3 MB)

SAM.zip;

Dear Colleague:

Thank you for your interest in the SAM. Please find attached:

- Three SAM scales in .jpg format
- Instructions to be used when administering the SAM
- A manuscript discussing the SAM measurement

We provide the SAM solely for use in academic, not-for-profit research at recognized educational institutions.

Please be sure to use the citations, and the copyright information below when publishing.

Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: Computer applications. In J. B. Sidowski, J. H. Johnson, & T A. Williams (Eds.), Technology in mental health care delivery systems (pp. 119-137). Norwood, NJ: Ablex Publishing.

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The Self-Assessment Manikin and the Semantic Differential. Journal of Behavioral Therapy and Experimental Psychiatry, 25(1), 49-59.

SELF ASSESSMENT MANIKIN © Peter J. Lang 1994

Best of luck on your research with these materials,

CSEA Media

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BORANG SOAL SELIDIK
QUESTIONNAIRE

Self-Assessment Manikin (SAM)

R / SR / S / C

Nama *(Name)* :

Umur *(Age)* :

Jantina (Gender) : Lelaki/Perempuan *(Male/Female)*

Bangsa (Race) : Melayu/Cina/India/Lain-lain *(Malay/Chinese/Indian/Others)*

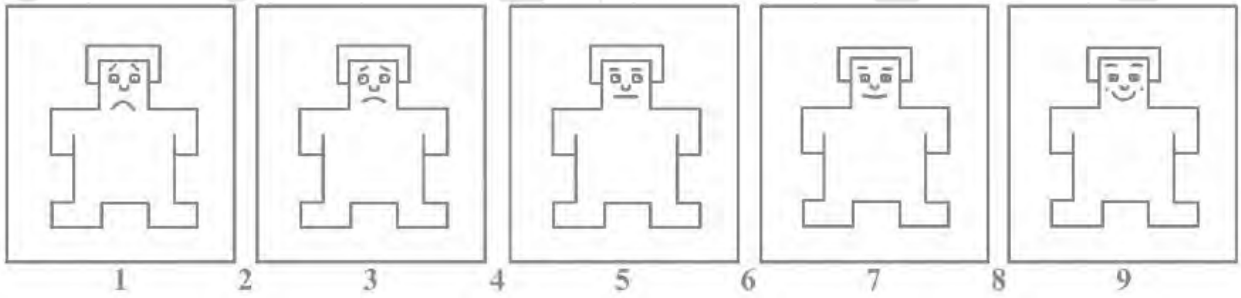
Politeknik (Polytechnic) : PUO/PPD/PSA/PSP/PMM/PSAS/PTSB/PSIS

Sila bulatkan jawapan anda untuk setiap kenyataan dengan menggunakan skala 1 hingga 9.
Please circle your answers for each statement using a scale of 1 to 9.

Keseronokan *(Valence)*

Sila pilih manikin (karakter) di bawah yang mewakili perasaan anda sekarang.
(Please select from the manikins below the one that represents your current mood best.)

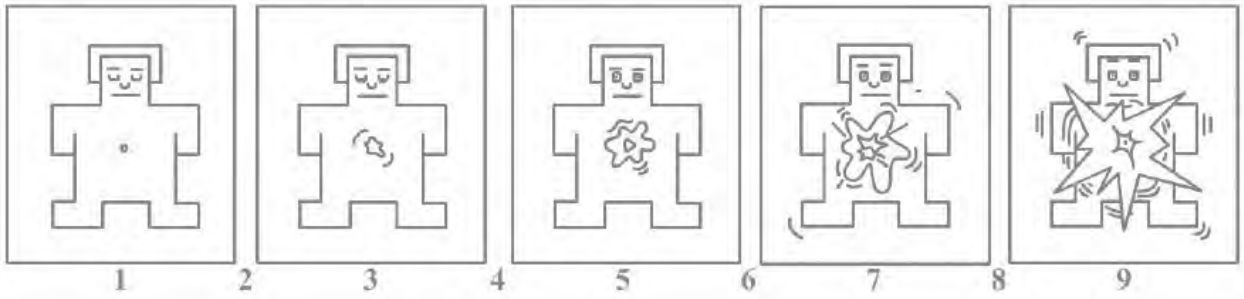
Marah *(Angry)* **Gembira *(Happy)***



Rangsangan *(Arousal)*

Sila pilih manikin (karakter) di bawah yang mewakili tahap rangsangan anda sekarang.
(Please select from the manikins below the one that represents your current arousal best.)

Mengantuk *(Sleepy)* **Teruja (*Excited*)**



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SULTAN IDRIS EDUCATION UNIVERSITY

BORANG SOAL SELIDIK
QUESTIONNAIRE

Kebolehgunaan dan Kepuasan Pengguna
Usability and User Satisfaction Questionnaire (PSSUQ)

Sila bulatkan jawapan anda untuk setiap kenyataan dengan menggunakan skala 1 hingga 7, di mana 1 adalah "sangat setuju" dan 7 adalah "sangat tidak bersetuju".
Please circle your answers for each statement using a scale of 1 to 7, where 1 is "strongly agree" and 7 is "strongly disagree".

Nama *(Name)* :

Umur *(Age)* :

Jantina (Gender) : **Lelaki/Perempuan**
(Male/Female)

Bangsa (Race) : **Melayu / Cina / India / Lain-lain**
(Malay/Chinese/Indian/Others)

Soal Selidik Kebolehgunaan dan Kepuasan Pengguna The Post-Study Usability Questionnaire		Sangat Setuju *Strongly Agree*						Sangat Tidak Setuju *Strongly Disagree*
Reka bentuk / Reka Letak *(Design / Layout)*								
1	Saya suka antaramuka aplikasi kuiz *I liked using the interface of the quiz application*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2	Organisasi maklumat di atas skrin-skrin aplikasi kuiz adalah jelas *The organization of information on the quiz application screens was clear*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3	Antaramuka aplikasi kuiz adalah menyenangkan *The interface of this quiz application was pleasant*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Kebolehfungsian *(Functionality)*								
4	Aplikasi kuiz ini mengandungi kesemua fungsi dan kemampuan yang saya mengharapkan ada *This quiz application has all the functions and capabilities that I expect to have*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5	Maklumat yang dibekalkan bersama aplikasi kuiz adalah jelas *The information provided with the quiz application was clear*	**1**	**2**	**3**	**4**	**5**	**6**	**7**

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Soal Selidik Kebolehgunaan dan Kepuasan Pengguna The Post-Study Usability Questionnaire		Sangat Setuju *Strongly Agree*						Sangat Tidak Setuju *Strongly Disagree*
6	Kesemua fitur dalam aplikasi kuiz berfungsi dengan baik *All the features in the quiz application functions well*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Kemudahgunaan *(Ease of use)*								
7	Adalah mudah untuk menggunakan aplikasi kuiz ini *It was simple to use the quiz application*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8	Adalah mudah untuk mencari maklumat yang saya kehendaki *It was easy to find the information I needed*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9	Maklumat yang dibekalkan dalam aplikasi kuiz adalah jelas *The information provided in the quiz application was clear*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10	Secara keseluruhan, aplikasi kuiz ini adalah mudah digunakan *Overall, this quiz application was easy to use*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Kebolehbelajaran *(Learnability)*								
11	Adalah mudah untuk belajar dengan menggunakan aplikasi kuiz ini *It was easy to learn by using the quiz application*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12	Tidak ada banyak maklumat yang perlu dibaca sebelum saya dapat menggunakan aplikasi kuiz ini dengan betul *There wasn't too much information to read before I can use the quiz application*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13	Maklumat yang dibekalkan dalam aplikasi kuiz adalah mudah untuk difahami *The information provided by the quiz application was easy to understand*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Kepuasan *(Satisfaction)*								
14	Saya rasa selesa menggunakan aplikasi kuiz ini *I felt comfortable using the quiz application*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15	Saya berasa terhibur menerokai aplikasi kuiz ini *I enjoyed exploring the quiz application*	**1**	**2**	**3**	**4**	**5**	**6**	**7**

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	Soal Selidik Kebolehgunaan dan Kepuasan Pengguna The Post-Study Usability Questionnaire	Sangat Setuju *Strongly Agree*						Sangat Tidak Setuju *Strongly Disagree*
16	Secara keseluruhan, saya rasa berpuas hati dengan aplikasi kuiz ini *Overall, I am satisfied with this quiz application*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Hasil / Penggunaan masa hadapan *(Outcome / Future use)*								
17	Saya percaya saya akan cepat menjadi produktif dengan menggunakan aplikasi kuiz ini *I believe I could become productive quickly using this quiz application*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18	Aplikasi kuiz ini berjaya menyakinkan saya dalam meningkatkan kemahiran *The quiz application was able to convince me on improving my skills*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19	Dari pengalaman kini dalam menggunakan aplikasi kuiz ini, saya rasa akan menggunanya secara kerap *From my current experience with using the quiz application, I think I would use it regularly*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Ralat / Kebolehpercayaan *(Errors / System Reliability)*								
20	Bilamana saya melakukan kesilapan dalam menggunakan aplikasi kuiz ini, saya dapat pulih kembali secara mudah dan pantas *Whenever I made a mistake using the quiz application, I could recover easily and quickly*	**1**	**2**	**3**	**4**	**5**	**6**	**7**
21	Aplikasi kuiz memberi maklumat ralat yang menerangkan secara jelas bagaimana untuk mengatasi masalah yang wujud *The quiz application gave error messages that clearly told me how to fix the problem*	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Komen / Cadangan
Comments / Suggestions

_____

_____

_____

_____

TERIMA KASIH DI ATAS KERJASAMA ANDA

THANK YOU VERY MUCH FOR YOUR PARTICIPATION

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APPENDIX G

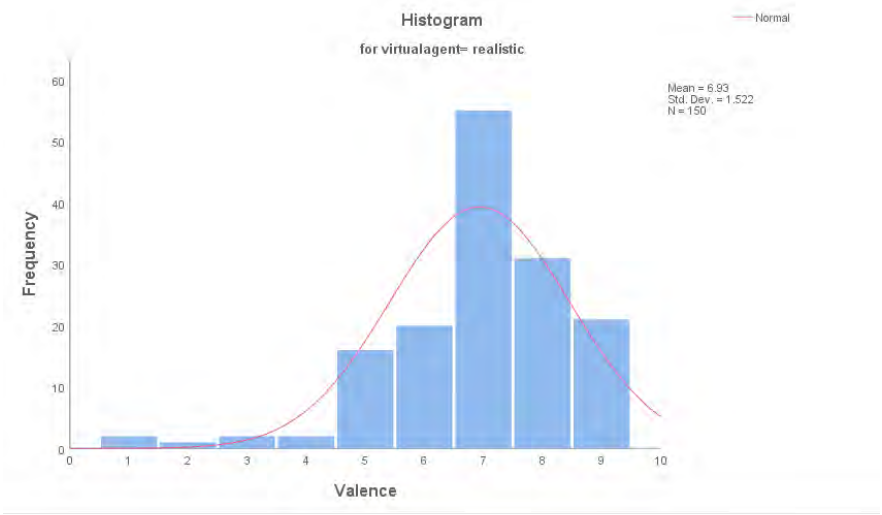
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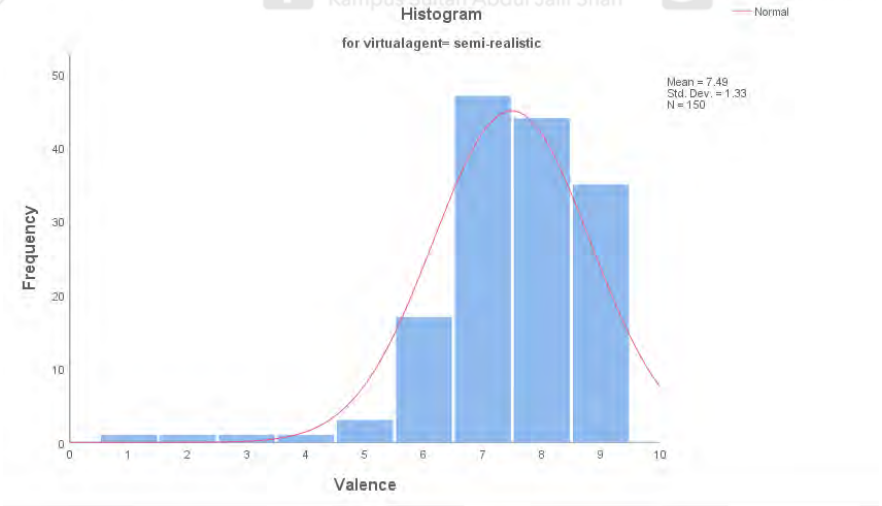
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Normality Test

1. First Research Question



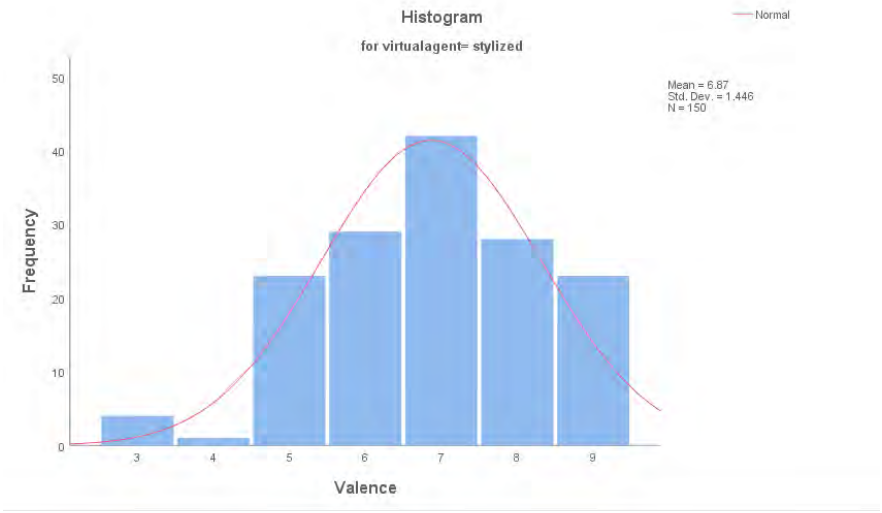
Realistic



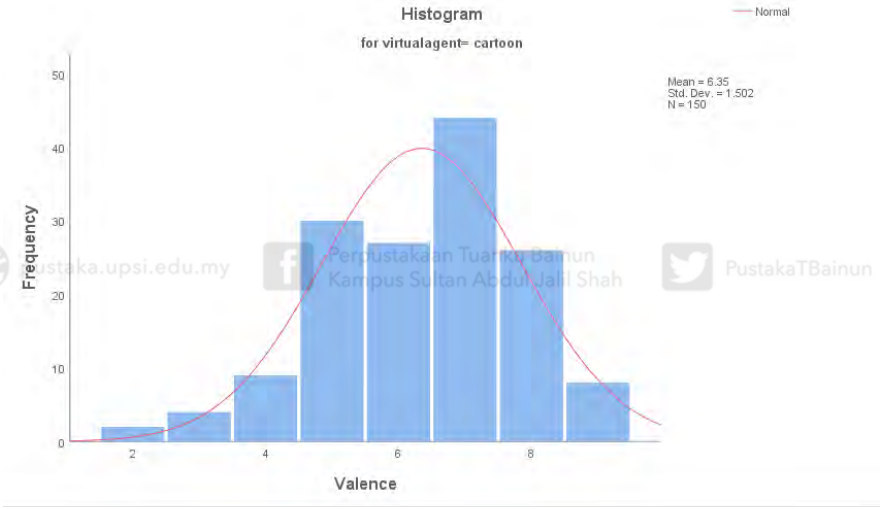
Semi-Realistic

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Stylized



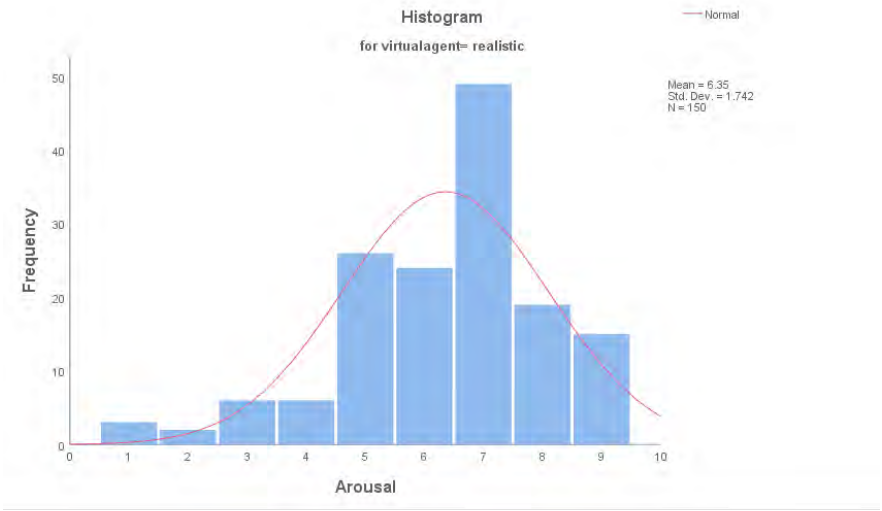
Cartoon-like

Normality of data distribution based on group of students on different realism designs

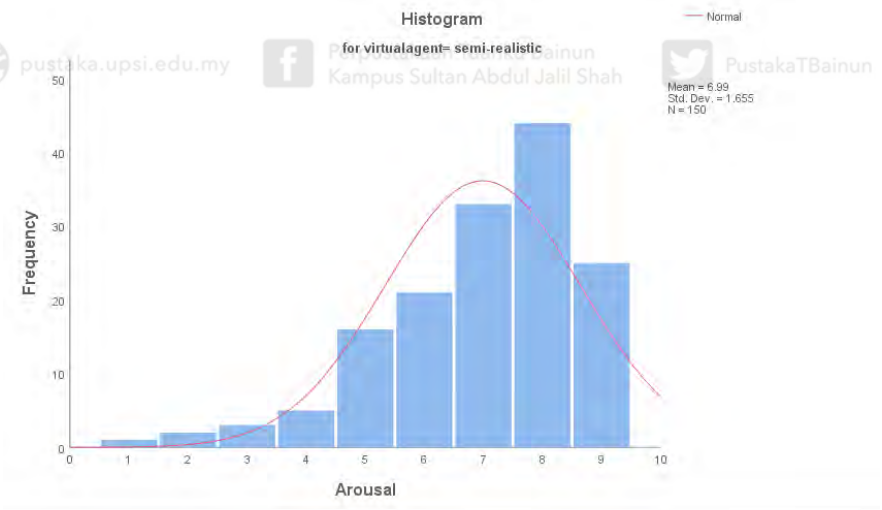
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2. Second Research Question



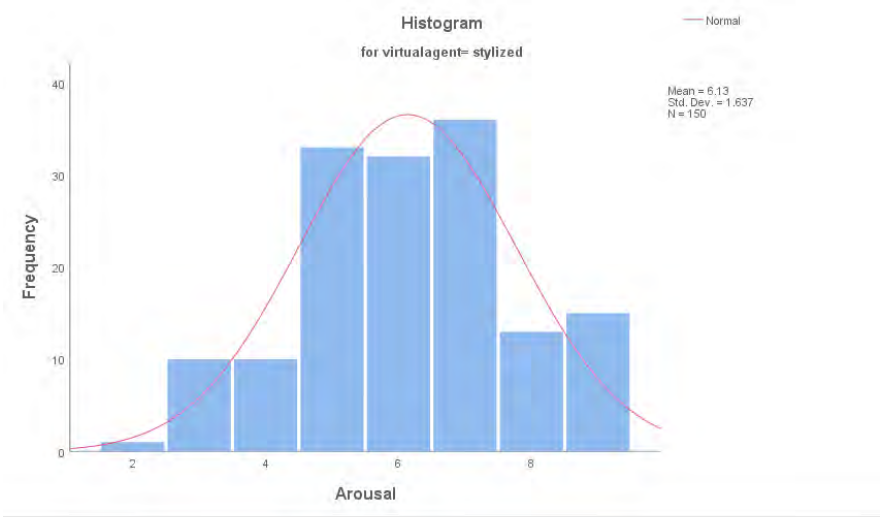
Realistic



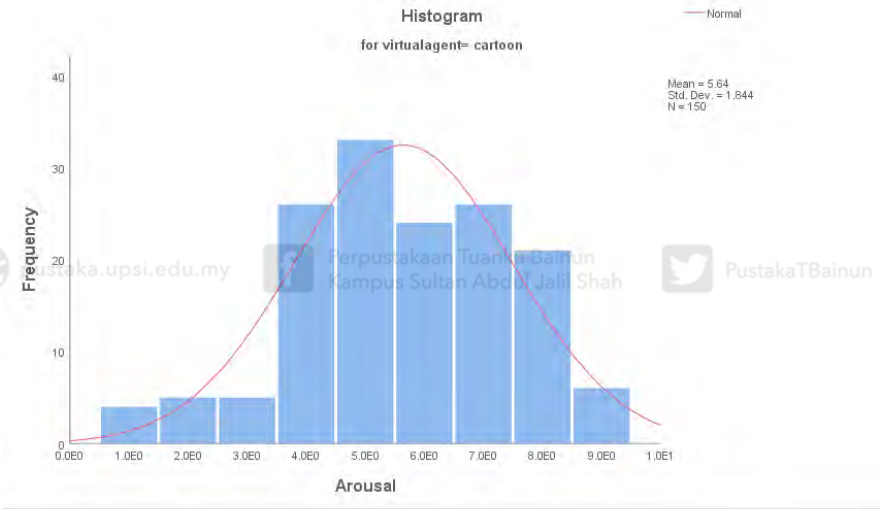
Semi-Realistic

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Stylized



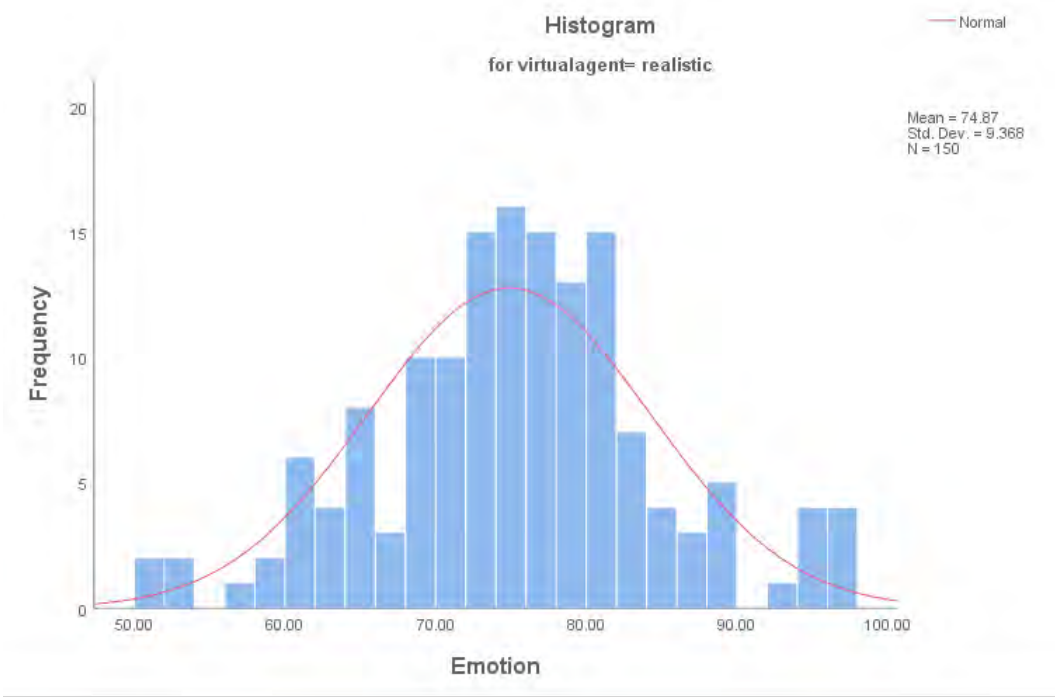
Cartoon-like

Normality of data distribution based on group of students on different realism designs

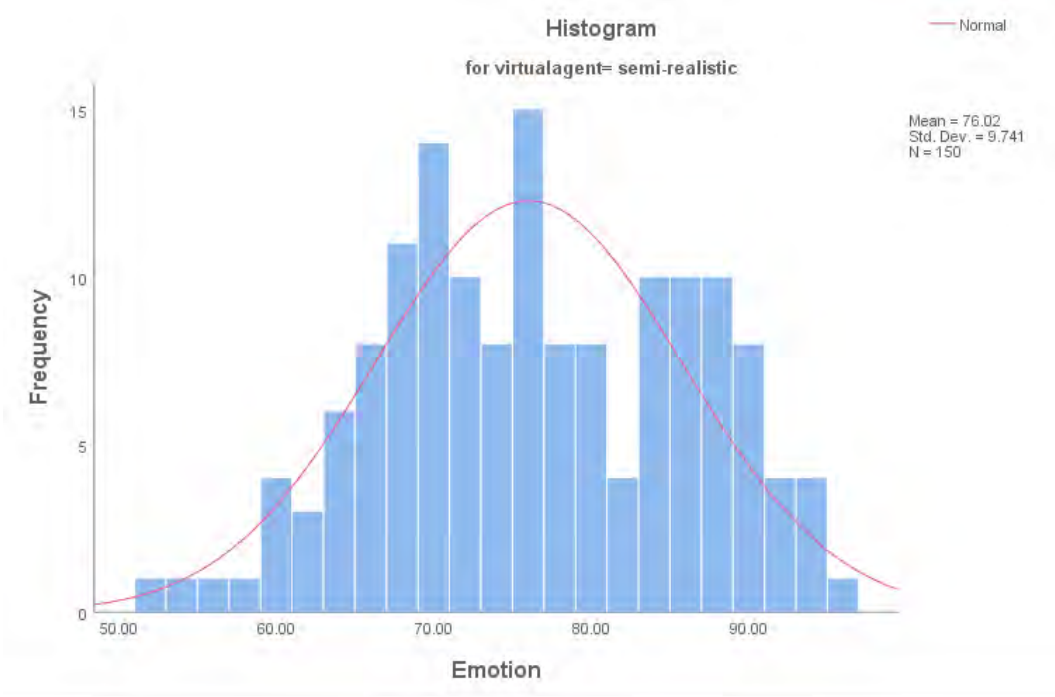
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3. Third Research Question



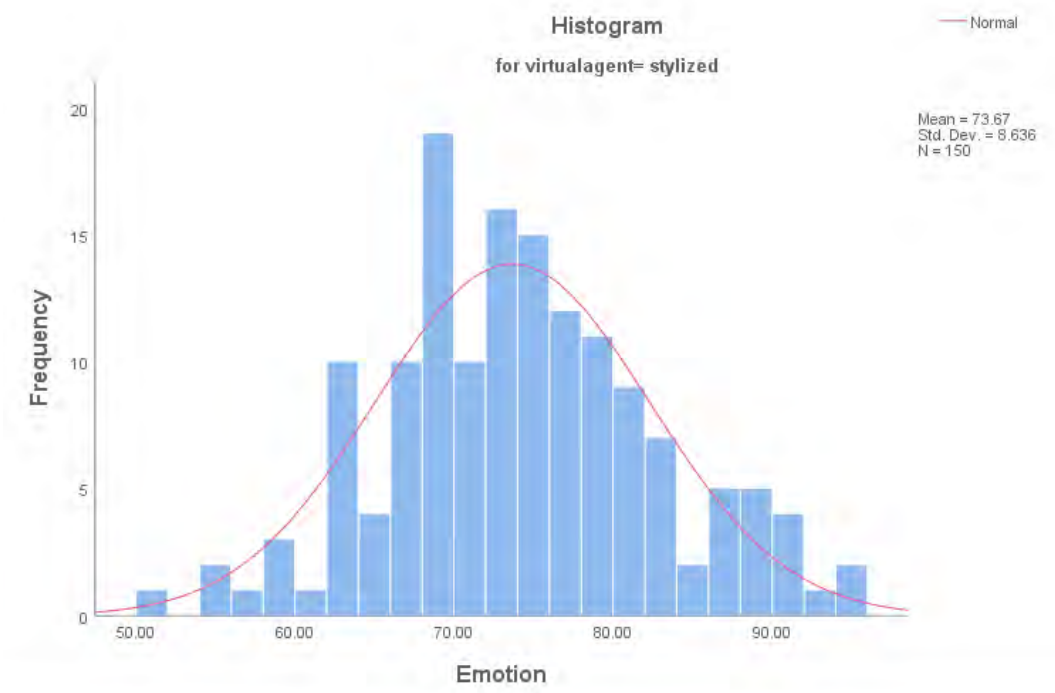
Realistic



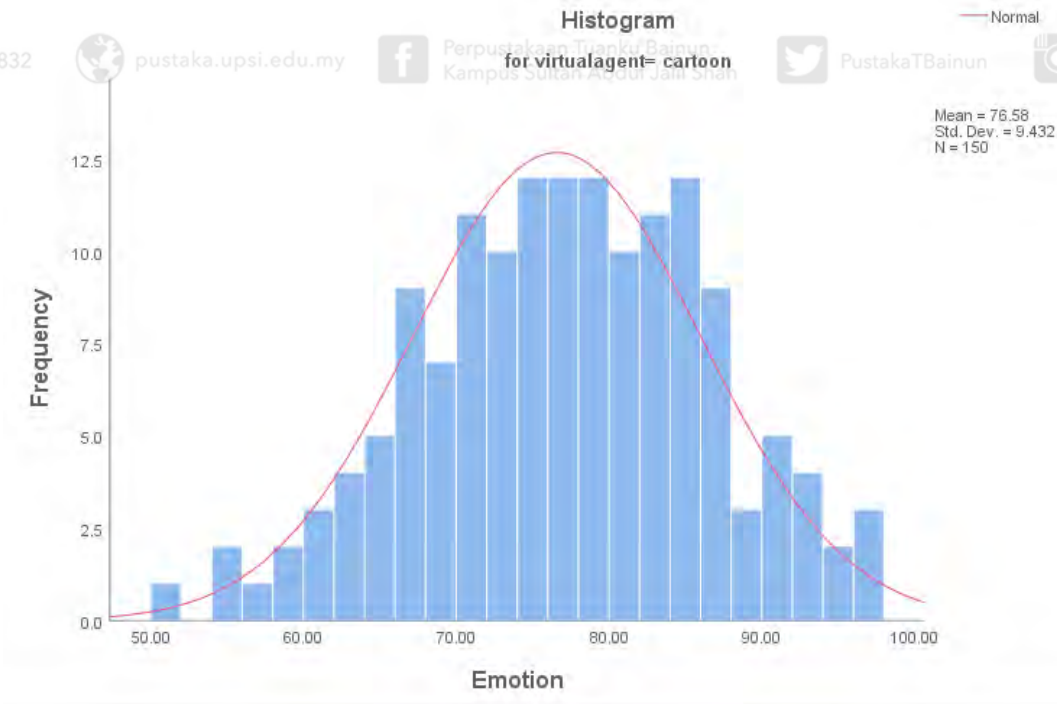
Semi-Realistic

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Stylized



Cartoon-like

Normality of data distribution based on group of students on different realism designs

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The output of 4th research question

Run MATRIX procedure:

********** PROCESS Procedure for SPSS Version 3.3 **********

Written by Andrew F. Hayes, Ph.D. www.afhayes.com

Documentation available in Hayes (2018). www.guilford.com/p/hayes3

****

Model : 4

Y : emotion

X : virtuala

M1 : VALENCE

M2 : AROUSAL

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Sample

Size: 600

****

OUTCOME VARIABLE:

VALENCE

Model Summary

R	R-sq	MSE	F	df1	df2	p
.1771	.0314	2.1931	19.3712	1.0000	598.0000	.0000

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Model

	coeff	se	t	p	LLCI	ULCI
constant	7.5033	.1481	50.6670	.0000	7.2125	7.7942
virtuala	-.2380	.0541	-4.4013	.0000	-.3442	-.1318

Standardized coefficients

	coeff
virtuala	-.1771

****

OUTCOME VARIABLE:

AROUSAL

Model Summary

R	R-sq	MSE	F	df1	df2	p
.1877	.0352	3.0758	21.8482	1.0000	598.0000	.0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	7.0267	.1754	40.0656	.0000	6.6822	7.3711
virtuala	-.2993	.0640	-4.6742	.0000	-.4251	-.1736

Standardized coefficients

	coeff
virtuala	-.1877

****

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OUTCOME VARIABLE:

emotion

Model Summary

R	R-sq	MSE	F	df1	df2	p
.2021	.0408	84.2266	8.4582	3.0000	596.0000	.0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	67.0124	2.1130	31.7145	.0000	62.8626	71.1622
virtuala	.5966	.3416	1.7462	.0813	-.0744	1.2676
VALENCE	.0371	.3920	.0946	.9247	-.7327	.8069
AROUSAL	1.0393	.3310	3.1399	.0018	.3892	1.6893

Standardized coefficients

	coeff
virtuala	.0714
VALENCE	.0060
AROUSAL	.1984

********** TOTAL EFFECT MODEL **********

OUTCOME VARIABLE:

emotion

Model Summary

R	R-sq	MSE	F	df1	df2	p
.0331	.0011	87.4228	.6567	1.0000	598.0000	.4181

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Model

	coeff	se	t	p	LLCI	ULCI
constant	74.5933	.9350	79.7788	.0000	72.7570	76.4296
virtuala	.2767	.3414	.8104	.4181	-.3939	.9472

Standardized coefficients

	coeff
virtuala	.0331

********** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **********

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI	c_ps	c_cs
.2767	.3414	.8104	.4181	-.3939	.9472	.0296	.0331

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Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI	c'_ps	c'_cs
.5966	.3416	1.7462	.0813	-.0744	1.2676	.0638	.0714

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	-.3199	.0965	-.5179	-.1473
VALENCE	-.0088	.0907	-.1858	.1824
AROUSAL	-.3111	.1171	-.5639	-.1137

Partially standardized indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	-.0342	.0102	-.0554	-.0157
VALENCE	-.0009	.0097	-.0199	.0195
AROUSAL	-.0333	.0124	-.0603	-.0122

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Completely standardized indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	-.0383	.0114	-.0619	-.0176
VALENCE	-.0011	.0108	-.0223	.0217
AROUSAL	-.0372	.0139	-.0676	-.0137

********** ANALYSIS NOTES AND ERRORS **********

Level of confidence for all confidence intervals in output:

95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:

5000

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NOTE: Variables names longer than eight characters can produce incorrect output.

Shorter variable names are recommended.

------ END MATRIX -----

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APPENDIX H

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Vicneas a/l Muniady
Unit ICT,
Politeknik Sultan Azlan Shah,
35950 Behrang,
Perak.

Pengarah,
Pusat Penyelidikan dan Inovasi Politeknik
Jabatan Pendidikan Politeknik
Aras 3, Bangunan 4C11, Galeria PJH,
Persiaran Perdana Presint 4,
62200 W.P.Putrajaya

21 November 2017

Tuan,

PERMOHONAN MENJALANKAN KAJIAN DI POLITEKNIK DI MALAYSIA

Dengan segala hormatnya perkara di atas dirujuk

2. Adalah dimaklumkan bahawa saya, Vicneas a/l Muniady, P20151000087, pelajar Ijazah Doktor Falsafah (Rekabentuk Multimedia) di Universiti Pendidikan Sultan Idris ingin memohon untuk menjalankan kajian di Politeknik di Malaysia.

3. Untuk makluman pihak tuan, saya menjalankan kajian bertajuk "**The Uncanny Impact on Different Realism Level of the Talking-Head on Students' Emotions In Learning**". Kajian ini akan dijalankan dalam tiga fasa utama iaitu, fasa pertama analisis keperluan, fasa kedua: rekabentuk dan pembangunan koswer dan fasa ketiga: penilaian koswer. Berikut merupakan pihak yang akan terlibat dalam kajian tersebut:

Institusi	Pihak Terlibat
1. Politeknik Ungku Omar 2. Politeknik Port Dickson 3. Politeknik Sultan Salahuddin Abdul Aziz Shah 4. Politeknik Seberang Perai 5. Politeknik Merlimau 6. Politeknik Sultan Azlan Shah 7. Politeknik Tuanku Sultanah Bahiyah 8. Politeknik Sultan Idris Shah	Pelajar- pelajar Jabatan Kejuruteraan Elektrik (Semester 4 & 5) Pelajar- pelajar Diploma Pemasaran, Jabatan Perdagangan (Semester 4

4. Pertimbangan dan kerjasama daripada pihak tuan saya dahului dengan ucapan terima kasih.

Sekian,

Vicneas Muniady
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JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI
Galeria PJH, Aras 3, Jalan P4W
Persiaran Perdana Presint 4, 62100 Putrajaya
Tel : 03-88919228 Fax : 03-88919322
Laman Web : http://politeknik.gov.my

POLITEKNIK MALAYSIA

Ruj. Kami : KPT.JPP.PPP.700-1 Jld. 6 (05)
Tarikh : 18 Disember 2017

VICNEAS A/L MUNIANDY
No. 9, Jalan Malim 13,
Taman Malim
35900 Tanjung Malim
Perak

Tuan,

KEBENARAN MENJALANKAN PENYELIDIKAN BERTAJUK *"THE UNCANNY IMPACT ON DIFFERENT REALISM LEVEL OF THE TALKING-HEAD ON STUDENTS EMOTIONS IN LEARNING"*

Saya dengan hormatnya merujuk perkara di atas.

2. Sukacita dimaklumkan bahawa pihak kami tiada halangan untuk memberi kebenaran kepada tuan untuk menjalankan kebenaran penyelidikan bertajuk ***"The Uncanny Impact On Different Realism Level Of The Talking-Head On Students Emotions In Learning"*** seperti yang dijelaskan dalam cadangan penyelidikan yang disertakan.

3. Kebenaran pengumpulan data hanya diberikan kepada penama dalam surat ini sahaja. Pihak ketiga tidak dibenarkan untuk mengumpul data bagi pihak penama. Sekiranya terdapat ketidakpatuhan, kebenaran ini terbatal dengan sendirinya.

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4. Sebarang pertanyaan lanjut berkenaan kajian penyelidikan yang akan dijalankan, sila hubungi Ketua Unit Penyelidikan Politeknik yang berkenaan untuk melancarkan lagi pelaksanaan kajian.

5. Untuk peringatan, tuan hendaklah mengemukakan senaskah laporan akhir kajian tersebut ke Pusat Penyelidikan dan Inovasi Politeknik (PPIP), Jabatan Pendidikan Politeknik. Dimaklumkan juga bahawa tuan, adalah diminta mendapatkan kebenaran terlebih dahulu daripada PPIP sekiranya sebahagian atau sepenuhnya dapatan penyelidikan tersebut hendak dibentangkan di mana-mana persidangan atau seminar, atau untuk pengumuman di media massa.

Sekian untuk makluman dan tindakan seterusnya, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(DR. ABDUL RAHIM BIN AHMAD)
Pengarah
Pusat Penyelidikan dan Inovasi Politeknik
Jabatan Pendidikan Politeknik

s.k:

1. Pengarah
   Politeknik Ungku Omar

2. Pengarah
   Politeknik Tuanku Sultanah Bahiyah

3. Pengarah
   Politeknik Port Dickson

4. Pengarah
   Politeknik Sultan Salahuddin Abdul Aziz Shah

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5. Pengarah
   Politeknik Seberang Perai

6. Pengarah
   Politeknik Merlimau

7. Pengarah
   Politeknik Sultan Azlan Shah

8. Pengarah
   Politeknik Sultan Idris Shah

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Institut Pengajian Siswazah

Rujukan Tuan :
Rujukan Kami : UPSI/IPS-1/623.5
Tarikh : 27 Julai 2018

KEPADA SESIAPA YANG BERKENAAN

Tuan/Puan ,

PENGESAHAN PELAJAR UNTUK MEMBUAT PENYELIDIKAN

Perkara di atas adalah dirujuk dengan segala hormatnya.

2. Adalah dimaklumkan pelajar sebagaimana nama dan nombor matrik seperti di bawah adalah pelajar Program Pengajian Siswazah , Universiti Pendidikan Sultan Idris (UPSI);

Nama Pelajar	: Vicneas A/L Muniady
No. Kad Pengenalan	: 820715146139
No. Matrik	: P20151000087
Program Pengajian	: Ijazah Doktor Falsafah
Bidang Pengajian	: PT150 - Reka Bentuk Multimedia
Fakulti	: Fakulti Seni, Komputeran dan Industri Kreatif
Sesi Kemasukan	: Semester 1 Sesi 2015/2016

3. Sehubungan itu, pihak kami memohon jasa baik pihak tuan supaya dapat membenarkan pelajar tersebut membuat kajian serta penyelidikan di tempat tuan/puan bagi memenuhi pengajian beliau di UPSI.

Sekian, untuk makluman.

'UNIVERSITI NO.1 PENDIDIKAN'

Yang benar,

UNIVERSITI PENDIDIKAN SULTAN IDRIS
INSTITUT PENGAJIAN SISWAZAH

(PROFESOR MADYA DR. RAMLEE BIN ISMAIL)
Dekan, Institut Pengajian Siswazah
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