



## **The Effect of Valence and Arousal on Virtual Agent's Designs in Quiz Based Multimedia Learning Environment**

**Vicneas Muniady**

Faculty of Art, Computing and Creative Industry, Universiti Pendidikan Sultan Idris, Perak, Malaysia, [vicneasm@gmail.com](mailto:vicneasm@gmail.com)

**Ahmad Zamzuri Mohamad Ali**

Faculty of Art, Computing and Creative Industry, Universiti Pendidikan Sultan Idris, Perak, Malaysia, [zamzuri@fskik.upsi.edu.my](mailto:zamzuri@fskik.upsi.edu.my)

Virtual agents are animated life-like characters generally used in virtual learning environments to facilitate learning tasks. With virtual agent, students can hold meaningful interactions throughout the learning process for more effective cognition. Hence, the effectiveness of virtual agent in term of promoting positive emotions is very much related to character realism influence. The level of realism of virtual agent may cause distress to the users, especially when the character mimics like human which was based on the uncanny valley phenomenon. For that, four different realism designs of virtual agents (realistic, semi-realistic, stylized and cartoon-like agents) in Quiz based Multimedia Learning Environment (Q-MLE) had been developed as experimental items and tested as experimental items to analyze emotions in the dimension of valence and arousal. Quasi-experimental design was used to answer the research questions derived and the data obtained was analysed using ANOVA and post hoc. The experiment was carried out on 600 electric engineering students from seven polytechnics of Malaysia. The experiment was carried out with 600 Electrical Engineering students from seven polytechnics in Malaysia. Students were divided into four different groups where each group consisted of 150 students who underwent four different realism designs of the virtual agents respectively. It has been found that the four different realism designs of virtual agents fall at high affective state with high arousal and positive valence. Consequently, the designed virtual agents escaped from uncanny valley effect.

Keywords: virtual agent, uncanny valley, arousal, valence, quiz, multimedia learning

### **INTRODUCTION**

Generally, virtual agents are animated life-like characters used in virtual learning environment to facilitate learning tasks (Bian & Yang, 2016; Hong, Chen & Lan, 2014).

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In addition, virtual agents play motivational role in an educational setting to increase motivation among the learners in order to provide meaningful learning (Mohanty, 2016). Such roles include tutors, coaches, and actors (Payr, 2003); experts, motivators and mentors (Baylor & Kim, 2005); 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 collaborate with learners in the facilitation of course contents (Baylor & Kim, 2004). This strategy helps to stimulate learners' interest and keep them focused on the provided content (Clark & Choi, 2005). When they are engaged in learning tasks, a good social interaction will be created and maintained between virtual agent and learners (Berry, Butler & Rosis, 2005).

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 (Ahmad Zamzuri & Mohd Najib, 2016). Since social relationship between the virtual agent and learner is important, bigger prominence should be granted in designing phase of the virtual agent's appearance (Shiban et al., 2015). Therefore, 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 while arousal varies from low-to-high state of excitement (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, 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. So far, previous studies only focused on students' emotions on the entire learning process and not on emotions caused by character's appearance in isolated. Therefore, this study was aimed to analyse students' emotions caused by the character's realism design in the dimension of valence and arousal.

Accordingly, four different realism designs of virtual agents namely realistic, semi-realistic, stylized and cartoon-like agents had been designed to perform the quiz through multimedia learning environment. Correspondingly, the delivery of quiz in the Quiz based Multimedia Learning Environment (Q-MLE) as a stand-alone package has been introduced as a computer-based assessment that tends to cover the content of the chapter with multiple choice questions. In addition, the use of virtual agent in Quiz based Multimedia Learning Environment (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.

Based on previous researches in animation and games industries, it is clearly indicated that the realism factors have impact on the success of the animation and games (Schwind, Wolf, Henze & Korn, 2015). Hence, question arises whether or not the same effects will befall on the virtual agent, specifically for education purposes. 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. Therefore, it is essential to conduct studies that address this phenomenon in instructional settings.

#### **LITERATURE REVIEW**

The understanding of fundamental of emotion is essential in order to develop good virtual agent that might affect the emotion of learning among students. In view of that, this study conducted based on references and previous studies. The literature of the study draws the emotion to the particular attention in the dimension of valence and arousal based on uncanny valley phenomenon by Mori (2012).

##### **Uncanny Valley**

These days, animations are consolidated as a feature of computer-based multimedia learning which aid to facilitate human learning through technologies such as virtual agent (Tien & Kamisah, 2010). Moreover, in designing aspects, the level of realism of the virtual agent is among the most vital attribute that should be addressed (Ahmad Zamzuri & Mohd Najib, 2016). It is to ensure that the virtual agent animation is capable of obtaining maximum impact in learning (Baylor, 2011).

According to Mori (2012), a character that is too realistic or almost resembles a human would eventually cause viewers to feel afraid and horrified when viewing these characters which is also known as the Uncanny Valley phenomenon (Ahmad Zamzuri & Mohd Najib, 2016). These kind of unpleasant psychological effects occur due to the people's difficulty in accepting a strange appearance (Sjödahl, Gard & Jarnlo, 2004). Indeed, it shows that a very high level of human-likeness in a virtual agent can produce a negative feeling instead of attraction (MacDorman, Green, Ho & Koch, 2009). This phenomenon is illustrated through the uncanny valley graph as shown in Figure 1.

Based on the uncanny valley phenomenon, physical presence is considered as an important medium to investigate level of realism (MacDorman et al., 2009). Towards the resemblance of human, the appearance of a robot gradually increased up to a certain level of similarity (Mori, 2012). However, beyond a maximum possible degree of similarity (between 80% and 85% human-likeness), the appearance of a robot is seen as eerie or disgusting. This point is referred as Uncanny Valley where the realism will drop. Figure 1 shows a visualization of Mori's theory that displays a steady rising of

familiarity as perceived human-likeness increases. At certain points, it decreases sharply causing a valley-shaped dip. This is referred as the uncanny valley phenomenon with reference to the precipitous fall in likability (Mori, 2012). Even though this phenomenon is about robots, it is also applicable for virtual agent that resembles real human.

As a consequence, if socially acceptable behavior is not exhibited by the virtual agent, it may be rejected. In fact, the level of realism of three-dimensional animated characters is higher in resembling the actual human compared to a two-dimensional animated characters (Walker, 2009). Therefore, this study is focused on various realism designs of 2D characters. Most of the studies on the impact of the level of realism were focused on the film industry and it has been found that very few studies on education aspects. Hence, it is important to conduct studies that analyze the effect of realism levels of the virtual agent in teaching and learning media as well.

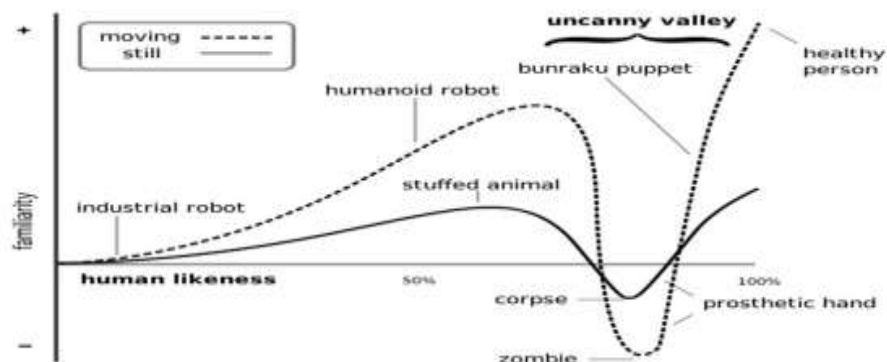


Figure 1  
Mori's Graph of the Uncanny Valley (Mori, 2012)

### Valence and Arousal

Emotion is a very important contribution towards learning (Hascher, 2010). Positive emotion increases learners' intrinsic motivation by stimulating their curiosity to explore new knowledge and thus leads to better learning performance (Pekrun et al. 2011). These motivational capabilities were measured from the emotional information provided by valence and arousal (Lang, Bradley & Cuthbert, 1997).

Valence is a fundamental component of emotional responding. Valence refers to the pleasant-to-unpleasant (Kensinger & Corkin, 2004). Positive valence is viewed as enjoyment and happiness while negative valence as anger, anxiety, and boredom. Negative valence is more reactive than positive valence for negative valence produces more negative effects compared to positive valence (Baumeister, Bratslavsky, Finkenauer & Vohs, 2001).

On the other hand, arousal describes through emotional experience that enrich with excitation or calm (Russell, 2003). This arousal is categorized 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). Also, arousal is a factor that contributes to memory enhancement effect (Kensinger, 2004). In brief, high impact of arousal causes a narrowing of attention. Typically, there is a model called Circumplex model (figure 2) which describes affective states with two dimensions, valence and arousal (Barrett & Russell, 1999). According to Russell (1980), any affective states will fall in this two dimensions.

In educational setting, the presence of emotionally arousing component aids to induce external mood and maintain it throughout the learning process (Um et al., 2012). The induced emotional experiences can influence cognitive functions (Um et al., 2012). Positive emotion 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 exploration to different intensity levels of positive and negative emotions is essential.

Furthermore, the measurement of valence and arousal in this research are based on learners' rating based on their affective experience when viewing a virtual agent. In addition, a learner's emotional state can be identified within four categories of valence and arousal: calm positive, arousing positive, calm negative, and arousing negative emotions (L. Shen, Wang & R. Shen, 2009). The different kind of emotional states influence motivational intensity. Learners who express positive emotions during the first view of the virtual agent maintained interest throughout the learning process, whereas those who express negative emotions showed decreased interest throughout the learning process. This permits the understanding of emotions that help in choosing appropriate design for virtual agent. A suitable design of virtual agent influences learning performance and improve the effectiveness of learning environment. Other than that, the measurement of valence and arousal also can determine the occurrence of uncanny valley on the virtual agents (Cheetham, Wu, Pauli & Jancke, 2015).

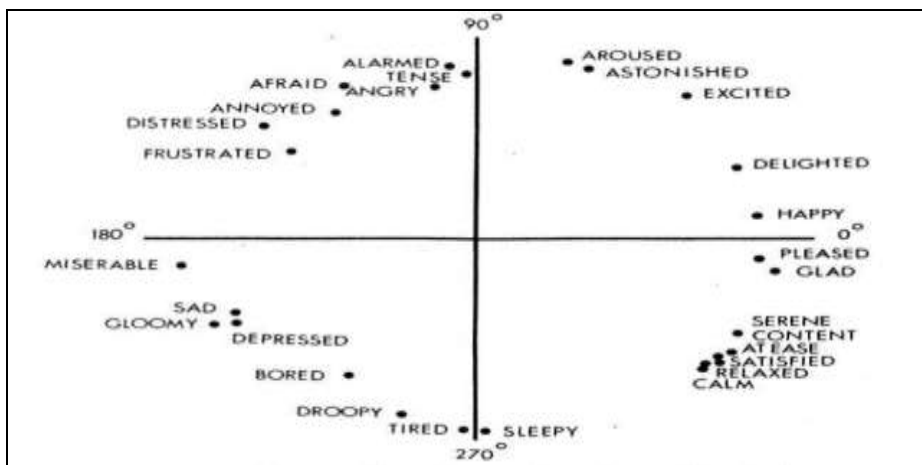


Figure 2  
Russell's Circumplex Model of Affect (Russell, 1980)

### **Research Objective**

The purpose of the study is to observe the effect of realism designs of 2D female virtual agents on students' emotions in the dimension of valence and arousal when exposed to Quiz based Multimedia Learning Environment (Q-MLE)

The specific objectives of the study are as follows:

- a) To analyze the effect of different realism designs of the virtual agents on students' emotions in the dimension of valence.
- b) To analyze the effect of different realism designs of the virtual agents on students' emotions in the dimension of arousal.

Therefore, the hypotheses of this study are:

- H1) There is a significant effect of different realism designs of the virtual agents on students' emotions in the dimension of valence.

There is a significant effect of different realism designs of the virtual agents on students' emotions in the dimension of arousal.

### **METHOD**

This section discusses the design and development of the virtual agent, Quiz based Multimedia Learning Environment (Q-MLE), instruments, participants and procedures used to develop the study. Quasi-experimental design was used to answer the research questions derived and the data obtained was analysed using ANOVA and post hoc analysis.

#### **Virtual Agent**

It was stated in the past studies that students are benefited from female agents compared to male agents in learning (Arroyo, Woolf, Cooper, Burlison & Muldner, 2011; Baylor 2011; Johnson, Ozogul, Moreno & Reisslein 2013). In addition, viewers are facing uncanniness in male human-like character (Tinwell, Grimshaw, Abdel Nabi & Williams, 2011). On the other hand, elements of virtual agent should reflect the cultural value of the country in which they were originated and tested (Sloan, 2015). To add, female virtual agent of Malaysian native-look was selected for the investigation purpose of this research. So, the look of the female virtual agent localizes Malaysian young Malay lady as a subjective approach to cultural acceptance.

The clothes for the four virtual agents were kept similar. The colours of the clothes were chosen appropriately. Past researches on colour has shown an increase in pleasure and excitement due to saturated and warm colours (Plass, Heidig, Hayward, Homer & Um, 2014), and has found that they can stimulate greater feelings of arousal. However, the strongest effects have been found between warm, light colours (e.g., yellow, orange) and dark or achromatic colours (e.g., grey) (Plass et al., 2014). Therefore, the hijab for the virtual agent is in orange and the top is in yellow. The four virtual agents' designs were adapted from the past studies (Baylor & Kim, 2004; Gulz & Haake, 2006; Ahmad Zamzuri & Mohd Najib, 2016; Schwind et al., 2015; Zell et al., 2015).

To brief, the four 2D female virtual agents' design are as follows:

1. Realistic agent

This strategy uses an animated character that is realistic (designed very detailed and it mimics like human).

2. Semi-Realistic agent

This strategy uses an animated character that is medium realistic (not as detailed as the realistic).

3. Stylized agent

This strategy uses an animated character that is stylized (cartoon character with exaggerated features).

4. Cartoon-like agent

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

Each designs sent to five experts, local and internationally for validation. It is to ensure the virtual agents' designs are according to realistic level as discussed. Based on their feedback, the designs were amended as shown in figure 3.

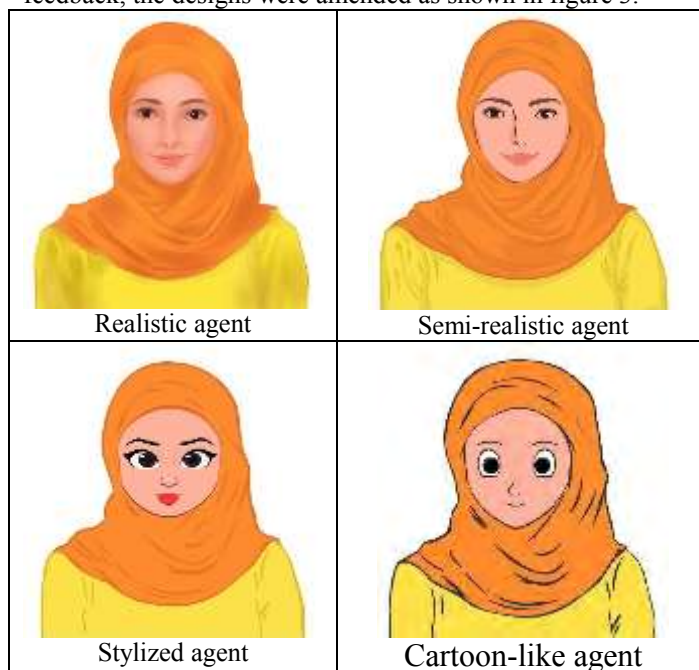


Figure 3  
Different Realism Designs of Virtual Agents

### **Content of the Quiz based Multimedia Learning Environment**

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. The quiz questions for the four prototypes are same.

### **Multimedia Quiz based Multimedia Learning Environment**

The developed quiz was fully based on Multimedia Learning Environment (MLE) that promotes learning among students (Mayer, 2008). A well-established line of researches demonstrated that students came about to learn better through words and graphics, in comparison to words alone (Mayer, 2008). Hence, the Q-MLE was designed using Gagne's nine events of instruction (Gagne, Wager, Golas & Keller, 2005) and integrated with several multimedia elements such as texts, graphics, audio and video clips, as well as animation.



Figure 4  
Cartoon-like Agent Q-MLE

The virtual agent presents at all times throughout the Q-MLE to guide the students with multiple spoken dialogues acting as a social affinity between the user and the agent. The students were required to answer 20 multiple-choice questions provided by the virtual agent. The virtual agent is designed to provide response based on the choice of answer made by the students.





Figure 5  
Realistic Agent Q-MLE

### Instrument

Students' emotions on designed characters of this virtual agent in the Q-MLE were measured using the adapted Self-Assessment Manikin (SAM) questionnaire (see Appendix A). Self-Assessment Manikin (SAM) is an effective rating system, used to assess these three dimensions of emotions which are valence, arousal and dominance (Lang et al., 1997). SAM is a non-verbal pictorial assessment technique devised by Lang, 1980 to measure valence, arousal and dominance. They are identified to be associated with a person's affective reaction towards an object or a stimulus (Bradley & Lang, 1994). Hence, the current study examined students' emotional states in the dimension of valence versus arousal. Therefore, in this research, students were capable to rate the design of virtual agent with four different realism designs based on experiences of valence and arousal from the neural systems.

Here, students rated each virtual agents using nine-point scale with pictorial manikins that 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 vignette ranges from an excited, wide-eyed to a relaxed and sleepy (Lang et al., 1997). In general, score 1 is rated as the lowest that represents a usual emotional experience and a score 9 as the highest that represents the most intense experience of the emotions.

### Participants

The target participants for this quiz are students from fourth and fifth semester who have enrolled in DEC5082 term for Interactive Multimedia Applications subject. The population of this study determined using multistage sampling method. It is a combination of cluster sampling and simple random sampling. First of all, polytechnics that offer Interactive Multimedia Applications subject had been identified, where the subject is offered at 12 out of 36 polytechnics in Malaysia. Secondly, the 12 polytechnics were divided into five clusters based on zones. Thirdly, three out of the

four clusters were selected using random sampling method for this study. Therefore, the study was conducted at seven out of 12 polytechnics from north, central and south zones. The participants are from electrical engineering department who have been 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). Students were randomly chosen for four different groups of realistic, semi-realistic, stylized and cartoon-like agents. Total of 600 students were participated; each groups were assigned with 150 students. Subsequently, the experimental study was conducted separately for all the groups in a controlled lab environment.

### **Procedure**

Prior to the experiment, the first chapter of the chosen subject has been already taught by their respective lecturers. On the experiment day, students were briefed about the purpose of the experiment conducted and the role of arousal and valence in investigating the influence of realism level in the design of 2D virtual agents on Q-MLE. In order to smoothen the process, students also directed about rules and regulations in using the Q-MLE. From there, the experiment has been carried out by allowing students to explore the Q-MLE for 5 minutes. Selected virtual agent was shown to the students. Then the adapted Self-Assessment Manikin (SAM) nonverbal pictographic questionnaire was given to measure students' emotional states in the dimension of valence and arousal. The experiment was conducted by same instructor for all the groups.

### **FINDINGS**

ANOVA test were used for the first and second research questions. Consequently, to identify which virtual agent pairs show significant differences, Tukey's Honestly Significant Difference (HSD) post hoc comparison tests were performed.

#### **One-Way ANOVA Test Analysis for Valence**

One-way ANOVA was conducted to investigate whether there is any significant effect of different realism designs of the virtual agents which are realistic, semi-realistic, stylized and cartoon-like agent on students' emotions in dimension of valence. Before the data were analyzed using one-way ANOVA, normality analysis, linearity and outlier were tested. Thus, ANOVA test assumptions were fulfilled.

The results of the ANOVA test showed 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 where the effect size is medium according to Cohen (1988). Hence, the hypothesis of this study (h1) is accepted. Alternatively, Tukey's Honestly Significant Difference (HSD) post hoc test was performed to see which group is significantly different from each other.

Table 1  
Summary of Tests Between-Subjects Effects

| Source        | df  | M      | F     | Sig. | Partial $\eta^2$ |
|---------------|-----|--------|-------|------|------------------|
| Virtual agent | 3   | 32.615 | 15.48 | .000 | .072             |
| error         | 596 | 2.108  |       |      |                  |

#### Tukey's Honestly Significant Difference (HSD) post hoc Test

Additionally, 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 2 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 ( $M=6.35$ ,  $SD=1.50$ ,  $n=150$ ).

On the other hand, the results of the pairwise comparisons test using the Tukey's method shows that the mean difference of valence for realistic agent and semi-realistic agent ( $MD=0.55$ ,  $p<0.05$ ), realistic agent and cartoon-like agent ( $MD=0.59$ ,  $p<0.05$ ), semi-realistic agent and stylized agent ( $MD=1.14$ ,  $p<0.05$ ), semi-realistic agent and cartoon-like agent ( $MD=0.59$ ,  $p<0.05$ ) and stylized agent and cartoon-like agent ( $MD=0.52$ ,  $p<0.05$ ) are significantly different. In contrast, realistic agent and stylized agent ( $MD=0.07$ ,  $p>0.05$ ) shows no significant difference.

#### One-Way ANOVA Test Analysis for Arousal

In order to analyze the occurrence of any significant effect of different realism designs of the virtual agents on students' emotions in dimension of arousal, one-way ANOVA was conducted. The four different realism designs of the virtual agents are realistic, semi-realistic, stylized and cartoon-like agents. The ANOVA test assumptions; normality analysis, linearity and outlier had been tested before began the one-way ANOVA test.

Based on the result, the value of  $F(3, 596) = 15.79$ ,  $p<0.05$  indicates there is a significant difference between arousal and different realism designs of virtual agents. The effect size is medium with partial eta squared = 0.07 as stated by Cohen (1988). As a result, the hypothesis of this study ( $H_2$ ) is accepted. This analysis was carried on with Tukey's Honestly Significant Difference (HSD) post hoc test to identify which group is significantly different from each other.

Table 2  
Summary of Tests Between-Subjects Effects

| Source        | df  | M      | F     | Sig. | Partial $\eta^2$ |
|---------------|-----|--------|-------|------|------------------|
| Virtual agent | 3   | 46.793 | 15.79 | .000 | .074             |
| error         | 596 | 2.963  |       |      |                  |

#### Tukey's Honestly Significant Difference (HSD) post hoc Test

According to Bonferroni's post hoc comparison tests, semi-realistic agent produced the highest mean score for arousal ( $M=6.99$ ,  $SD=1.66$ ,  $n=150$ ). The mean score by realistic

agent is  $M=6.35$ ,  $SD=1.74$  and  $n=150$  while the mean score by stylized agent is  $M=6.13$ ,  $SD=1.64$  and  $n=150$ . In contrary, cartoon-like agent obtained the lowest mean score for arousal ( $M=5.64$ ,  $SD=1.84$ ,  $n=150$ ).

The results of the pairwise comparisons test using the Tukey's method shows that the mean difference of arousal is significantly different from the result for realistic agent and cartoon-like agent,  $MD=0.71$ ,  $p<0.05$ , semi-realistic agent and realistic agent is  $MD=0.63$ ,  $p<0.05$ , semi-realistic agent and stylized agent is  $MD=0.85$ ,  $p<0.05$  and semi-realistic agent and cartoon-like agent is  $MD=1.35$ ,  $p<0.05$ . However, there is no any significant difference for realistic agent and stylized agent ( $MD=0.22$ ,  $p>0.05$ ) and stylized agent and cartoon-like agent ( $MD=0.49$ ,  $p>0.05$ ).

## **DISCUSSION**

The realism level of virtual agent may cause distress to the users, especially when the character mimics human; which is based on the uncanny valley phenomenon highlighted by Mori (2012). Therefore, the virtual agent effectiveness in term of promoting positive emotion is influenced by the character's realism. Conversely, the findings of this study prevail that uncanny valley does not occur in exploring virtual agents in the Q-MLE as the four virtual agents fall on positively activating state when plotted in the Circumplex model as shown in figure 6. Both dimensions have similar range of mean score that holds the four virtual agents in the positive valence and high arousal. This indicating the existence of happiness, delightful and excitement among students that result in their acceptance of all the different realism level of virtual agents.

On the other hand, since the virtual agents were designed with similar common elements such as Malaysians' native look, attire and voice, students recognize well the virtual agents as the virtual agents seems familiar to them. Sloan (2015) stated that virtual agent should reflect the cultural value of the country in which it originated and tested. Accordingly, even the virtual agents designed with different realism level, they appear to be attractive and pretty to students. Consequently, students reported to experience pleasantness and excitement. This is in line with the statement by Vogel, Ram, Conroy, Pincus and Gerstorf (2017) that found individuals feel excited and happy to see close and highly familiar people. Accordingly, the four virtual agents escaped totally from falling in the range of negative valence and consequently uncanny valley does not exists for these designs. The positive relationship between human likeness and familiarity in the design of virtual agents' result in highest positive affective valence and greatest affective arousal for semi-realistic agent. Student are very excited to see semi-realistic agent with closely human-like skin texture and appearance. Therefore, students experienced highest arousal and valence towards the semi-realistic agent. Realistic agent obtained second highest score after the semi-realistic agent. Student accepted the agent as their friend as it resembled exact appearance like human. Hence, it is highly likeable by students and they feel excited to interact with it.

Besides that, the exaggerated features of stylized agent less imitate like human that lead to achieve moderate mean values for arousal and valence. On the other hand, the achievement of valence and arousal were lowest for cartoon-like agent. The flat look of

cartoon-like agent with dark outline produced less likability among students. However, as all the features fit perfectly with appropriate arrangements, the four different realism designs of virtual agents such as semi-realistic, realistic, stylized and cartoon-like agents appear to be attractive and stimulated pleasant impression among students that allowing all agents fall within the range of high arousal and positive valence. As a result, students accepted the four different realism designs of virtual agents. In overall, emotional state with less arousing and positive valence lead to better overall cognitive-motor performance (Lu, Jaquess, Hatfield, Zhou & Li, 2017). Indeed, a very high level of human-likeness in a virtual agent can narrow students' attraction. Future research should therefore concentrate on the investigation whether arousal and valence effect students' emotion in learning.

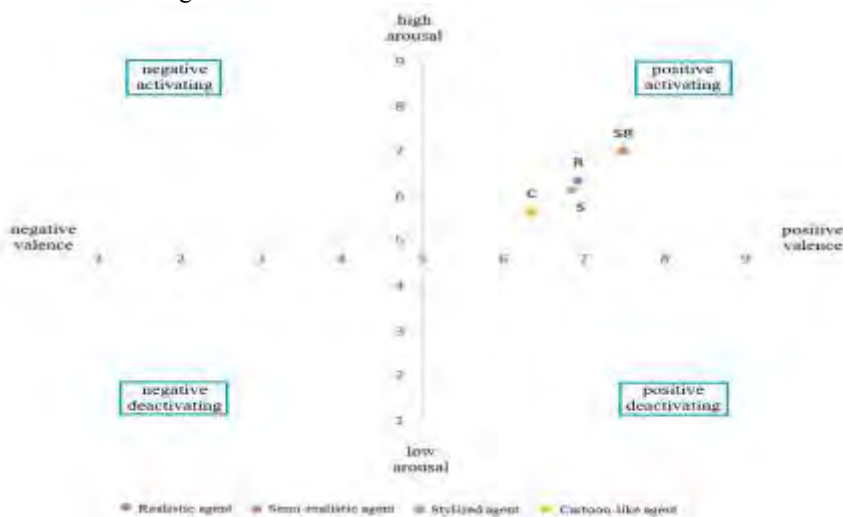


Figure 6  
Circumplex Model of Four Different Realism Designs of Virtual Agents

Besides that, the agent's gender could be a factor that the realism didn't occur in 2D virtual agent. Generally, viewers tend to face uncanniness in male human-like character (Tinwell et al., 2011). According to Arroyo et al. (2011), female agent for a mixed population enhances students' motivation. Adding to this, Johnson et al. (2013) found 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. 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. Moreover, the study by Plant, Baylor, Doerr and Rosenberg-Kima (2009) suggested that such a design "may benefit both genders equally" (p. 214). Therefore, female agent is identified to be the best and most suitable virtual agent for education.

## CONCLUSION

To conclude, animated virtual agent acts as a computer-generated animated character that serves as a social model to hold meaningful interaction with learners. Perhaps, it is necessary to analyse physical presence of virtual agents to understand how the uncanny valley affects the students. A mismatch in virtual agents' visual elements could attribute to negative impact on students. This is due to the level of realism on agent which may cause distress to the users, especially when the character mimics like human based on uncanny valley phenomenon. Nevertheless, this study has identified that there is no occurrence of uncanny valley for 2D female virtual agents with different realism designs. This could be due to the agent's 2D design. In addition, the virtual agent's gender and native-look could be another factor the realism does not affect the students. Therefore, it is recommended that 2D design and female virtual agent with native-look can be used in designing virtual agent in education.

## 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. Therefore, further investigation needed to address this.

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