Developing and Evaluating of Non-Realistic Three-Dimensional (3d-Nr) And Two-Dimensional (2d) Talking-Head Animation Courseware

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ABSTRACT

The talking-head animation is an instructional animation capable of improving the communication skills through enhancing the pronunciation skills; whereby a word is pronounced correctly and accurately. This had been proven by several researches, which indicate that learning with interactive animation is much more advantageous than conventional learning. Hence, the mistake in choosing the realistic level of an animated character at a particular condition has negative effect on students' learning performance. Therefore, this study would focus on the Uncanny Valley phenomenon, which is understood to have an effect on the students' emotions. This phenomenon is mainly attributed to the animated character design which is almost similar to real humans. To overcome these problems, the non-realistic three-dimensional and two-dimensional talking-head animation courseware has been developed to ensure that students get the maximum learning from the point of emotional reaction and learning performance. In this regard, the focus of this study was mainly on developing non-realistic three-dimensional talking-head animation. The courseware was developed based on theories, principles and literature review conducted. The paper also reports the evaluation of usability and user satisfaction (PSSUQ) test carried out. One hundred students from Teluk Intan Community College in Malaysia were involved in this study. Overall, the findings of this study show that the students agreed on the level of usability and satisfaction of using the non-realistic three- dimensional and two-dimensional talking-head animation courseware and that it meets the standards of an animated instruction, specifically for learning to pronounce English words.

Keywords: *Animation, realism, uncanny valley phenomenon, talking-head*

INTRODUCTION

Malaysia is now moving toward the evolution of education that applies computer aided in the learning process (Dorothy, Norlidah & Saedah, 2013). Hence, animation applications is one of the latest computer technology is used as a Teaching Aid in the world of modern education

(Norabeerah, Halimah, & Azlina, 2012) as the elements found in the animation make teaching and learning more attractive, effective, stimulating, and it can be suited according to student needs (Plass, Homer, & Haward, 2009). Currently, animation is not only used in certain disciplines such as science and technology, but it has also been expanded into language and linguistics (Muyassar, 2010). This includes animation in the form of talking-head which is being used in learning language and linguistics (Daniehelka, Hak, & Kenchl, 2011; Wik & Hjalmarsson, 2009; Wik, 2011). It is found that by using the talking-head

animation, students can learn a language by imitating the style and speech according to the animated character (Wik, 2011; Wik & Hjalmarsson, 2009). This element has been proven by several researches related to learning to pronounce words in English, where there is a positive effect on students who used the talking-head animation (Wang, Chen & Li, 2012; Wik & Hjalmarsson, 2009). Therefore, the use of talking-head animation has the potential to become a Teaching Aid in the learning of words, which is the main problem in learning English as a second language (Fraser, 2000).

BACKGROUND OF STUDY

An appropriate teaching approach is important when learning a second language (Morley, 1998). It is very meaningful for overcoming problems faced by students who need to practice clear pronunciations of new words pertaining to a second language, which is different from their first language (Cook, 1996). Numerous instructional approaches were undertaken in establishing English as a second language being acquired globally, which eventually resulted in the introduction of Computer-Assisted Language Learning (CALL). In CALL, the embodied agent, or talking-head animation, becomes the prominent virtual aid for teaching pronunciation, vocabulary, articulation and so forth (Wik & Hjalmarsson, 2009). Generally, talking-head animation is a visual character that functions by saying a word or telling a story to the students (Dey, Maddock, & Nicolson, 2010). The talking-head character is limited in a sense that the display on the screen only shows the section from the top of its head to the shoulders (Dey et al., 2010). In addition, talking-head animation was developed by combining the principles of linguistics, pedagogy and a good audio system that is capable of helping students to optimize their pronunciation skills (Massaro, 2006).

However, the effectiveness of the talking-head animation is closely related to the character used in the animation (Moore, 2012). Generally, this animated character could be divided into two categories, which are the two-dimensional (2D) and three-dimensional (3D) characters (Oke & Alam, 2010). The three-dimensional character, which is very human-like, is said to have an emotional effect on students during the learning process compared to the two-dimensional animated characters (MacDorman, Green, & Koch, 2009). Thus, if this realistic factor is not handled properly it could have a negative impact on the learning process (Tinwell, Grimshaw, & William, 2010). Nevertheless, the impression of comfort and human emotions of the three-dimensional animation can be controlled if the design is not too realistic (Bruthcher, 2013; Ventrella, 2011). Therefore, this study will use three-dimensional and two-dimensional talking-head animated characters to ensure students gain a maximum learning outcome when using this courseware.

RESEARCH OBJECTIVES

The objectives of the research are:

1. To develop the non-realistic three-dimensional and two-dimensional talking-head animation courseware.
2. To evaluate the views of students of usability and satisfaction of non-realistic three-dimensional and two-dimensional talking-head animation courseware.

Research Question

The research question to be answered by the study is:

What are the views of students of usability and satisfaction of non-realistic three-dimensional and two-dimensional talking-head animation courseware?

The Effect of Realistic Levels of Animation Characters on Humans

The realistic level factor has actually become a main issue in animation filming media (Kaba, 2013). The film *Toy Story,* produced by Walt Disney Pictures, is one example of a non-realistic 3D film that has successfully attracted moviegoers in early 2000 (Butler & Joschko, 2009). The development of 3D animation technology has brought about a realistic 3D animation character that is capable of looking very human-like from numerous aspects such as body design, face, hair and so forth (Kaba, 2013). For example, the animated film *Final Fantasy* was produced in 2001 using realistic and human-like 3D animated characters. This realistic rendering of animated characters actually has a negative impact on human emotions (Kaba, 2013). Consequently, the film failed to achieve its financial target (Geller, 2008; Kaba, 2013). The producer was caught up in the virtuosity of 3D animation technology and the film was affected by the *Uncanny Valley* phenomenon (Kaba, 2013). This was because the realistic level of 3D animated characters was actually higher compared to the 2D animated characters (Oddey & White, 2009). Hence the level of comfort and human emotions would be affected when the 3D animated characters are used in an animated production compared to 2D animated characters (Oddey & White, 2009).

***Figure 1*. The Incredibles – Non-realistic 3D animated characters (Kaba, 2013)**

Based on the experience from the *Final Fantasy*, *Shrek* is another animated movie produced using non-realistic 3D animated characters (Butler & Jashko, 2007). The main character was a green 3D animated monster with a fantastic figure and it was not human-like (Butler & Jashko, 2007). The movie received encouraging response from moviegoers and managed to meet its financial target (Butler & Jashko, 2007). The success of this movie was followed by the production of a 3D animated movie called *The Incredibles* (Butler & Jashko, 2007) (Figure 1). This movie also used non-realistic 3D animated characters with cartoon characteristics. This design was chosen in order to avoid the *Uncanny Valley* phenomenon from affecting viewers, as what had happened to the movie *Final Fantasy* previously (Butler & Jashko, 2007). Based on that consideration, the movie was successful in meeting the target set by the producer, just like the animated movie *Shrek* (Oddey & White, 2009).

Besides research on the filming aspect, the effect of the realistic levels and the *Uncanny Valley* phenomenon was also evaluated and measured using medical technology, such as the Functional Magnetic Resonance Imaging (FMRI). For example, research done by Saygin, Charminade, and Ishiguro (2010) had evaluated the effects of the realistic levels on three characters, namely a mechanical robot character, a realistic human-like android character and an actual human character using the FMRI technology. The

research involved 20 samples comprising physically fit individuals who were required to watch all three videos repeatedly. Just after watching the videos, their brain cells were analyzed using the FMRI technology and the results are shown in Figure 2. The results obtained from the FMRI technology showed that the android character (Figure 2: Character B), which was realistic and resembled an actual human, had brought about high cognitive activity in the brain cells compared to the actual human character and the mechanical robot character (Saygin et al., 2010). This finding can be related to the *Uncanny Valley* phenomenon, which stated that animated characters that have a high level of realism and resemble actual humans have a potential negative effect on the level of comfort as well as human emotions.

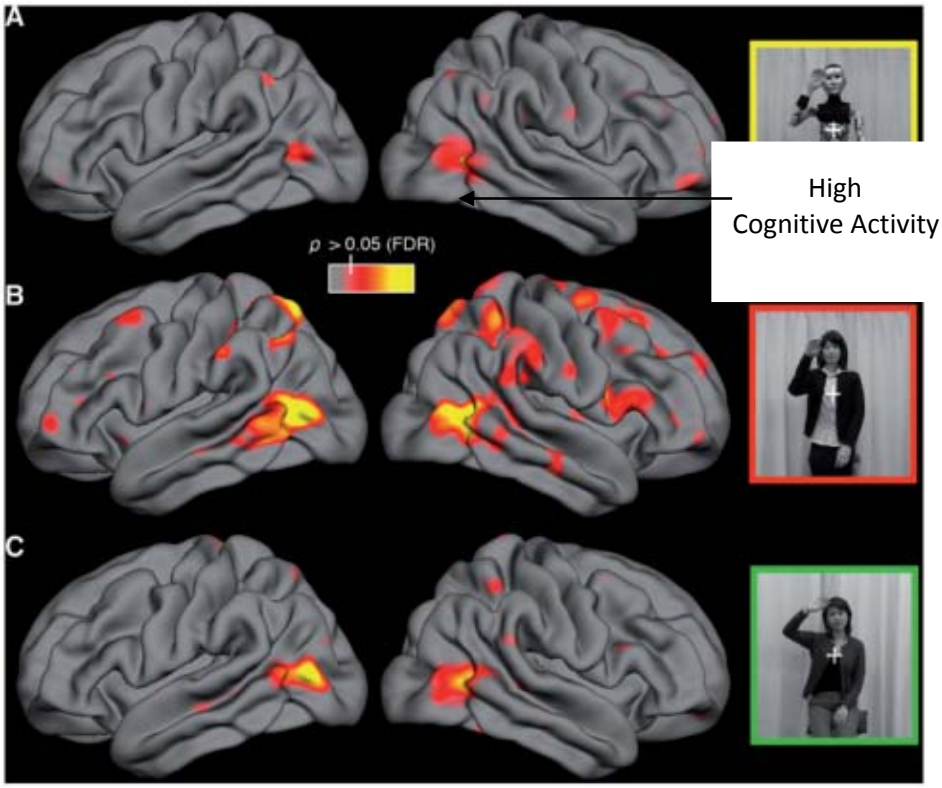

Figure 2. Repetition suppression. Whole-brain repetition suppression effect for (A) Robot, (B) Android and (C) Human Conditions rendered on the lateral views of the cortical surface of each hemisphere (Saygin, Charminade, & Ishiguro, 2010)

The Design and Development of the Talking-Head Animation

The process of creating and developing an effective multimedia learning material needs an instructional design model that is well arranged to ensure a systematic development process (Ahmad Zamzuri, Laili Farhana, & Syamsulaini, 2012). This is no exception in the process of developing instruction materials based on the talking-head animation, which also needs a pertinent instructional design model for maximum impact in terms of enhancing student performance. According to Andrew and Goodson (1980), the evaluation and implementation involve almost 40 instructional material design models. Hence, most of these models consist of the same elements such as analysis, design, evaluation and implementation (Boyle, 1997; Gustafson & Branch, 2002). Among the instructional material design models are the ADDIE model, the Assure Model, the Product Orientation Model and the Dick and Carrey Teaching Design Model (Kailani & Muhammed, 2011). Thus, most of the novice developers of instructional materials faced problems in establishing the assignments in each phase of the instruction design model because the framework presented is only represented by words (Ahmad Zamzuri et al., 2012). To overcome this problem, the DIDEA

instruction design model was developed by Universiti Pendidikan Sultan Idris (UPSI) aimed at guiding developers on the procedures for developing the instructional material involved in the teaching and learning process (Ahmad Zamzuri et al., 2012). DIDEA is the acronym for five phases, which are Determine, Illustrate, Development, Execute and Analyze (Figure 3). Each phase in the DIDEA model contains several sub-assignments that would assist in elucidating the function of each phase, and the sub-assignments are not present in most of the current instruction design models. Therefore, the DIDEA instruction design model has been selected in the designing and developing process of the talking-head animation in this research.

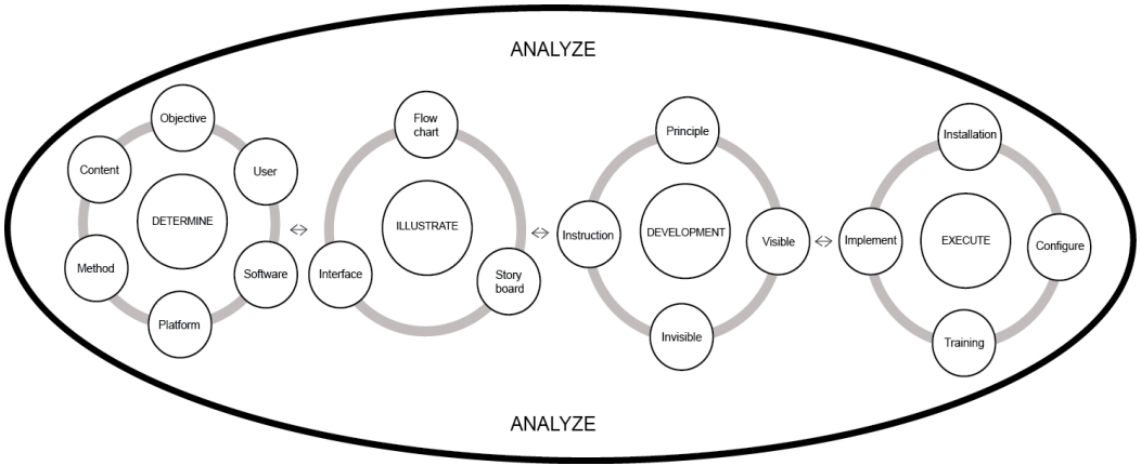

***Figure 3*. The DIDEA model (Ahmad Zamzuri, Laili Farhana, & Syamsulaini, 2012)**

NAVIGATION

The talking-head animation courseware begins with the introduction screen. From the introduction screen, students can choose to move directly to the main menu screen, the guide menu or the courseware objective menu. Through the main menu screen, they can choose a word to begin their pronunciation training. After the students have chosen a word, a screen will display the talking-head animated character that pronounces the same word with a display of the word in syllable break form (Example - Pro/nun/ci/a/tion). After that, the students will again look at the talking-head animated character pronouncing the word in full (Example - Pronunciation). Then, the students will look at the explanation on the meaning of the word shown on the next screen. After the learning session, they can choose to repeat the learning session for the same word or choose another word. Besides that, the talking-head animation courseware that has been developed involved the combination of linear and hierarchal navigation. The linear navigation is a structure comprising a chain of continuous stories (Farag & Shamy, 2011). This enables students to follow the steps one-by-one from the beginning when they choose the word until the animated character pronounces the word. Meanwhile, the hierarchal navigation enables students to return to the main menu in order to select a new word or repeat the word that has been taught (Lee & Olson, 2005). This supports the drill learning strategy method. The efficacy of the talking-head animation courseware is closely related to the principles of screen design (Rozinah, 2005). According to Ahmad Zamzuri et al. (2012), the development phase, especially the screen design aspect, comprises several multimedia principles that need to be fulfilled, such as principles regarding texts, graphics, audio, animation, video, and colour.

Besides that, the abovementioned multimedia principles should follow the knowledge discipline stated in the Human-Computer Interaction (HCI) field. This is intended to ensure the existence of a relationship or effective interaction between the consumer and the instructional material that has been developed in order to ascertain effective information delivery to the consumer (Ahmad Zamzuri et al., 2012). The following are multimedia principles that have been practiced in the talking-head animation development phase.

MULTIMEDIA PRINCIPLES

a) Texts

Text is an arrangement of alphabets that form a clear expression and later leads to a meaning (Rozinah, 2005). Text refers to several combinations of symbols such as alphabets, numbers, types of fonts, notations, and styles of fonts (Ahmad Zamzuri, Rahani, Khairulanuar & Muhammad Zaffwan, 2013). Texts that portray facts or ideas of an individual are built from a combination of sentences, words and paragraphs (Rozinah, 2002). Hence, text selection is important to ensure all the information is effectively delivered to the consumer (Rozinah, 2002). Generally, text is categorized into three main groups, which are the Serif type (Times New Roman, Bookman Old Style & Courier New), the Sans Serif type (Arial & Verdana) and the Decorative type (Old English Text & Egyptienne). The Serif type is text that is "tailed" at the end. Meanwhile, the Sans Serif has endings that are not decorated (Ahmad Zamzuri et al., 2013). The last group of texts is the decorative type, whereby the text style is in decorative or flowery form. The decorative font makes words difficult to read; thus, a font that is easy to read and with an appropriate size is encouraged when developing a multimedia application (Vaughan, 1998). Therefore, a textual concept that is brief and concise needs to be assimilated into the multimedia design (Ahmad Zamzuri et al., 2013). The justification for a concise and brief text is that it is appropriately less than half of the screen size used (Rozinah, 2002). Hence, when developing the talking-head animation courseware, the Arial font (Sans Serif) with an appropriate size was used for the entire software based on the advantage of using this font, such as ease of reading on the computer screen (Ahmad Zamzuri et al., 2013). In this courseware, the texts are presented in a combination of large and small letters. Using large letters would make it difficult and impede the reading fluency because the words are all of the same size (Peck, 2003). Figure 3 shows an example fonts used in the courseware talking-head animation.

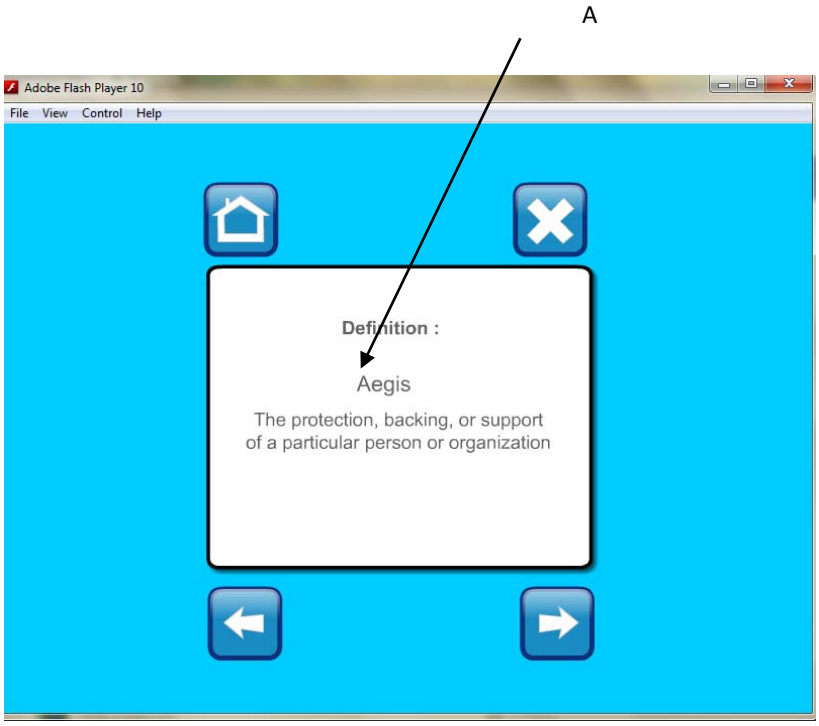

***Figure 4*. Example of using the Arial font and graphics in the Talking-Head animation courseware.**

b) Graphics

Graphics are the main element in multimedia courseware that is used to process the visual delivery of information. Compared to the conventional method, information received through the graphical process is faster and easily received by students (Chandler, 2009). Good quality and effective graphics are capable of

enhancing motivation and stimulate students to further focus on the learning sessions. Hence, using graphics that are too decorative have the potential to disrupt the student's concentration on the learning material (Rieber, 1990). Therefore, graphic components are only used as icons, such as the "main page" (home), "next", "previous", "play" and "exit" so that navigation is easily understood by all students.

c) Audio

Audio is among the important elements used in this research to ensure that the words pronounced by the character are accurate and clearly heard by the user. Hence, every word pronounced by the talking-head character is based on the voice of a male character called Mike (a native speaker), which was obtained directly from a software known as "text to speech" found in the website http://www.yakitome.com. The voice of a local English teacher was chosen to pronounce the selected words, and this was verified by three lecturers who are experts in English. The audio was saved in the form of file.mp3 before it was used in the talking-head animation courseware.

d) Animation

Choosing the animation character is the most important component in the talking-head animation courseware. Hence, the choice of character was evaluated based on typical Malaysian characteristics and a student-friendly appearance. A human character called Teacher Malik was chosen based on the demands of both these characteristics. The human character was animated as a non-realistic three-dimensional animated character (Figure 5) and two-dimensional animated character (Figure 6). From an animated character design aspect, a number of studies have suggested several special designs for the face and eyes of the character aimed at avoiding the effect of the Uncanny Valley phenomenon on viewers, such as the size of the character's eyes being less than 50% of the actual size of a human eye, the position of the character's eyes, nose and mouth of an actual human and the character's face-body proportion should follow the design of an actual human, and the skin texture of the character should not be similar to that of a human (Tinwell, Grimshaw, Nabi & Williams, 2011; MacDorman, Green, Ho, & Koch, 2009). These designs are considered important when developing an instructional-based animated character in order to avoid negative emotional effects encountered during the learning process. Besides, the display of the talking-head character is limited on the screen, which portrays the head only until the shoulders (Dey et al., 2010). Meanwhile, facial expression and lip synchronization are also important elements in developing the talking-head animation (Dey et al., 2010).

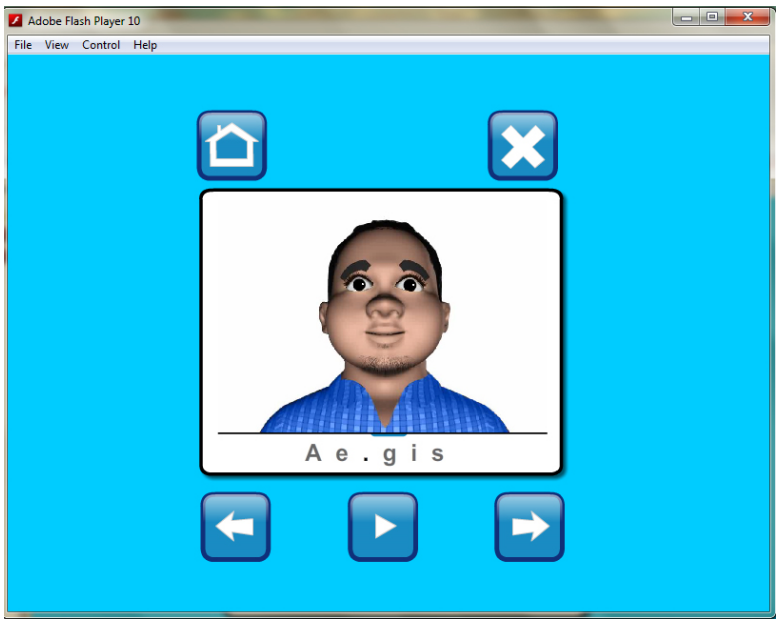

***Figure 5*. An example of a non-realistic three-dimensional character.**

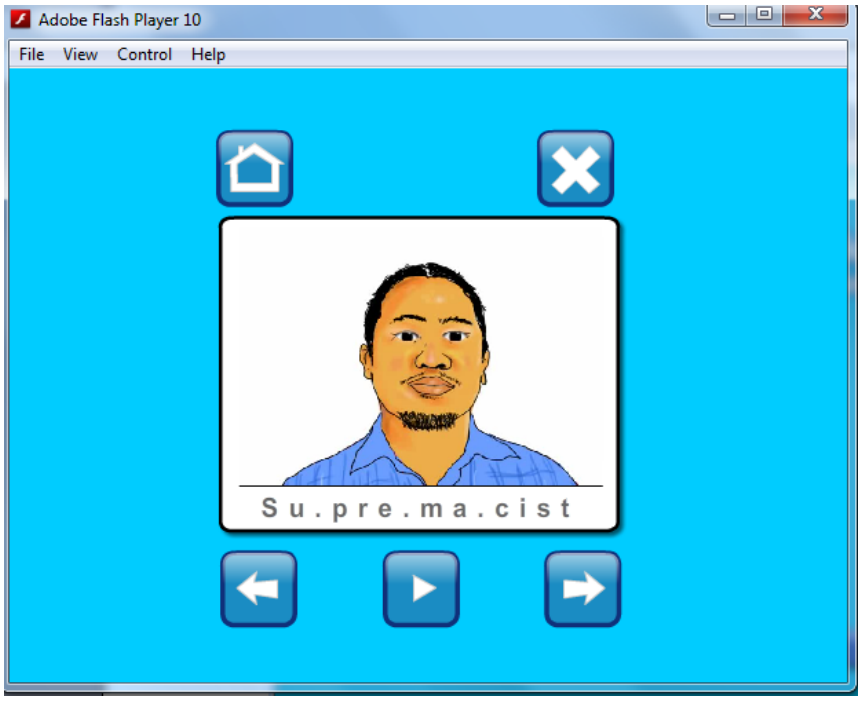

***Figure 6*. An example of a two-dimensional character.**

e) Video

The talking-head video animation that has been developed through the editing process would be converted into an flv file format to enable faster access. This way, students could avoid feeling bored during the learning session (Alessi & Trolip, 2001).

f) Colour

Among the important components of graphics is colour (Fenrich, 1997). Using too much colour (or more than five colours), is not suitable for designing a good animated presentation (Fenrich, 1997; Peck, 2003). Therefore, the colour used in developing the talking-head animation courseware did not exceed five colours, as shown in Figure 4. Blue was used as the courseware background because the colour is characterised as being cool and suitable as a background colour (Fenrich, 1997). Meanwhile, white was used in the animation block in order to attract students' attention to the animation. The font colour should be in contrast with the background to facilitate reading (Fenrich, 1997). Hence, the font colours used were white and black.

EVALUATION

The analysis process involving the three-dimensional and two-dimensional talking-head animation courseware was carried out throughout the development process based on previous research, interviews and advice from several chosen experts. The analysis is not only limited to the physical appearance but also covers the overall performance, especially the usability and user satisfaction when using the 3D-NR and 2D talking-head animation courseware. To evaluate the courseware usability and user satisfaction, a test was carried out as soon as the design and development process were completed. The questionnaire on usability

and user satisfaction (PSSUQ) was adapted to acquire feedback from students. The questionnaire consisted of 21 items divided into seven categories, such as design, function, convenience of use, ability to learn, satisfaction, future use, errors and reliability. This questionnaire was developed based on research done by IBM (Lewis, 1995).

The questionnaire items were developed based on a 7-point scale with 1 for strongly agree, ending with 7 for strongly disagree. There were 100 students involved in this study from the Teluk Intan Community College; they were divided into two groups. The study lasted 25 minutes after the students had explored the courseware. The teacher had explained the main function of the courseware before the students were allowed to explore the courseware at their own pace. After 25 minutes of exploration, the students were allowed to ask questions and have discussions during the session, which ended with the students answering the questionnaire. Generally, the Cronbach alpha value for the applicability and user satisfaction test using the PSSUQ questionnaire was .96. This value shows a high reliability for the questionnaire items (Pallant, 2007). Table 1 shows the findings of this study.

Table 1 Usability and User Satisfaction on Non Realistic Three-Dimensional and Two Dimensional Talking-Head Animation Courseware

Overall, the results show that students from the Community College agreed on the level of applicability and satisfaction of using the three-dimensional and two-dimensional talking-head animation courseware for learning to pronounce English words.

Description of Items	**3D-NR**		**2D**	
Design and Layout	*M*	*SD*	*M*	*SD*
Overall, the students agreed with the design of the courseware interface	3.34	1.40	3.20	1.38
The order of information given was clear and concise	3.34	1.50	3.18	1.53
The interface was pleasant	3.56	1.32	3.50	1.38
Functionality				
The courseware had all the functions and capabilities anticipated by the student	3.66	1.34	3.55	1.40
The information taken from the courseware was effective in assisting the students to complete their daily tasks	3.40	1.31	3.33	1.35
The students agreed that all the characteristics in the courseware function had functioned well	3.32	1.59	3.25	1.61
Ease of use				
The students agreed that the courseware was convenient to use	2.74	1.61	2.67	1.46
It was easy to find the required information	3.26	1.48	3.25	1.46
Generally, the courseware was easy to use	3.14	1.55	3.02	1.51
Learnability				
The students agreed that the courseware was convenient for learning	2.98	1.55	2.90	1.53
They found that there was not much information that needed to be read before using the courseware	3.28	1.56	3.20	1.57
They also agreed that the information given through the courseware was easily understood	3.00	1.39	2.87	1.32
Satisfaction				
Generally, the students felt comfortable using the courseware	3.20	1.68	3.08	1.70
They were happy and enjoyed exploring the courseware	3.20	1.4	3.07	1.39
Overall, the students were satisfied with the courseware's development	3.30	1.66	3.15	1.69
Future use				
The students agreed that they could become productive at a faster pace when using the courseware	3.36	1.35).	3.25	1.34
They were confident that the courseware could enhance their pronunciation skills	3.20	1.51	3.35	1.64
Based on the current experience, they were confident in frequently using the courseware again	3.35	1.38	3.08	1.44
Errors and reliability				
The students agreed that every time they made a mistake in using this courseware, they could easily and quickly return to use the courseware again	3.36	1	3.30	1.40
They agreed the courseware has been developed to give a clear message on the error and inform them on how to solve a problem	3.74	1.58	3.57	1.62

CONCLUSION

The non realistic three-dimensional and two-dimensional talking-head animation courseware represent an instructional animation that is capable of enhancing communication skills through encouraging skilful pronunciation of a word correctly and accurately. This matter has been proven in several studies, whereby it has been found that using dynamic animation is better compared to conventional learning. Therefore, to ensure ease of use, usability and user satisfaction tests were carried out and the analysis showed a positive effect from the student's perspective. This shows that the three-dimensional and two-dimensional talking-head animation courseware meet the standards of an animated instruction, specifically for learning to pronounce English words.

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