# A Conceptual Framework for 3D Hologram Talking-Head Character Design

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*Abstract*—In a previous study, we made some new discoveries regarding the use of holograms, particularly as a substitute for classroom instructors. The appropriate hologram tutor character is an important topic to study, considering that the character design as a hologram can significantly influence student learning emotions. In addition, the character design of the hologram tutor is believed to influence the student's learning experience (LX). Since hologram tutors can have a positive impact on learning sessions, their use should be maintained. However, one of the issues that will hamper the use of hologram tutors in the future is the size of the platform, which is big and challenging to handle. In fact, hologram technology can also utilize the Talking-Head application. This 3D Hologram Talking-head is more manageable due to its smaller size. However, since the 3D Hologram Talking-head only displays the character's head, the effect of using it on students' learning emotions remained unclear. Therefore, in the context of this study, we will determine the emotional responses of students to the use of 3D Hologram Talking-Heads with different levels of realism of various characters.

*Index Terms*—3D hologram, talking-head, uncanny valley, emotion in learning, educational technology

## I. INTRODUCTION

The process of creating components for multimedia content has gotten better and easier as a result of advances in digital technology, particularly in the area of animation. In recent years, the use of multimedia materials has grown across a variety of industries, including education [1, 2]. The rapid development of technology is required for the innovation process of its use in teaching and learning sessions, to increase the effectiveness of the teaching and learning process [3, 4].

Hologram technology is one of the technologies developed, particularly in the area of 3D visualization [5]. With the term "hologram tutor," educators are currently represented in the classroom by holograms [6]. Typically, the primary display for these hologram educators is a real human character [5, 7–9]. According to research on the use of character design in video games [10, 11] and pedagogical agents [12, 13], the use of different levels of realistic character design can influence different levels of user comfort and emotions. For instance, although using too

realistic a real human character design as a pedagogical agent character should be avoided to prevent uncomfortable feelings [12], it also can have a positive comforting effect when used as characters in animated videos [14]. The use of realistic real-human characters as hologram tutors is also said to have the potential to have a positive acceptance and experience effect on users, according to research findings [9].

The study on the use of this hologram tutor, on the other hand, displays the design of the entirely human character in actual size, which is a realistic display of human design from head to toe. Even though acceptance and emotional impact on the user is seen to be positive [9], the way it is handled limits the use of hologram tutors in specific situations. Since the hologram tutor is designed to be the size of a real person, the hologram platform that must be prepared is also larger and more difficult to manage. This is because hologram tutors are usually displayed through a hologram platform that applies the 'Pepper Ghost' technique [15] or Pseudo3D [16], in which a large transparent glass uses as a display reflection.

To facilitate handling and use, the hologram tutor can also be transformed into a talking-head application platform. The use of a talking-head application as an alternative to a hologram tutor suggests being more practical because the talking-head application is smaller in size. This is since the talking-head application only displays the character design on the head [12]. The question that arises, however, is whether or not the emotional impact on student learning will remain positive if this 3D Hologram Talking-head application is used as a substitute for educators in the classroom. There is a belief that the use of actual-size, realistic human characters in a hologram display could induce a sense of dread in the user [17]. This gives the impression that there is a significant difference in student learning emotions if the 3D Hologram Talking-head that only displays the head is used as a representation of the educator in the class. The use of this 3D Hologram Talking-head can affect students' emotions when receiving educational information if their comfort and emotions are disturbed, so it is important to identify this.

## II. 3D HOLOGRAM TECHNOLOGY IN EDUCATION

Holograms are currently considered the future 3D visualization technology [18]. In particular, a hologram display is created when two light sources interact and produce 3D images [19]. Another method of creating a hologram display involves combining 2D images that are reflected from a projector or computer screen onto a transparent screen to create the illusion of 3D depth [6]. Additionally, hologram techniques that can show 3D

visualizations of objects or characters in various dimensions make the presentation more engaging and capable of providing users with information in a novel way [20]. Due to the benefits concerned of using this hologram, it has found widespread use in a variety of industries, including entertainment [21], education [22], and advertising [23]. Holograms are thought to be beneficial in the field of education for grabbing students' attention, particularly younger students who are becoming decreasingly interested in conventional delivery methods [9, 20, 24].

From an academic point of view, various types of holograms are frequently used to convey educational information to students. The information to be conveyed and its appropriateness typically dictate which holograms should be used. This is because holograms are used in many areas of education, such as medicine, geography, and construction, [25] as well as to represent educators [5]. Holograms are said to have a special ability that makes the process of students receiving information more efficient in addition to their capacity to catch their attention [26]. Using holograms in the classroom is another way to get students more involved and focused. This is due to the claim that using holograms can also affect students' learning environments [24]. Therefore, it is clear that holograms have great potential to serve as an efficient teaching tool and aid students in their learning.

Following the benefits identified in the use of holograms, numerous efforts have been made to investigate the important aspects that can be used as a learning medium for students. When using a new technology tool or application, it is critical to conduct research to determine its effectiveness. Especially in terms of display design, which is said to influence students' emotions and comfort. As a result, a thorough investigation into the use of holograms as one of the most important learning methods is studied, emphasizing the principles of hologram display design that will be used to ensure its effectiveness.


Fig. 1. Hologram as teaching agent in the classroom.

As shown in Fig. 1, hologram tutors are one of the innovations that are currently being used as a representation of educators in the classroom [5–7, 9]. However, the holograms used as a representation of the educators in this class are usually present in a large size, which is the size of a real person. This causes problems with its use, such as the placement factor, the setting of teaching materials, a larger environment with less light, and the mobile factor. These existing issues become a source of concern when it comes to implementing the use of hologram tutors in general. Since holograms can be used in a variety of display sizes and

platforms that can be customized based on the environment, using holograms as a talking-head application platform can be implemented as an alternative method. Whereas the hologram tutor character display only uses a part of the character design which is only on the head, this is known as 3D Hologram Talking-head. As a result, the use of the 3D Hologram Talking-head is a new technological innovation that must be thoroughly tested for its effectiveness on students.

## III. 3D HOLOGRAM TALKING-HEAD

Since holograms are available in different sizes, they can also be used as a platform for talking-head applications. A talking-head animation character uses visuals to communicate information and can only be seen from the head to the shoulder [12]. There is also a talking-head that only shows the head, as shown in Fig. 2 [12]. The use of talking-head animation as a pedagogical agent in an interactive learning environment has a positive impact on students' emotions and motivation [27]. Furthermore, the use of talking heads as learning material is said to be capable of avoiding students' negative emotions such as fear or sadness about the subject being studied during the learning process [28]. However, nowadays, talking-head applications are only found on smartphone screens, standard computer screens, or projector screens [29]. Students' emotional impact when using a talking-head application through a hologram 3D display is considerably different from that of a hologram 3D display that is said to be in the real dimension [30].
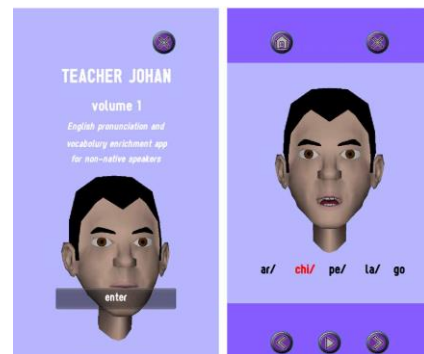

Fig. 2. Talking-head application.

According to the use of the talking-head application through a 3D hologram display, the 3D hologram talking-head is capable of displaying character designs with different levels of realism. As a result, the potential of 3D Hologram Talking-head character design that has the greatest positive effect on students' emotions must be determined. This is because a person's comfort level when using a character-based application is said to be directly related to the realistic level of the character design [31]. This level of ease has a significant emotional impact on student learning.

## IV. STUDENTS' EMOTION AND UNCANNY VALLEY

The Control-value theory of achievement emotions [32] and the Uncanny Valley [31] are the two theories that this

study draws upon for guidance.

Student achievement emotions are those felt by students both during and after learning activities [32, 33]. Emotions are divided into two main types: positive emotions and negative emotions [34, 35]. Positive emotions experienced by students can increase motivation, whereas negative emotions experienced by students can decrease motivation and cause students to avoid continuing the learning session [32]. Students' emotions are said to be able to influence their level of motivation during a learning session [36].

The Control-Value theory of achievement [37] provides an integrated framework for understanding the impact of students' emotions on academic achievement [37]. This theory emphasizes the values that are important for improving students' emotional achievement, such as excitement, frustration, and boredom, which may occur during a learning session. Furthermore, this theory investigates students' emotional outcomes associated with success or failure, such as joy, confidence, pride, fear, decision-making, humiliation, and anger [37]. Table I clearly refers to three-dimensional taxonomy of achievement emotion.

TABLE I: THE THREE-DIMENSIONAL TAXONOMY OF ACHIEVEMENT EMOTIONS BASED ON THE THEORY OF CONTROL-VALUE OF ACHIEVEMENT EMOTIONS

| Object Focus | Positive | | Negative | |
| --- | --- | --- | --- | --- |
| | Activating | Deactivating | Activating | Deactivating |
| Activity Focus | - Enjoyment | - Relaxation | -Anger -Frustration | -Boredom |
| Outcome Focus | - Joy - Hope - Pride - Gratitude | - Contentment - Relief | - Anxiety - Shame - Anger | - Sadness - Disappointment - Hopelessness |

Since success-related emotions are particularly prevalent in the academic world, it is crucial to assess and determine how the use of 3D Hologram Talking-head in the classroom will affect students' feelings. According to this theory, increasing positive emotions can boost student learning motivation. For example, using 3D Hologram Talking-head during student learning activities can elicit positive emotions in students, increasing student motivation throughout the learning session. Students, on the other hand, are likely to feel bored if the 3D Hologram Talking-head uses the incorrect character design, and this negative emotion will affect the students' motivation to stay in the learning session. Given this emotional component, a study must be conducted to determine the best character design for the 3D Hologram Talking-head display. The scope of this study is specifically focused on the dimension of positive emotional response and its impact on student learning motivation. Following that, the 3D Hologram Talking-head character design that can best increase students' positive emotions can be identified.

Currently, studies on the effects of user acceptance and emotions on character design used in video game displays [10, 11], animation [13], and real human-sized holographic tutors are being conducted [9]. There is still very little research on the effect of emotions in student learning on character design in the use of 3D Hologram Talking-head. However, research findings on the use of character design in

animation, video games, and hologram tutors indicate that different levels of realism can have a significant impact on students' emotions, especially the use of 3D cartoons and real human designs. However, since the 3D hologram Talking-head only displays on the head, the results of this study might differ from those of others.

Various 3D Hologram Talking-head character design approaches based on the Uncanny Valley phenomenon can be tested to increase positive emotions in student learning [31]. The Uncanny Valley phenomenon explains the relationship between character design realism and human comfort [31]. In the context of this study, the development of the 3D Hologram Talking-head must include the selection of a character design with an appropriate realistic level.

Fig. 3 shows the Uncanny Valley graph with two different types of character designs: static images (not moving) and dynamic images (moving). The user's level of comfort is different for each of these categories. According to the Uncanny Valley theory, mechanical characters for dynamic character design provide a level of comfort at a neutral level, but if a robot character design that resembles a human is used, the user's comfort is seen to enhance in a higher direction. Following the 3D Hologram Talking-head is a representation of the educators in the class, so the suitability of the selected character design is a character design in the dynamic category. However, dynamic character design has been shown to reduce user comfort if the character is horrifying; in fact, the level of comfort felt is lower when compared to static horrifying characters. This is imperative to highlight because the 3D Hologram Talking-head's characters are created using dynamic character design.
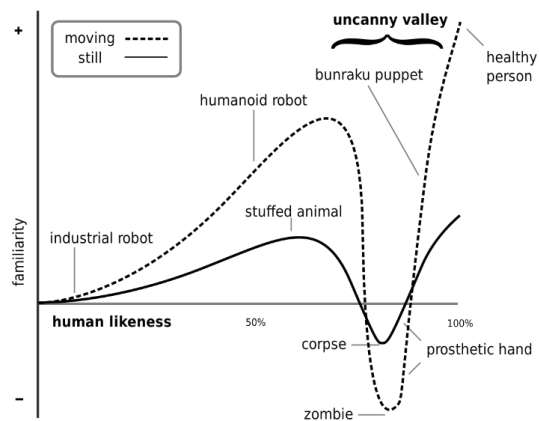


Fig. 3. Uncanny valley graph.

According to previous research on the use of character design, user comfort is said to be high if the characters used have a high level of realism [31]. A high level of character realism is also said to increase users' trust in the characters displayed [37]. However, a high level of realism is not a guarantee that the user will feel completely comfortable; it may also be able to generate a different effect, especially when the character design is presented through various applications and displays. It is assumed that using character design for the 3D Hologram Talking-head application will have a negative impact because it will only display the hologram character design on the realistic part of a human head. However, if the character's head design uses a different

level of realism, such as a 3D cartoon design or a human robot, the level of comfort may also change. Choosing the right character design for the 3D Hologram Talking-head application is crucial to preventing user discomfort, which can then have an impact on the user's emotions as a whole.

## V. CONCEPTUAL FRAMEWORK

This study proposes a conceptual framework as a guide for answering the constructed research questions based on the discussions that have been done. The 3D Hologram Talking-head will act as an independent variable in this study, and student learning emotions will act as a dependent variable.

*RQ: Does the use of 3D Hologram Talking-head character designs with different levels of realism have a significant impact on the student's emotion in learning?*
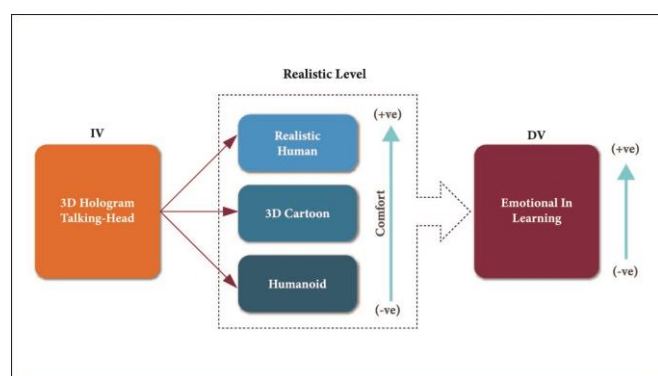


Fig. 3. Conceptual framework.

Student comfort is significantly influenced by the level of realism of the 3D Hologram Talking-head character design used as a representation of the educator in the classroom. The comfort of the student will affect the emotions in the student's learning as a whole. Positive student emotions will motivate students to stay in the learning session longer, whereas negative student emotions will demotivate students and make them avoid continuing the lesson.

In particular, the chosen 3D Hologram Talking-head character design must be sufficiently realistic to effectively enhance the student's emotions. This is because, in order for the 3D Hologram Talking-head to be used as a learning tool, it must not only be able to capture students' attention but also effectively convey educational information. Positive learning experiences will motivate students to stay in the learning session longer. Therefore, it is important to determine the emotional impact on students that use the 3D Hologram Talking-head application of this character at different levels of realism. The aim is to assist teaching materials designers in choosing the best character design for the use of 3D Hologram Talking-heads that can create better students' emotions and deliver lesson content effectively.

## VI. FUTURE WORK AND CONCLUSION

For the purpose of conducting this research, a 3D Hologram Talking-head will deliver a learning session. This 3D Hologram Talking-head instructional session will be experienced by 90 undergraduate students aged 21 from Malaysian public higher education institutions. The respondents will be split into three groups of 30 students each. Each student group will participate in a learning session with a 3D Hologram Talking-head based on the characters with different levels of realism, i.e Real Human Characters, 3D Cartoon Characters, and Human-Robot Characters. Several methods will be employed to examine the impact of emotions on student learning when utilizing 3D Hologram Talking-head. The Achievement Emotion Questionnaire (AEQ) [33] will be used to assess the emotions of students during learning. The collected data will then be analyzed using the One-Way ANOVA technique and SPSS software. The level of realism for the 3D Hologram Talking-head character to increase student emotions can be determined based on the findings of this study.

As a conclusion, the use of holograms in the learning environment has been proven to be successful in piquing students' interest and having a positive impact on them as they learn new material. As a result of the innovation that has been implemented, the hologram can be used as a platform for the 3D Hologram Talking-head application to represent classroom educators. The main aspect of character design needs to be emphasized strongly because this 3D Hologram Talking-head application only shows the character design on the head. Where inappropriate 3D Hologram Talking-head character design can stimulate negative emotions in students and impede their ability to receive information. As a result, the focus of this study will be on the effect of student comfort on character design as demonstrated by the Uncanny Valley phenomenon. To order to increase students' emotions and motivation during learning sessions, it is important to identify the realistic level of 3D Hologram Talking-head character design, as suggested in the conceptual framework that has been proposed.

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