Smart Three-Dimensional (3D) Hologram as an Innovative Teaching Tool in Virtual Learning Environment during Exigent Circumstances

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ABSTRACT
It cannot be denied that almost all aspects of human life are in gadgets. Gadgets are equipped with different types of applications that can make human activities more effective. Smart 3D hologram is one of the applications that can be downloaded and installed on a smartphone. Smart 3D Hologram is considered as the most advanced technology that gives several advantages in education such as helping teachers and students to view devices that cannot be seen in traditional teaching-learning, offering virtual teachers, and making teachers and students still connected. It also shows us the real-size object. This article intends to describe Smart 3D hologram, an innovative teaching tool for future education that can be used offline in students-parents’ smartphones in a virtual learning environment. It is hoped that smart 3D hologram can become a smart solution in facilitating students in learning during exigent circumstances.

INTRODUCTION
Gadgets have become a primary need for humans in the 21st century. Childs cannot be separated from games, people are always connected to social media such as Instagram, Facebook, Twitter, and others, the employee that used gadgets in a meeting, data sharing and management, and administrative tasks. It also can be used in instruction such as YouTube did it to us, people still communicate with each other in a different country because of gadgets, and education is can be accessed easily (Waxman, Boriack, Lee, & Macneil, 2013). It helps us to do almost all aspects of life easier and less time consumed.
Now, gadgets hold a very significant role in the world of education. It can enhance the teaching and learning process, also it can become an active, collaborative, and cooperative learning (Raja and Nagasubramani, 2018). Besides, the educational system has used gadgets because of the outbreaks of the Covid-19 pandemic. Students have used some online learning platforms in their gadgets such as Edmodo, Google Classroom, WhatsApp, Zoom Cloud Meetings, Google Meet, Ruangguru, Zenius, Facebook Messenger Desktop, and many others application (Supriyanto, 2020). It helps students to learn the materials at home.

During the Covid-19 pandemic, when we take a look overseas, they have been used their gadgets for using blended learning. Even, some countries have been yet in blended learning before the pandemic, such as Finlandia and India (Iivari, et al., 2020). Finlandia is also known as the better education system in the world is faced this situation in a well-prepared system. Finnish public-school students have learned so fast through the situation and two special’s education in India also. Alsalhi, et al., (2019) were investigated the effect of blended learning in United Emirate Arab intermediate schools, the results had a positive impact and attitude. The students’ score during blended learning implementation was good in science and the experimental group was have more good attitude. On the other hand, the use of blended learning in Tahsin education was increased students’ motivation, enthusiasm, and collaboration (Syaiful, Rahmah, and Wirani, 2019).

In Indonesia, the Ministry of Education and Culture 2020, Nadiem Anwar Makarim has instructed us to do a home-learning program during this pandemic (Maris, 2020). This program has started from the beginning of the Covid-19 pandemic. It is aimed to make learning valuable and it can be accessed easily. It means that the teaching and learning process can be done everywhere at any time. Besides, this situation was obliged students from the conventional classroom into the virtual learning environment. A virtual learning environment is a complex process that is included in three parts such as learning resources, teaching strategies, and relevant tools (Peng, Tan, & Liu, 2015). It is a condition when the teaching-learning process has been done using digital platforms such as the internet, laptop, smartphone, and others. Virtual learning is a part of E-learning. This is not a new phenomenon in education. The use of e-learning was first oriented between 1994 and 1999 (Küren & Cellatoglu, 2008). It is the effect of the use of the internet is increasing over time. Another study found that the use of a virtual learning environment can be seen in higher education in Turkey and the United Kingdom is accepted (Efijo & Tingöy, 2017). In short, a virtual learning environment can be told as the most better solution to implement in the education system that cannot be achieved in the traditional classroom (Kalansooriya, Marasinghe, and Bandara, 2015).

The program promoted by the Ministry of Education and Culture in Indonesia has made students difficult in learning. One of the problems faced during a home-learning program is lack of the device, internet connection, and unwell prepared education systems (Angdhiri, 2020). The facts have also shown that a lot of families lost their jobs and, therefore, stable income because of the Covid-19 pandemic. Also, they need to pay for mobile data so that their child could study with those applications, and it is not cheap. Moreover, students cannot sort out their subjects. Universities and schools have
changed the dates of tests and exams, and all studies have been transferred online (Newhall, 2020). The uncertainty is what scares students. In an epidemic mode, they cannot pull themselves together and just keep studying. We could look at many online applications that have been used by many schools during the study from home implementation. Also, they need to pay for mobile data so that their child could study with those applications, and it is not cheap and they need to provide it in their hard condition due to the impact of distance learning during the Covid-19 pandemic (Prabowo, 2020).

Due to the teaching and learning process in some other countries as well as in Indonesia during the pandemic, teachers need to have knowledge and skill in using an effective teaching-learning tool to maintain the educational system in their country, teachers need to prepare technological teaching tools that can be used for students at home. But we could not make sure either the parents or the students themselves can use those applications easily, or it is hard for them because perhaps some parents lack technological things (Gayatri et al., 2015). And they need to provide it in their hard condition due to the impact of distance learning during the Covid-19 pandemic (Prabowo, 2020). Moreover, UNICEFs data stated 66 % of students feel inconvenient (Kasih, 2020) and did not get to know what is being taught of their teachers in this virtual classroom (Zakaria, 2020). Students were clearly in a confused state of mind from the effect of the virtual learning environment so this is a challenge for the teachers to provide smart learning tools, which can be used by students easily, affordable for their parents, and it should make students attractive.

To overcome the problems, the smart 3D hologram can be an effective tool in education. A hologram is a product of holfography technology. It can be operated by creating three-dimensional imagery (Upadhye, 2018). Smart 3D Hologram can be used during exigent circumstances, such as disasters, pandemics, or other events that will probably happen in the future. Particularly, related to the Covid-19 pandemic that we are facing today smart 3D hologram (an innovative teaching tool) needs Because we could not imagine that we will be faced the Covid-19 pandemic so we need to prepare an innovative teaching tool such as smart 3D Hologram (Tsampa and Skolariki, 2018). Furthermore, 3D Hologram can be told as the most advance technology that gives several advantages in education such as helping teacher and students to view device that cannot be seen in traditional teaching-learning, offering virtual teacher, and making teachers and students still connected (Ramachandiran, et al., 2019). It is a technology in helping students to visualize real-life situations in the teaching-learning process and make students learn easily (Makris et al., 2019). In short, 3D Hologram is not only to visualize the objects that are being taught but also to show the virtual teacher in real-time so students could not feel bored during the classroom because they still could see their teacher.

Based on students-parents’ situation about the difficulty to access the internet during Covid-19 pandemic because of the lacks on mobile data (Harususilo, 2020) so we need to prepare 3D Hologram that can be used without any internet connection to help either students or parents to provide the teaching-learning process in their exigent circumstances. And smart 3D Hologram system will be used offline for the students. To make it available offline, the school-related should purchase the program and install it to the smartphones belong to the students or parents. Once it has been installed, the smartphone will be able to receive a notification whenever the teachers have sent their material. After that, the students will be able to see their teacher in a real-time situation.
or to stream the material or download it first so that they could watch it whenever they want. And once, they have watched it, the teachers will receive a notification as well.

The purpose of this study is to describe an innovative tool in the future education through the teaching-learning process with the use of smart 3D Hologram that will be used offline in students-parents’ smartphones in a virtual learning environment during exigent circumstances. The authors would like to know whether there is smart 3D Hologram can be accessed offline via a device such as a smartphone or not. Also, it can be an innovative teaching tool in the next Industrial Revolution (IR) 5.0. Besides, the purpose of this research is to put forward innovative ways in which holographic technologies can be used in education. Thus, this work focuses on holography and its application in education. This research intends to promote further research and development in the field of holography and its application in education because it is a virgin area to many academics, especially in Indonesia. It, therefore, needs to be explored. The advantages of creating this paper are to give brainstorming and adding persisting knowledge related to the topic that is going to discuss below.

METHODOLOGY

There have been numerous studies about the using of 3D hologram in educational field. The implementation of the 3D Hologram enhanced the on-site teaching and learning experience of the instructors as well as the learners (Ramachandiran et al., 2019). 3D Hologram technology is recognized as an effective visualization tool and its application has large potential in the field of education (Loh & Shaharuddin, 2019). Holograms now allow students to be taught by a "virtual teacher" who could be many kilometers away. 3D Hologram technology is potentially an effective teaching tool that could reinforce the learning process in the future (Ghuloum, 2010). Because of the weak signals that faced in Riau Archipelago, we need to prepare the teaching tool that can be used offline. Then, by the research dealt by Microsoft that the hologram can be used both online and offline (Smith, 2020). Also, by the research dealt by (Hamed Abbasi, 2014). They stated that not only using pyramid plates, hologram can also be displayed on a mobile device using holographic projection. It can be constructed by making a software that can be shared and accessed in phones from one source. In short, based on those previous studies, the authors have gathered an idea about Three-Dimensional (3D) Hologram as an Innovative Teaching Tool in Virtual Learning Environment that can be produced offline and can be shared by school’s system to students phone so it will effectively help students both financially and efficiency during Exigent Circumstances through the writing of this article.

RESULT AND DISCUSSION

With the use of the technological tools in education, students’ engagement and motivation have increased prominently (Francis, 2017), attending the discussion in the case of online learning (Ahern and Repman, 2014), and make learning interesting (Periathiruvadi and Rinn, 2012). Another study found that classroom demonstration with technological tools is one of the effective ways to capture students’ attention in the learning process (Ramachandiran, et al., 2019). It comes to this conclusion because students mostly enjoy audiovisual rather than only one of them.
Dennis Gabor, the father of holography, discovered the basic technology of holography in 1947 (Glover, 2016). However, the technique was not fully utilized until the 1960s, when laser technology was perfected and finally 3D Holographic Technology was created in 1962 by scientists in both the United States and the Soviet Union (Upadhye, 2018).

A hologram is known as the most advanced technology that can be used in many sectors in life. It can be used in arts and entertainment field (Kirk, 2020), business as Alibaba Company that recently did (Smith, 2020), Politic that happened in Indonesia, 2019 in the field of elections (Bhaskara, 2019), and education also (Roslan and Ahmad, 2017). It could be shown us the real object because of the transfer of some lights (Manekiya and Arulmozhivarman, 2016). Hoon Loh and Sukhaila (2019) state hologram is a visualization tool that can be referred to as a three-dimensional image and produced by holographic projection during the classroom. The way 3D Hologram operates is by creating the illusion of three-dimensional imagery (Ghuloum, 2010). It is a process in transmitting light beams become the 3D image.

There are three major types of hologram are reflection hologram, transmission hologram, and hybrid hologram in a combination of reflection and transmission hologram (Manekiya and Arulmozhivarman, 2016). The hybrid hologram can be divided into several parts such as embossed holograms, integral holograms, holographic interferometry, multichannel holograms, and computer-generated holograms. But the most famous types of holograms are reflection, transmission, and computer-generated holograms (Maziah, Barkhaya, Dayana, and Halim, 2016). Reflection hologram can be viewed as truly three-dimensional near its surface that can be seen in Figure 1, transmission hologram that depends on the laser that can be seen in Figure 2, and the computer-generated holograms that can be used for making holographic optical element that can be seen in Figure 3.

![Figure 1. Reflection Hologram](https://example.com/figure1)

(Ramachandiran et al., 2019)

![Figure 2. Transmission Hologram](https://example.com/figure2)

(Ramachandiran et al., 2019)
Figure 3. The interference on computer-generated holograms (Noghani, Tofighi, and Bahrampour, 2020).

3D Hologram is regarded as teaching agents, assistants, and exchange (Manekiya and Arulmozhivarman, 2016). It can be told as an effective teaching tool in the classroom. Besides, all of the learning styles are visual, auditory, and kinesthetic will be conceptualized ideas through their brain functions (Tsiampa and Skolariki, 2018). It is also enhanced students’ cognitive skills at primary school (Hoon Loh & Sukhaila, 2019). Moreover, teachers someday will be replaced by 3D Hologram (Ghuloum, 2010).

3D Hologram Application in Education Field have been numerous studies conducted about the application of Hologram in education. Luévano, López, Juan, and Castro (2015) stated that the combination of telepresence robot and holographic projection is used at the university level that gives students the feel of professor in the classroom. Besides, Makris et al., (2019) found that the use of hologram enables the 3D visualization in real-size dimension. It helps students for visualizing and interacting in education content. The use of 3D Hologram in medical science is helping students for learning easily as can be seen in Figure 4 as shown below

Figure 4. 3D Hologram in medical science (Ramachandiran et al., 2019)

However, the use of hologram can be told as an important factor related to the teaching environment in the comparison between video-based education and hologram-based education as shown in Figure 5 below.
Furthermore, Upadhye (2018) explains that the application of 3D Hologram in engineering education can be told as an innovative teaching tool for futuristic education. Also, Ramachandiran et al., (2019) added that the 3D Hologram application was enabled the 21st-century learners to experience the realistic content that can be shown in Figure 6 below.

Another study found that the use of 3D Hologram will be shown a positive effect and it will be enhanced students’ learning capacity and attracts their attention (Hoon, Shukhaila, and Shaharuddin, 2019). Besides, the application of 3D Hologram in Egypt’s educational theater is bound to be the next generation of effective technology (Zaghloul, 2020). It also can be used as an innovative teaching tool that helped students to visualize the learning materials (Maziah et al., 2016). According to ten studies which were published on 3D Hologram in educational context from the year 2005 to 2015, the results of the meta-analysis were presented in Table 1.

| Study                  | Field (Applications) | 3DH in Educational fields | Advantages                                                                 |
|------------------------|----------------------|---------------------------|-----------------------------------------------------------------------------|
| Vandenbosch et al. (2005) | Cardiothoracic Surgery (Dynamic 3D echocardiography) | Observing the 3D echocardiographic data sets (normal and pathological) mitral valve in hologram | As useful tool due to its applicability and use-fullness in clinical practice |
| Robin (2013)            | Medical training Neurosurgery (Pulse data on 3D image) | Explaining on planned procedure to... |... |
| Study                                      | Field (Applications)                                                                 | 3DH in Educational fields Uses                                                                 | Advantages                                                                                   |
|-------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Brain Hologram)                           |                                                                                      | increase patient satisfaction due to good operative explanation                                 |
| Romero (2015)                             | Neuroscience (Cerebellar control model CCM)                                            | Evaluation of brain models to control robotic origami arm                                        |
|                                           |                                                                                      | Precisely and fast movement of robotic arm                                                        |
| Abin (2013)                               | Business training (Advertisement)                                                    | Advertising and promotion as eye catching success                                                |
|                                           |                                                                                      | A business product gets stand out from the competitors                                           |
| Khan et al (2013)                         | Photo-Optical Instrumentation Engineering                                             | HOE-based display (as fast converging lens)                                                     |
|                                           |                                                                                      | High resolution images, relatively bright, visible under ambient indoor lighting.                 |
| Freeman (2010)                            | Pharmacology                                                                         | Display internal organ of human body about drugs movement                                         |
|                                           |                                                                                      | Help student to comprehend clearly on how drugs work and effect the human body                   |
| Aina (2010)                               | Astronautical engineering (Genx Theatre Farnborough Airshow in 2006)                  | Show and discuss about large engine which not fit into classroom                                |
|                                           |                                                                                      | Very interesting technique to view different angle of an object that needed in case of imagination |
| Jurmain et al. (2008)                     | Archeological study (Artifacts)                                                      | Projecting realistic image of artifacts                                                           |
|                                           |                                                                                      | Archeology student able to explore and analysis artifacts which expensive and rare, also can prevent damaging of original state of real artifact |
| Upadhye (2013)                            | Engineering education (Graphics and Drawing)                                          | A diagram of projection of hexagonal pyramid with isometric view                                |
|                                           |                                                                                      | Increase student understanding                                                                  |
| Monnin (2010)                             | Early childhood education (“Bugs Act as teaching assistant (stand on                  | Increase student understanding                                                                  |
From all the previous studies above, it can be concluded that the application of 3D Hologram will attract students’ attention, provided the futuristic education, increased the cognitive levels, promoted learning effectiveness at primary school levels, it can be told as an innovative teaching tool, helped students to visualize the materials that will be taught in the classroom, shown a virtual teacher, and making the teaching-learning process became effective.

Teaching can be regarded in transferring knowledge and values to students. To make it easy in making students understand the materials well, teachers need to prepare an innovative teaching tool (Upadhye, 2018). One of them is to create a hologram that can be used either by students or parents’ in their smartphones. The first design of smart hologram for teaching was conducted by (Awad and Kharbat, 2018). The visualization of smart hologram can be seen in Figure 7 below.

![Figure 7. The visualization of smart hologram (Awad and Kharbat, 2018)](image)

To make it easy in providing the smart 3D hologram, first of all, we have to select the type of hologram that will be used in creating the program on a smartphone. The hologram type that will be used is reflection hologram in the form of a pyramid. It consisted of pyramid mirrors or glasses. This pyramid mirror is installed on top of a screen. The screen shows a 3D object, and this 3D object will be reflected in the pyramid mirror. The reflected 3D object will be displayed as a Hologram which is floating in the air in front of the student. Figure 8 shows the composition of the Pyramid mirrors or glasses. Figure 9 shows how the 3D object is showing on screen and be reflected in the pyramid glasses to reach the eyes of the student.

![Figure 8. The composition of pyramid mirrors or glasses (Awad and Kharbat, 2018)](image)
To take it easy in using the smart hologram, we need to prepare the hand gesture system to control the object that can be used in a hologram. Hand gesture control is a way in controlling the object that appears in hologram by using a hand gesture. This technology depends on receiving a real-time video of moving hand than doing many processes of image analysis to detect the hand and its movements. Figure 10 is showing an example of Hand Gesture Detection.

Another holographic display that can be seen in a smartphone is in Samsung (Diaz, 2019). It is revealed that Samsung Galaxy 11 is used as the smart 3D Hologram that can be seen in Figure 11 below.

To sum it up, the possibility of using a smartphone that has been used 3D Hologram is presented. With the use of smart hologram in teaching, it will make student easy in learning the materials. It can also be used to present their virtual teacher in the real-time condition during exigent circumstances.
Implementation of 3D Smart Hologram in Schools shows how Smart 3D Hologram will be used in schools as figure out in Figure 12 below.

**Figure 12.** The process of Smart 3D Hologram Implemented in School

First of all, the school’s institution needs a hologram. After hologram has been installed in schools, the 3D hologram will be installed or downloaded in students-parents’ smartphones and finally, students can use smart 3D hologram during exigent circumstances.

**CONCLUSION**

Smart 3D Hologram is regarded as an effective solution to overcome students’ learning difficulties as well as to engage students’ motivation during the learning hours. The use of smart 3D Hologram will help teachers in transferring knowledge and skills to students. It can be used for facing the new era of the Industrial Revolution (IR) 5.0 in Indonesia. Also, it can improve students’ learning achievement. As a result, in exigent circumstances, students may still have class as usual by using smart 3D hologram with its virtual teachers.

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