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The Use of Interactive Media with 3-Dimensional Virtual Environment for Indonesian History Lesson About Indonesian Proclamation for Eleventh Grade Students

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Abstract. Previous studies have found several problems in history lesson process for students, including the lack of variety on how the lesson is taught. Which shows that there needs to be innovations or alternatives in the way history lessons can be taught to students. Meanwhile, 3D virtual environment technology has been used for various aspects of life. Previous studies have also found several benefits of 3D virtual environment and interactive media for learning. As such, the aim of this research is to examine the combined potential of interactive media with 3-dimensional virtual environment as an alternative learning tool for formal learning, and to identify design recommendations that can be used for designing such media. This research chose Indonesian history lesson about Indonesian Proclamation event for eleventh grade students as a case study because of its relevancy with Indonesian curriculum and citizens. This research uses qualitative approach that uses triangulation analysis of data collected from literature study, interview, and questionnaire. This research found that interactive media with 3D virtual environment has good potential to be used as an alternative tool/medium for formal learnings, more so for the chosen case study. This research also found various design recommendations that are categorized into method, concept, and visual recommendations.

Keywords: *3-dimensional virtual environment; history; indonesian proclamation; interactive media; learning medium.*

1 Introduction

Several previous studies have found that there are problems in history lesson process for students. A survey made by Schug, et al. in [1] found that students frequently are not positive about their social studies experience, which includes lessons about history. Some of the reasons that made the students feel uninterested or disliked the lesson includes boredom (which occurs due to too much need for memorization and lack of interest from the students), the lessons being too complicated and having no correlation with the present, and learning routines that lacks varieties and innovations [1]. In Indonesia, Komalasari in [2] also found that the teaching methods that are being used are causing students to

not have interest in learning history, which mainly happens because the way the teachers deliver and explain the lesson materials is not easy to be understood by the students. The teaching process that makes students less interested includes too much monologue by the teachers, too many note-writings and summarizing activity, and too many assignments given to students [2]. From the reasons above, it is clear that there needs to be an innovation in how history lessons can be taught to students in order to increase students' interest in history lessons.

Meanwhile, 3D virtual environment technology in the form of video games, virtual reality, and augmented reality is a technology that have been used for various aspects of life. Such as for communications (through application like VRChat); entertainment (in the form of video games like World of Warcraft); as a virtual sets for film and TV series (like the use of "the Volume" for Mandalorian 2019); and as a simulation for technical work, which includes training medical professions, like the one found in Wiecha et al. in [3] and Al-Hiyari & Jusoh in [4], as a training method for using forklift, by Neira-Tovar et al. in [5], and as a method to aid in rehabilitation for the blind, by Villane & Sanches in [6]. Not only that, research have also been conducted about the use of virtual environment as a tool for aiding non-formal learning, such as for learning the German language by Berns et al. in [7], in civil engineering education by Wang et al. in [8], and in teaching fire-safety skills for children by Smith & Ericson in [9].

A study by Tversky et al. in [10] also found that appropriate and carefully designed graphics (a form of visual) can be beneficial for conveying complex systems. The same study also stated that judicious use of interactivity can be the key to overcome the disadvantage that can be found in the use of animation (a media with moving visuals) for communicating information and concepts. A study by Merchant et al. in [11] also found that that interactive media with 3D virtual environment such as games, simulations, and virtual worlds are effective in improving learning outcome gains. Dalgarno & Lee in [12] also found 5 learning affordances of 3D virtual environment. Which includes the ability to facilitate learning task that can assist in developing spatial knowledge of a real environment, greater opportunity of experiential learning (facilitate experiential learnings that would be impractical or impossible to do in the real world), increased motivation and engagement of students, improved contextualization of learning, and give more effective collaborative learning experience compared to its 2D alternatives. Munir in [13] also found several benefits of using multimedia for learning: its capabilities to visualize complex material, to explain abstract concept, to provide a real and direct experience to students, to give students the ability to study lesson materials repeatedly, to attract students' attention and increase their motivation, and to overcome the limitations of space, time, and energy. In this research, the case study of lesson about the event of Indonesian Proclamation is chosen because the event itself is an event that is included in

Indonesian school curriculum for eleventh grade students, and is also a monumental event about the creation of Indonesia as a country that is relevant and generally needs to be known by Indonesian citizens.

There have been previous studies that have discussed about the problems of history lessons done by Schug et al. in [1], Komalasari in [2], and Haydn & Harris in [14]; about the benefits of 3D virtual environment for learning done by Tversky et al. in [10], Merchant et al. in [11], Checa & Bustillo in [15], Wrzesien & Raya in [16], and Dalgarno & Lee in [12]; about the benefits of interactive media for learning done by Munir in [13], and Hoogeven in [17]; about the methods that can be used to design interactive media for learning such as the studies by Bork in [18], Luther in [19], Munir in [13], and Sutopo in [20]; and about the methods that can be used to create 3D environment for historical locations by Checa & Bustillo in [15] and Rua & Alvita in [21]. However, no previous studies have been found that specifically examines the potential of the use of 3D virtual environment in the form interactive media as an alternative medium/tool for formal learning, especially for history lessons about the event of Indonesian Proclamation for eleventh grade students. Nor has there been a study that combines the potential of interactive media with 3D virtual environment and the methods that can be used to design such media.

The novelty of this research is to find the combined potential of both 3D virtual environment and interactive media as an alternative learning tool for history lesson, specifically about the event of Indonesian Proclamation for eleventh grade high school students. This research also aims to find design recommendations that can be used for designing an interactive media with 3D virtual environment for lesson about Indonesian Proclamation for eleventh grade students.

2 Method

This research uses qualitative approach that uses triangulation analysis of data collected from literature study, interview, and questionnaire about the problem of history lessons for eleventh grade students, the history lesson about the event of Indonesian Proclamation, about interactive media with 3D virtual environment, and the methods, techniques, or procedures to create interactive media with 3D virtual environment for formal learning. The questionnaire that was given to eleventh grade high school students was conducted for 32 days and received 110 respondents from 7 different schools. The main purpose of the questionnaire was to find primary data about the characteristics of eleventh grade students that corresponds with their computer usage, their familiarity with interactive media and virtual environment, their opinion of history lessons, and their knowledge and opinion of history lesson about the Indonesian Proclamation event. While the interview was conducted with 2 instructional designers to specifically discuss

about the methods that can be used to design interactive media with 3D virtual environment for formal learning. All of this process is done to find the potential of virtual environment with 3D virtual environment as an alternative tool for history lesson about Indonesian Proclamation for 11th grade students, and to find design recommendations that can be used as a reference to design such media.

3 Result and Discussion

3.1 History Lesson About the Event of Indonesian Proclamation

In the curriculum that are currently being used in high school lessons in the time of this research, "*Kurikulum 2013*" or Indonesian 2013 Curriculum, the lesson about the event of Indonesian Proclamation can be found in *kompetensi dasar* (fundamental competencies) number 3.7, 3.9, 4.7, and 4.9. Which can be seen in Table 1.

Table 1 Fundamental competencies about Indonesian Proclamation event.

Fundamental Competencies 3 (knowledge)	Fundamental Competencies 4 (skills)
3.7 to analyze the event of the proclamation of independence and its meaning for the social, cultural, economic, political, and educational aspect of the Indonesian society	4.7 to reason about the event of the proclamation of independence and their meaning for the social, cultural, economic, political and educational aspect of the Indonesian Society and presenting them in the form of historical stories
3.8 to analyze the role and values of the struggle of Bung Karno and Bung Hatta as proclaimer and other figures around the (Indonesian) proclamation	4.9 to write down the roles and values of the struggle of Bung Karno and Bung Hatta and other figures around the (Indonesian) proclamation

Based on the questionnaire, the information about Indonesian Proclamation event that are remembered the most by the respondent of the questionnaire (eleventh grade students) are the event of the kidnapping of Soekarno and Moh. Hatta to Rengasdengklok, the proclamation by Soekarno (along with the place and time), the differences between the old and young figures about how the proclamation should be done, the bombing of Hiroshima and Nagasaki that helped trigger the proclamation event, and the creation of the Indonesian Proclamation text. With few mentioning about Admiral Maeda's house, and none mentioning about the names of the youth figures that are involved in the event. Out of all of the respondent, it was found that 56% of students feel that they understand, 43% feel that they understand a little, while only 5% of student feel that they don't understand the lessons about the Indonesian Proclamation event.

3.2 The Problem of History Lesson for Eleventh Grade Students

Apart from the problems that has been mentioned in the introduction, Haydn & Harris in [14] also found that many students thinks that history lessons is not relevant, and some students does not know the importance of history lessons in school. Schug, et al. in [1] also found that some of the reasons that made the students like their favorite subjects are because they provide more opportunities for activities, and have greater variety of instructions on how the lessons are being taught and learned. Such as learning through experience by doing activities, by doing problem solving, and by creating something (like writing).

The questionnaire found that one of the main problems that students find about history lesson are the lack of visual elements that can help students imagine historical events that is being studied; teacher's way of teaching that feels boring/monotonous with too many one sided monologue; the explanation being delivered too fast that students don't have time to take notes and understand it; learning materials that are too complex with lots of details to remember; and the lack of learning hours provided in schools to discuss history lessons in a detailed and slow manner. These findings are in accordance with what is being discussed by Schug et al. in [1] and Komalasari in [2], which both discussed the reasons that makes a lesson becomes less interesting. It is also found that the teacher's way of teaching may differ from school to school; some teachers give too much homework, while others do not give enough homework. Also note that some students mentioned that the teacher in their school gives history lessons in a fun and creative manner.

Overall, the main problem with history lessons is the lack of variety in teaching method, the lack of activity and involvement of students in how the lessons is taught, the communication, and the lack of learning hours in school. The aspects of history that is hard to remember, according to the questionnaire, consecutively are when an event happened (34%), how an event happened (28%), why an event happened (18%), who were involved in the event (11%), and where an event happened (4%). The questionnaire also found that the activity that the students do the most to help them understand history lessons are paying attention to the teachers in class (39% of students), rewriting learning materials by making their own notes (36%), reading textbook independently (13%), doing assignments (7%), watching videos or animation related to history (3%), reading other historical books (1%), and conducting study sessions with friends (1%).

3.3 The Potential of Interactive Media with 3-Dimensional Virtual Environment for Formal Learning

Ellis in [22] define virtual environment as interactive, virtual image displays that is enhanced by special processing and by nonvisual modalities, like auditory and haptic, to convince users that they are immersed in a synthetic space. It can also be described as a form of human-computer interaction (HCI) that consists of computer-generated visual and audio simulation of 3-dimensional space, from Kien in [23]. What separates virtual environment from other form of HCI is interactivity, which is perceivable as engagement, immersion, or presence, Kien in [23]. Previous studies have also proven the benefits and the potential of 3D virtual environment for learning. Which includes the potential use of appropriate and carefully designed graphics that is proven to be beneficial in conveying complex systems [10]; the potential of judicious use of interactivity for communicating information and concepts [10]; the ability of 3D virtual environment to facilitate learning task that can assist in developing spatial knowledge of a real environment [12][14]; greater opportunity of risk-free experiential learning (to facilitate experiential learnings that would be impractical, dangerous, or impossible to do in the real world) [12][25]; increased motivation, engagement, enjoyment, creativity, and interest of students [12][15][22][25]; improved contextualization of learning (learning skills that can be transferred to the real world) [12]; richer/more effective collaborative learning experience compared to its 2D alternatives [12]; the ability to explain abstract concept through visual [24][25]; the ability to create alternative classroom [25]; and a study by Merchant et al. in [11] that have proven that 3D virtual environments are effective for improving learning outcome gains, and for teaching overall, in K-12 and higher education.

Based on Munir in [13], Vaughan in [26], dan Phillips in [27], interactive media can be defined as a media that use more than one medium (audio and visual) at once to fulfill its function of informing messages and creating interactivity between the user and the media, with the help of interactive element that can be controlled and navigated by the user, so that the media is more meaningful and more satisfying for the user. According to Munir in [13], several benefits and potentials of interactive media for learning includes its capabilities to visualize material that is difficult to explain via conventional methods, to explain abstract concepts and objects in learning materials, to provide a real and direct experience to students, to give the students the ability to study lesson materials repeatedly, to attract students' attention and increase their motivation, and to overcome the limitations of space, time, and energy. Hoogeveen in [17] also found the use of 3-dimensional element in interactive media can increase memorization of a subject by 60%.

The questionnaire that was conducted by the author also found that students are already familiar and are used to using computer and using interactive media in the form of video games, where it was found that 45% of students are using computer more than 4 hours daily, 46% used 1-4 hours daily, and 9% used less than 1 hour daily. While it was found that 55% of students play computer games daily, ranging from 1 hour, 1-2 hours, 3-6 hours, and even more than 6 hours depending on whether there is school on that day. With 49% of students feel neutral but play it, 30% like it and play it regularly, 16% feel neutral and doesn't play it, and 5% is against playing video games. It was also found that students are already familiar with topics about virtual environment (37% are familiar, 43% have heard, 20% are not familiar), and familiar with the term interactive media (49% are familiar, 38% have heard, 13% are not familiar). It was also found that 55% of students have studied using interactive media in various forms (websites, applications, and video games). When asked about their opinion about using interactive media like video game for history lessons, 72% of students are interested, 20% of students strongly think that using interactive media can help them understand history lesson, 78% think that it has the potential to help them, while only 2% think that it will be counter-productive.

As a whole, interactive media with 3D virtual environment have the potential to solve the problems of history lessons, such as the boredom of students through innovating and/or disrupting the routine of the teaching process of history lessons, and can help with students' process of understanding with the use of visual [10], interactive elements [10][12], and the freedom of learning within 3D virtual environment [12]. From all of the reasons above, it can be concluded that interactive media with 3D virtual environment have a good potential to be used as an alternative tool or medium for formal learnings, more so for history lessons about Indonesian Proclamation event for eleventh grade Indonesian students.

3.4 The Method of Designing Interactive Media with 3-Dimensional Virtual Environment for Formal Learning

According to Merchant et al. in [11], to create an interactive media with 3D virtual environment for formal learning, the designer needs to use instructional design principle or at least involve at least one instructional designer in the design process. Based on various software and multimedia development methods for learning that have been developed by Bork in [18], Gery in [29], Hartemink in [30], Zaman and Munir in [31], Luther in [19], and Sutopo in [20], and the method of reconstructing a real location into a virtual environment that has been developed by Rua & Alvita in [21] and Checa & Bustillo in [15], the method of designing interactive media with 3D virtual environment for learning purposes include 6 main stages which includes the following stages: (1) Concept creation and analysis; the stage to determine media objectives, to identify users, and to

analyze what is needed to develop the multimedia, which is all carried out on the basis of instructional design and school's curriculum; (2) Pre-production design phase; the pre-production stage that includes creating concepts, scripts, and/or storyboards in order to identify the required materials and resources that need to be collected; (3) Material collecting phase; the process of collecting materials and resources such as photos, videos and audios that will be used on the production stage; (4) Main-production and development phase; the stage of producing the media; creating 3d models, programming the interactive media in a game engine, etc.; (5) The testing, assessment, or evaluation phase of the prototype that has been designed. Based on the research by Rua & Alvita in [21] and Checa & Bustillo in [15], where each of them reconstructed a historical place in 3-dimensional environment, the method of creating a 3-dimensional virtual environment based on a real location or of a history include 4 main steps. The 4 main steps are location data surveys, 3-dimensional asset modeling, texture creation and implementation, and importing the 3D assets into a game engine.

Based on the author's interview with 2 instructional designers, it was found that before creating the concept of the media interactive for formal learning, it is important for the designer to analyze the curriculum that are used in the school to turn it into narrative, visual, and interactive elements that can be implemented into the interactive media with 3D virtual environment. The interview also produces a table that can be used for the process of analyzing curriculum, as shown in Table 2. As seen in the table, the designer of the interactive media for formal learning first have to try to create a new learning indicator based on the curriculum made by the government to optimize the use of narrative, visual, and interactive elements in interactive media with 3D virtual environments. In creating the learning indicator, the designer can use previous learning indicators that have been made by teachers as a reference. From there, the designer can list all of the key knowledge or necessary information that have to be taught to students through the lessons. While trying to list this information, the designer can use the textbooks that had been approved by the government as one of the primary sources of information, as the amount of information in those books are already approved by the government. Specifically for history lessons, from the list of information that have to be taught, the designer can then identify the information and categorize it into dates and times, locations, and characters (historical person). At this point of the process, the designer can also breakdown the information into separate game-levels if needed. Then after all of that have been listed, the designer then can create the narrative or the story that the students can follow along; the missions or objective that serves as learning incentives for students; and identify the interactive elements that can be interacted by students. Apart from the methods that have been discussed, there are also things that an interactive media designer must pay attention to while making such media for learning, which will be discussed directly as design recommendations.

Table 2 Model for the process of analyzing curriculum to create learning indicators, visual, narrative, and interactive elements for interactive media with 3D virtual environment for formal learning.

Fundamental competencies (KD)	Learning Indicator	Key Knowledge/ Core Information	Level/ Settings/ Characters	Main Storyline/ Narrative	Interactive and Visual elements
Fundamental Competencies from the school curriculum that is used in the states or country about the topic	Learning Indicator created by the designer to maximize the use of the elements within interactive media	The list of all the information that have to be taught to students about the topic	Breakdown of the level settings and designs, and also all of the characters that needs to be included in the level	The storyline or narrative created by the designer that is made according to the core information	Breakdown of noteworthy visual elements and interactive element like missions & clickable object

4 Design Recommendation

Based on the results and discussions, various design recommendations for interactive media with 3D virtual environment as an alternative learning tool for history lessons about Indonesian Proclamation was identified. The recommendations that have been identified can be categorized into three main recommendations categories. The three main categories are design method, design concept, and design visual recommendations. (Note: not all of the design recommendations have been explained in previous chapters, and are explained directly in this chapter)

4.1 Design Method Recommendations

The various recommendations that are related to the method or technique of designing the interactive media are as follows.

1. Instructional design principles need to be considered when designing virtual reality-based instructional learning media, Merchant et al. in [11].
2. In designing the concept of interactive media as learning media, instructional designer needs to make diagnosis on the part of the curriculum content (from the chosen learning topics) that should be touched by multimedia. As well as determining what learning objectives will be achieved and how they compare with conventional learning formats, Tropin in [13]. Before designing the design concept, the designer also needs to process the school curriculum into narrative, visual, and interactive elements.
3. While choosing the technology to be used for interactive media-based learning, the designer must pay attention to how users use and learn the navigation system, how program elements and interactivity are integrated,

the rules and roles of learning facilitator (such as the school and the teacher), the form of practice questions, technical support, and administration relating to learning using the designed interactive media, Tropin in [13].

4. In designing interactive media, the designer need to pay attention to 6 criteria in evaluating interactive media which includes ease of navigation (the multimedia used must be designed as simple as possible so that it is easy for students to use); cognition content (the designed multimedia has clear knowledge content); information presentation; media integration (the media must integrate aspects of knowledge and skills); artistic and aesthetic aspects (multimedia has a good appearance and aesthetics to attract students' interest); and function as a whole (the multimedia developed must provide the learning desired by the learning participants), Thorne [28] in Munir [13].
5. In designing interactive media with 3D virtual environment for learning, designer can use interactive multimedia development methods which are a combination of various software and multimedia development methods for learning, and the methods of reconstructing real-life location into 3D virtual environment. The multimedia development method includes the following stages: Concept creation and analysis based on instructional design and school curriculum, pre-production design phase that also identify materials that needs to be collected, material collecting phase, main-production and development phase, and testing and evaluation phase.
6. The process of reconstructing historical location to virtual environment can be divided into 4 main stages. Namely location data surveys, 3-dimensional asset modeling, texture creation and implementation, and importing them into a game engine.
7. In the production stage of reconstructing the location of the Indonesian Proclamation event, or any other historical locations, into a 3D virtual environment, designers need to collect and use primary documentation as the main reference for making the 3D assets.

4.2 Design Concept Recommendations

The recommendations that are related to the interactive and narrative concept of the interactive media are as follows.

1. The design concept must encourage learning by experience, or the cycles of experiential learning theory. A learning theory by Kolb in [32] which is based on students' ability to engage in direct learning experience which includes a cycle of 4 sequence of events: a concrete experience (with elements of interactivity), reflective observation and abstract conceptualization (with the help of visual elements), and active experiences (supported by virtual environment that students can explore, and incentives or responsibilities in the form of missions that students must do). The design concept of the

interactive media must also encourage students to be able to do problem solving, and to create something based on the topic they are studying [1].

2. Interactive media that are designed must emphasize interactivity elements and multimedia elements (visual and audio) in order to increase the level of engagement, immersion level, and level of presence of the user, Kien in [23].
3. In order for an interactive media to give knowledge or information to the users, based on the model by Sundar et al. in [33], the designed interactive media needs to add buttons or features that can encourage action from the user, or increase the sense of agency (the ability of users to control their actions and also be affected by the consequences of these actions) to users, so that they can increase the level of engagement (user engagement).
4. It must have elements of storytelling and visual narratives that are interesting to students, while consisting of all of the information that needs to be taught.
5. Interactive media for learning should be single-player, so that users play individually. Because playing individually produced higher performance than in groups, Merchant et al., in [11]. The designed interactive media must also be able to be used independently by students, so that it can overcome the problem of the lack of learning hours of Indonesian History lessons in school.
6. In creating interactive multimedia concepts that will be designed at the pre-production stage, designers need to create their own learning indicators based on the school curriculum that is used for the chosen learning topic, the learning indicators and lesson plans that have been made previously, and from textbooks that have been approved by the government. Learning indicators need to be made to maximize the use of interactivity elements in the designed media. The learning indicators that have been made by the designer will be used as a benchmark for the development of the visual, narrative, and interactivity of the designed interactive multimedia.
7. Based on the questionnaire, in creating the concept, it should be noted that students still feel dependent on textbooks. So, it can be said that in the learning process, textbooks are still needed to be given or owned by students.
8. In creating the narrative concept, designers need to distinguish between core information or key knowledge, and optional information or opinions, especially information found from textbooks. Key knowledge needs to be presented in the media directly and explicitly so that it won't be missed by students like through the use of audio narration, while additional knowledge/information can be conveyed through visuals in the form of 3D assets or as an optional interactive element, and spatial knowledge can be conveyed by encouraging users to explore virtual environments [15].
9. To ensure that the indicators and concepts fulfill all of the points contained in the school curriculum, designer of the interactive media needs to conduct interview or focus group discussion with instructional designer.

10. If the topic of the designed interactive media is related to history, the story elements of the designed interactive media must be linear, not a branching story. So interactive element must come from other aspects besides story.
11. In describing aspects of information regarding the events of the Indonesian Proclamation, or any other history lesson topics, designers can prioritize them in the order of importance. Which are as follows: (1) How it happened, (2) why it happened, (3) when it happened, (4) who are involved (historical figures), (5) where it happened.
12. Based on the questionnaire with eleventh grade students, the designed interactive media with 3D virtual elements that is most suitable for history lessons for eleventh grade can be in the form of a video game with a concept where players play as a third person who sees all of the events that is unfold, and is tasked with mission elements that encourage players to explore and search for information independently.

Some recommendations that are related to the concept of interactive media with 3D virtual environment specific for history lesson about the event of Indonesia Proclamation are as follows..

1. Of all the fundamental competencies (KI) related to the Indonesian Proclamation Event in Indonesian 2013 Curriculum, an interactive media about the event of Indonesian Proclamation can focus on the fundamental competencies number 3.7.
2. In the designed interactive media, the designer can prioritize on making exploration elements for the event of Soekarno and Moh. Hatta kidnapping to Rengasdengklok, the impact of the Indonesian Proclamation, the event where the youth figures found out about Japan's surrender in WWII, the event of the creation of the Indonesian proclamation text, and the creation of the first Indonesian flag. As well as some information that students often forget. Such as the information about what happened at Admiral Maeda's house, the information about the "Rengasdengklok house", and about the Indonesian historical youth figures that are involved.

4.3 Design Visual Recommendations

The recommendations that are related to the visual concept of the interactive media are as follows.

1. Based on the result of the questionnaire, the suitable visual style to be used in the interactive media with 3D virtual environment for history lesson is a realistic visual style. A visual style where all of the objects, characters, and settings in the 3D virtual environment are made as closely as possible to resemble the real-life counterpart.

2. While designing and producing the interactive media, the designer of the interactive media must pay attention to the hardware requirement/hardware demand of the media that they are designing. So that all the users (students and teachers) with average computer specifications can easily open and use the interactive media with decent performance in the learning process. Because the questionnaire found that the majority of students feel like they can run realistic visual with low FPS (frame per second).

5 Conclusion

Based on the results of the literature analysis, questionnaires, and interview, it can be concluded that interactive media with 3D virtual environment has good potential to be used as an alternative learning tool/medium for formal learning, more so for history lesson about Indonesian Proclamation event for eleventh grade Indonesian high school students. With some of the reasons being its ability to help visualize abstract and complex information, to increase students' motivation and interests, to have risk-free and impractical lessons, and proven benefit of increasing learning outcome for K-12 and higher education. This research has also identified various design recommendations for interactive media with 3D virtual environments that can be used as a reference for further research and implementations. The design recommendations that have been identified can be categorized into 3 categories, which are method, concept, and visual recommendations.

The questionnaire also found that eleventh grade students overall hoped that interactive media with 3D virtual environment for history lesson about the event of Indonesian Proclamation will be interesting, contains good storytelling and visual elements, can help students in learning and understanding history lessons, and can make history lessons fun and interesting. The author of this research hope that the results of this research can provide insights regarding the use of interactive media with 3D virtual environment for formal learning, and be used as a reference for designing interactive media with 3D virtual environment for formal learning; to increase the number of interactive media that can be used for curriculum and instructional based formal learning in (Indonesian) school.

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