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Development of Three-Dimensional Virtual Reality Technology for Learning Languages in Pencak Silat Curriculum

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Abstract
The objectives of this study were to determine the development process of three-dimensional Virtual Reality (3-D VR) model design and its application for learning languages in junior high schools undertaking training in *Pencak silat*, the Indonesian traditional martial art. This study adopted the R&D research design, with data collected from 30 respondents of class VII of State Junior High School 2 Tasikmalaya City. The 3-D VR assessment was done through a questionnaire validated by media and physical education subjects. The procedure included an assessment of software and hardware application in the 3-D VR application, and it's integrated with the curriculum using modules related to the rules that exist in scientific learning. The findings suggested that virtual reality display (audio visual) could be utilized for language learning. It was also evident that the development of 3-D VR technology for junior high school physical education subjects, especially in the implementation of learning activities with the scientific approach method, can meet the language learning needs of students' by influencing their cognitive and affective skills and keep students from understanding abstract and complex things.

Keywords: Virtual Reality, Technology, Learning, Movement Art, Curriculum.

Introduction

Three dimensional (3-D) Virtual reality (VR) is known to provide interactive experiences and help students enhance their language skills (Alizadeh, 2019). Owing to its interactive nature, 3-D VR is popular in several language learning programs. For instance, a program like *FluentU* allows students to watch authentic language learning videos through like movie clips, news segments and vlogs, most of which are interactive and bearing subtitles (Berns, 2021). Another advantage of VR is that it helps learn language skills without the intimidation factor, wherein the foreign students can interact with native speakers and practice the target language. In other words, VR facilitates to simulate real life in language learning, preparing learners to encounter real life speaking scenarios. The reason why VR language programs focus more on real-life contexts is because it wishes to prepare the language learners for even abstract scenarios, hence a functional knowledge through interactive modes proves useful and easily applicable (Lin & Lan, 2015).

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Language Learning methods assisted by the VR platforms are scientific, contextual, problem-based, project-based, and have cooperative and communicative learning approaches (Luo, Li, Feng, Yang, & Zuo, 2021). However, based on the reality on the ground, many teachers complain about VR based curriculum as they find it difficult to implement appropriate learning methods. Additionally, such VR assisted language learning programs based on new curriculum use scientific approaches through contextual and constructivist learning, involving five learning experiences, namely observing, asking questions, gathering information, associating, and communicating. The learning models formulated in the new curriculum include discovery/inquiry learning, project based learning where students produce problem-solving-based work, and collaborative learning (Nsor-Ambala, 2022). The problem that arises is how far from the concepts of the learning model have been implemented in the field.

To overcome these problems, the current study aimed to develop a Virtual Reality application (Azuma, 2019). This research was conducted as an effort to help teachers understand learning methods and approaches to implement the 2013 Curriculum which includes scientific methods, project-based learning, and problem-based learning enriched with cooperative learning and learning with a communicative approach through Virtual Reality technology. These lessons are student-centered learning by active learning to acquire knowledge, skills, and attitudes.

Teaching language learning programs in physical education domain gets more challenging with teaching materials requiring accuracy in displaying skilled movements, particularly in learning the art of *pencak silat*, a kind of martial arts that must be taught to students through a VR assisted language, as most of the lexical terms are jargons that need to be practiced by students prior to learning the martial art. *Pencak silat* is a traditional martial art native to Indonesia. demand by many people, especially the people of Indonesia. In *pencak silat*, there are sections that deal with mental-spiritual aspects of martial arts, particularly in sports (Irianto & Lumintuarso, 2020).

Pencak silat, apart from being an activity to maintain physical fitness, is also a kind of sport, included at the National Sports Week (PON-VIII) in 1975 as well as one of the events in the Southeast Asian Games since 1987. Besides the parent organization, Indonesian *Pencak silat* Association (IPSI), there are several martial arts federations in various countries that have association of *Pencak silat.* On December 13, 2019, *pencak silat* was designated as an Intangible Cultural World Heritage by UNESCO. *Pencak silat* at school levels requires accuracy and flexibility of movement because it requires repetition of every movement systematically, for that visual media is needed along with clear instructions in a language that students understand and are better able to repeat aspects of basic movements. With the limited ability of physical education teachers in teaching basic movements, a solution was needed. Thus, the current study aimed to find a solution that can help design learning media that can replace the role of the original teaching aids. The learning media must also be able to carry out the simulation process in the basic movements of *pencak silat.* It was also aimed that with this media, mistakes made by students during the process of basic *pencak silat* movements will not have an impact on the damage to the display components. Hence, the technology that could produce such learning media was virtual reality (VR) model.

Literature Review

Virtual reality is a technology that can make users enter the virtual world and interact in it, because virtual reality is a computer-based technology that combines special input and output devices so that users can interact deeply with the virtual environment as if they were in the real world (Luo et al., 2021). Virtual reality is a technology that allows users to interact with the virtual world environment, so that users feel like they are in that environment (Gupta & Cantt, 2014; Parmaxi, 2020). The main advantage of virtual reality is an experience that makes users feel the sensation of the real world in the virtual world (Chandel & Chauhan, 2014). These studies opine that with virtual reality we are taken to another learning dimension where the depiction of the situation resembles the original purpose of learning. Language learning media, in such a case, based on virtual reality, can be used by students anytime and anywhere, so that students can learn a language without being limited by space and time. The media is used repeatedly and will diversity to all language skills including grammar and vocabulary because it sees lexical items of a language as visual objects.

There is no dearth of research on the implementation of virtual reality technology as a learning medium in learning languages (Alizadeh, 2019; Berns, 2021; Chen, Hung, & Yeh, 2021; Evers & Nijholt, 2000; Lin & Lan, 2015; Parmaxi, 2020; Yang, Lo, Hsieh, & Wu, 2020). Each of these studies unanimously agree that virtual reality application in an online learning environment can help students acquire language through an interactive learning environment and through self-directed learning, which is mostly self-initiated, self-planned and self-regulated (Knowles, 1975; Zimmerman, 2000) also defines it is as "a process by which learners direct and coordinate their efforts, thoughts, and feelings in order to achieve their learning goals" (p. 15). Such self –directed learning becomes interactive when 3-D virtual reality technology-based instruction are used (Lin & Lan, 2015; Parmaxi, 2020).

One of the reasons why technology has been accepted as an integral part language learning environment is its flexibility and ease to provide personalized language instruction (Lin & Lan, 2015). Alizadeh (2019)

asserts that VR enables learners to choose lessons and adapt them to their needs. In this way, it opens many communication channels enabling students to learn a language in its actual form. According to Chen et al. (2021) virtual reality offers learners a supportive learning environment, offering them ample opportunity of interaction and self-expression.

There are studies that highlight the importance of integration of technology (Gokcearslan, 2017); using behavioral support and enhancing confidence through technological resources for language learning (Lai, 2015); believing that VR technology imparts confidence in students (Geng, Law, & Niu, 2019); and make them more interactive and autonomous (Demir & Yurdugül, 2013; Tawafak, Romli, bin Abdullah Arshah, & Almaroof, 2018). Other studies have shared the concern about VR technology integration is not sufficient since there are pedagogical implications as well in VR assisted language learning (Yilmaz, Yilmaz, & Ezin, 2018). Lai and Gu (2011) also found out that the technology can be successfully integrated with language learning only if there is a compatibility of its use.

The Luther-Sutopo version of the Multimedia Development Life Cycle (MDLC) is primarily recommended in VR language learning environment. The MDLC consists of six stages, namely: (1) Concept, which is the stage to determine the purpose and who the program users are (audience identification). In addition, it determines the type of application (presentation, interactive, etc.) and the purpose of the application (entertainment, training, learning, etc.). (2) Design, is the stage of making specifications regarding the program architecture, style, appearance and material/material requirements for the program. (3) Material Collecting is the stage where the collection of materials that meet the needs is carried out. This stage can be done in parallel with the assembly stage. In some cases, the Material Collecting stage and the Assembly stage will be carried out in a non-parallel linear manner. (4) Assembly (making) is the stage where all objects or multimedia materials are made. Application development is based on the design stage. (5) Testing, carried out after completing the assembly stage by running the application or program and seeing whether there are errors or not. This stage is also known as the alpha testing stage where testing is carried out by the maker or the maker's own environment; and (6) Distribution stage where the application is stored in a storage medium. At this stage if the storage media is not sufficient to accommodate the application, then it is done

A 4-D model was adapted for the study based on MDLC, which comprised four stages, namely define, design, develop, and disseminate. The first stage is the definition stage which contains the steps of background analysis and problem identification. The second stage is the design stage, which is designing the initial form of the learning media sketch. The third stage is development stage, which is an activity to create learning media. In making learning media the author uses the Luther-Sutopo media development model. The fourth stage is the dissemination stage which is carried out to promote product development so that it can be accepted by users.

Based on the exposure and the results of previous research and premises of 3D Models, the current study explored and examined the possibility of developing and modelling upon a learning media to enhance language learning skills in a three-dimensional virtual reality environment. The objective of this research was therefore to determine the process, design, application and results of developing three-dimensional virtual reality as a reinforcement and support for language learning methods in junior high schools for the implementation of the 2013 curriculum. However, the real objective was to devise a support method for learning basic movements of *pencak silat* that could meet the valid, practical, and effective criteria of language learning.

Method

- *Research design*

The Research and Development (R&D) was the research design adapted for this study as it aimed to test the effectiveness of new products (Gustiani, 2019), particularly when a three-dimensional Virtual Reality Technology is used as a reinforcement and support for learning methods in schools for the Implementation of the 2013 Curriculum. The model created by Gustiani (2019) basically consisted of two main objectives, namely: (1) developing a product, (2) testing the effectiveness of the product in achieving its goals. The first goal leads to the development of a product and the second goal leads to validation. Through adaptation of various studies, the development prototype used in this study was obtained.

- *Sampling*

The study conducted individual trials (one to one) at Junior High School on 2 Tasikmalaya City involving 5 students as a test subject for physical education subjects. These subjects were sampled as they were skilled in the basic movements of *pencak silat* and understood the linguistic jargon of the art. On a larger scale, based on the results of the pilot group, field trials were conducted involving 30 students as test subjects.

- *Data collection instrument and research procedure*

The data was obtained from needs analysis instruments comprising needs analysis sheets and material expert sheets validated by media and visual communication experts. The techniques used in data collection were observation, interviews and questionnaires. The questionnaire was used to collect data on participants' responses about virtual reality application. There was also a learning outcome test that tested the appropriateness of the

three-dimensional virtual reality application to learn languages. The three-dimensional virtual reality technology approach is prepared with the intention of presenting virtual and simulated key information about these methods and approaches so that teachers have an adequate understanding and can then present active learning according to the demands of 2013 curriculum implementation. The three-dimensional virtual reality-based learning media was tested for product validity, product practicality, and product effectiveness. These tests were carried out by distributing questionnaires to respondents highlighting the components of the curriculum, which many of the physical education teachers did not know about.

- *Data analysis*

At each stage of research, an analysis was carried out in accordance with the aims and objectives of this study. In general, the analysis used in this study was a descriptive analysis that described the results of development, validator responses, results of one-to-one trials, and the interaction of small and expanded groups. The data was also analyzed by considering the minimum specifications, with reference to software development for learning media, namely efficiency and effectiveness, reliability, usability, accuracy of application selection, compatibility, packaging, documentation, and reusability.

Results and Discussion

The results of the 4D model based on MDLC comprised four stages, namely define, design, develop, and disseminate. At the Define Stage, activities were carried out to find the potential and problems that occur in the research location. The process included results of observation activities and interviews feedback with teachers and students. After finding the problem, analysis and identification was carried out to determine alternative solutions that can be applied. The results obtained were in the form of teaching aids to be used for acquiring the relevant language skills and vocabulary development, prior to the practice of the art of *pencak silat*. The next stage of Design of learning media for the basic movements of *pencak silat* was carried out with three-dimensional virtual reality technology. This design stage paid special attention to the results of discussions with users who were using this media, namely teachers and students. The Development Stage was the step of making learning media where the Luther-Sutopo media development model was used, that was designed for physical education teachers so that it can be used as a medium in teaching and learning activities and can also be used by students as independent learning material. The idea of making this three-dimensional virtual reality-based learning media design was to attract students' interest and attention so that learning activities for learning the basic movements of *pencak silat* become easier and more enjoyable.

During the Needs Analysis stage, information was collected by conducting observations and interviews with physical education teachers at State Junior High School 2 Tasikmalaya City regarding acquiring language learning through VR scientific-based learning in a classroom. The results of the analysis of interviews and observations were obtained as follows: (1) first, the physical education teachers at Junior High School on 2 Tasikmalaya City were not yet using a student-centered or student-oriented language learning approach; (2) second, the language learning strategy applied by the teacher was not in accordance with the deductive learning process. In deductive learning strategy, the message to be conveyed starts from the general to the specific, from the abstract to the real, from abstract concepts to concrete examples; (3) third, the teachers employed the usual learning methods such as lecture and recitation (assignment) models, while the discussion model was rarely used. The lecture method was also an explanation and oral narrative to explain the description. The discussion method, on the other hand, would expose students to the real problem and its solution. (4) fourth, the teaching media used were almost non-existent, since the teacher only explained the class the basic movements of analog or digital *pencak silat* and only noted important points on the white board, which involved very little use of language; (5) finally, it was observed that in the whole process when students observed the process and working principles of components, it took a long time which made the learning process become ineffective. Figure 1 presents the stages of Needs analysis that involved the implementation of the 2013 curriculum and choice of the learning method to learn languages

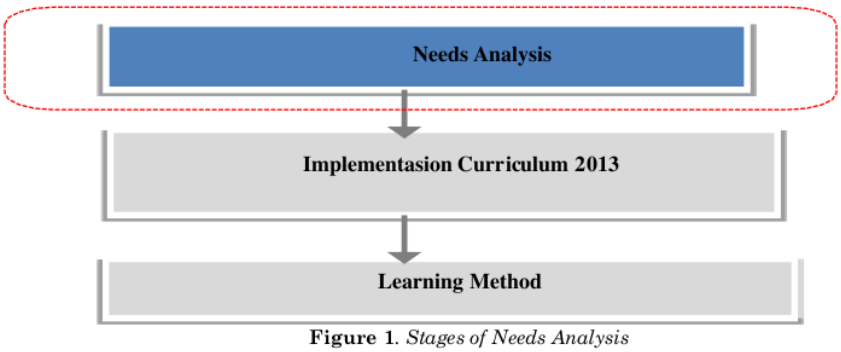

Figure 1. *Stages of Needs Analysis*

Multimedia learning using the three-dimensional Virtual Reality method is very interesting to help the learning process on analog electronics and digital electronics, with the hope that three-dimensional Virtual Reality multimedia is made interactively which involves students directly in the learning process with multimedia. However, when it comes to learning a language or mastering its vocabulary or jargon, the material contained in language learning multimedia must be easy for students to understand displayed in a form that is in great demand and favored by students. In short, multimedia is expected to provide a learning experience that makes it easier to understand a language component with much ease.

The study also examined the significant use of VR Tool Kit, which is a collection of software libraries designed to link application programs. The VR-ToolKit is either analog or digital and only records important points on the white board. If problems arise, students need to observe the process and principles of the basic movements of *pencak silat* directly. This process takes time in the absence of a proper knowledge of language and the vocabulary or jargon and turns out to be ineffective. In addition to software requirement, the multimedia development also requires minimum hardware specifications as presented in Table 1.

Table 1. *Minimum Hardware Specifications*

Hardware Specifications
• Processor: Pentium IV 2.0 GHz
• RAM: 1 GB
• Hard disk: 20 GB
• Resolution Monitor: 1024x768
• Camera: Webcam

To make the VR platform more interactive for the language learners, the multimedia interface model designed in the study was given an interface design, dominated by purple and blue colors, used for coding. Movie clips and markers in an interface cannot function, therefore a code is given for functions to operate as expected. A special 3D animation designed VR Toolkit was provided for enabling interactive multimedia and support the learning of *pencak silat*. In general, giving animation to multimedia objects helps students use their senses, namely audio and visual. It is also important to ensure a proper camera placement so that the marker can be read by the camera. The VR Toolkit generally uses the VRML language to read 3D objects to be rendered. VRML (Virtual Reality Modeling Language) is a virtual programming language that is often used by programmers to create 3D objects. By using the WRL files, the programmer often creates a presentation of 3D objects on a particular Web. VRML can interact with 3D Objects as it monitors the movement of atoms. Table 2 presents the movie/ 3D testing results:

Table 2. *Movie / 3D Testing Results*

Test Case	**Expected results**	**Output**
Marker	The marker can be read by the camera	Succeed
Camera	Camera can detect marker	Succeed
VR Programs	Can run Virtual programs	Succeed
3D View	Reality with VR Toolkit	Succeed
Interactivity	3D view with visual effects Real effects approach	Succeed
Ease of Use	The process of interaction between the User and the Application program	Succeed
Time	This app is easy to use	Succeed
Animation	Display timeliness	Succeed
Simulation	Animation Process	Succeed

The Virtual Reality Assessment involves media experts in the application process and its application to analog electronics subjects. The assessment of the media consists of the following aspects: (1) Virtual Reality (Audio Visual) display; (2) aspects of VR (Virtual Reality); and 3) programming aspects. The media expert's assessment of the Virtual Reality aspect obtained an average score of 4.73 (very good) consisting of simulation indicators, animation techniques and 3-Dimensional images, as presented in Figure 2 and Figure 3.

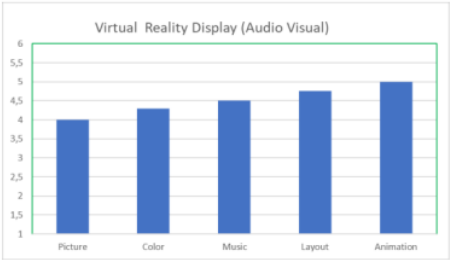

Figure 2. *Graphics of Assessment of Audio Visual Aspects of Virtual Reality Appearance*

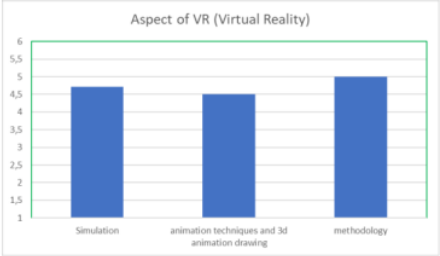

Figure 3. *Rating Graph for Virtual Reality Aspect*

Virtual Reality Assessment involves students in the application process and its application to the subject of *pencak silat*. The assessment of the application involved 30 students. The assessment of the Virtual Reality (VR) based learning model through a scientific approach was assessed by students for three aspects: (1) software engineering aspects; (2) aspects of learning design; and (3) aspects of visual communication. The results of the assessment consisted of aspects of software engineering with an assessment percentage of 84.16 percent aspects of learning design with a percentage of 86.66 percent assessment, visual communication aspects with a percentage of 82.96 percent as shown as in Table 3 below.

Table 3. *Student Assessment of Virtual Reality (VR) Based Learning Models Through Scientific Approach*

No	Indicator	Percentage (%)
1	Software engineering aspects	84,16
2	Learning design aspects	86,66
3	Visual communication aspect	82,96

Based on students' answers that the advantages contained in this application are that it cannot only be used on a PC (computer/laptop) but can also be used on Android-based mobile phones. The weakness of this application when used on a PC requires additional camera hardware to move and display 3D images. Students' opinions and suggestions about this application are very interesting. Furthermore, the feasibility of using media for independent learning is that this application is suitable for use as a medium for independent learning and can also be used as a medium for group learning as a presentation tool. Based on the description of the feasibility of the program, the program made is included in the good category and can be said to be feasible to be used in the learning process. Respondents agreed that the Virtual Reality-based learning media, the subject of the basic movements of *pencak silat*, was not boring, did not feel afraid of *Pencak silat* lessons and was easy to practice.

The next issues taken up in this study was the integration of the 2013 curriculum. To integrate Virtual Reality with the 2013 Curriculum, a module related to the rules in scientific learning was designed with three domains, namely attitudes, knowledge, and skills (Kemendikbud, 2013, pp. 203, 212). The domain of attitude adopts the transformation of the substance or teaching material so that students "know why;" the realm of knowledge uses the transformation of the substance or teaching material so that students "know what;" while the domain of skills uses the transformation of the substance or teaching materials so that students "know how". The result of this process is an increase and a balance between the ability to become good human beings (soft skills) and humans who have the skills and knowledge to live properly (hard skills) from students which include aspects of attitude, skills, and knowledge competencies.

The development of three-dimensional Virtual Reality technology in *pencak silat* subjects in junior high schools, especially in the implementation of language learning activities is a form that can meet the needs of improving students' cognitive, affective, and cognitive skills and keep students from understanding something abstract and complex. This learning model is designed in such a way that students actively build concepts, laws or principles through the stages of observing (to identify or find problems), formulating problems, proposing or formulating hypotheses, collecting data with various techniques, analyzing data, drawing conclusions and communicate concepts.

The application of Virtual Reality technology in experiments or experiments is intended to develop various domains of learning objectives, namely attitudes, skills, and knowledge. The real learning activities for this are: (1) determining the theme or topic in accordance with the basic competencies according to the demands of the curriculum; (2) learn how to use the tools and materials that are available and must be provided; (3) studying the relevant theoretical basis and the results of previous experiments; (4) conduct and observe experiments; (5) record phenomena that occur, analyze, and present data; (6) draw conclusions on the results of the experiment; and (7) making reports and communicating experimental results.

Some of the advantages of Virtual Reality technology that are integrated into the 2013 Curriculum are stated as follows: (1) providing high usability and interactivity facilities; (2) learning approach using three-dimensional virtual reality students understand better and more easily understand how to work and not be

boring; (3) learning with a simulation-based environment can display 3-Dimensional objects including the structure and function of body parts, students can learn system principles quickly, effectively, interactively and navigatively through the created virtual environment; (4) providing creative freedom to students in carrying out learning activities without having to follow the existing schedule; (5) requires interaction, emphasizes active participation rather than passive; (6) Virtual Reality technology has a dynamic environment for development, knowledge achievement, and skill enhancement.

Virtual reality has several key elements. The first element is the virtual world, which is a three-dimensional environment that is often realized through media (i.e. rendering, display, etc.). The second element is immersion, namely the perception of being physically present in the non-physical world, a sensation created by virtual reality technology for users to feel a real environment when in fact it is fictitious. Immersion is divided into three types, namely mental immersion (the user's mentality is made to feel like being in a real environment), physical immersion (making the user physically feel the atmosphere around the environment created by the virtual reality), and mentally immersed (the sensation felt by the user to experience the virtual reality). dissolve in the virtual reality generated environment). Next, the third element is sensory feedback, where virtual reality requires as many of our senses as possible to simulate. These senses include sight (visual), hearing (aural), touch (haptic), and so on. Finally, the fourth element, namely interactivity, oversees responding to actions from users, so that users can interact directly in fictitious fields.

Conclusion

The conclusions obtained in this study are as follows. First, the Virtual Reality development stage is divided into small stages, namely the creation of a multimedia interface, coding or coding, movie testing, publishing, packaging, expert validation, and multimedia revision. To integrate Virtual Reality with the 2013 Curriculum, in this study, a module related to the rules in scientific learning was created. The development of Virtual Reality technology for sports subjects with the basic movements can meet the needs of improving students' cognitive, affective, and affective skills and keep students from understanding something abstract and complex. It was also noticed that students practiced interpersonal skills as they interacted via video, audio, or text in real-time with other speakers of the target language during the physical activity.

The study showed evidence that technology assisted virtual reality tools support language learners in their acquiring a target language, appropriate to accomplish physical tasks in any sports activity. It was also felt during the study that educational technology tools appeal greatly to language instructors due to their contribution to enhancing students' active engagement and maximizing positive language learning outcomes. The use of technology has become an important part of the learning process in and out of classrooms and is viewed as the core requirement in modern schools and universities.

The study would like to make a few recommendations: First, for physical education teachers, especially teachers who teach the basic movements of *pencak silat*, it is recommended to use Virtual Reality technology as a learning tool in the classroom, with a strong focus on the technical jargon, assisted either by a language glossary or a good translating dictionary. Virtual Reality technology can also be used as a supplement of real learning, a complement of real learning, and a substitute for real situational learning in the classroom for sports subjects like *pencak silat*. Moreover, all language learning opportunities whether facilitated through VR technology or in a classroom setting, should be instructor-designed and learner-centered, and aimed at developing proficiency in the target language through interactive, meaningful, and cognitively engaging learning experiences.

Last, but not the least, the authorities, administrators, and academicians, are advised to participate in the socialization, use, and dissemination of Virtual Reality Technology as a practical, effective, and efficient form of practical learning whose implementation would help integrate the implementation of the 2013 curriculum.

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