



Virtual Reality Development for the Physically Disabled

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Abstract. Children with special needs experience physical, mental-intellectual, social, and emotional limitations that affect growth and development. Children with special needs in Indonesia are estimated to be between 3–7% under the age of 18 years, with the most category being Cerebral Palsy. Cerebral palsy is brain damage that is permanent and cannot be cured. One indication of cerebral palsy is impaired development of movement and posture, which causes activity limitations. Therefore, developing virtual Reality for the physically disabled is necessary. The development model carried out in this study uses the ADDIE development model, which consists of five stages of development, namely: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. The expected results from this research will be virtual reality applications for the physically disabled using application software designed using virtual reality techniques.

Keywords: Virtual Reality · Movement Development · Cerebral Palsy

1 Introduction

In recent years, the number of children with special needs (ABK) in Indonesia has increased. According to WHO (World Health Organization) calculations, it is estimated that 10% of all Indonesians (24 million people) experience special needs [1]. Further data from the PUSDATIN of the Ministry of Social Affairs of the Republic of Indonesia revealed that 3,010,830 children with special needs experienced physical barriers, including cerebral palsy [1]. Cerebral palsy is not a single disease but a name given to various static neuromotor disorder syndromes that result from lesions in the developing brain [2]. The brain damage is permanent and cannot be cured, although the consequences can be minimized [3]. The motor disorder of cerebral palsy is also accompanied by impaired sensory perception, cognition, communication, and behavior by epilepsy from secondary musculoskeletal problems [4].

Furthermore, cerebral palsy is also indicated by impaired development of movement and posture, which causes activity limitations. So that it can be seen that the condition of cerebral palsy results in the development process, even though the growth process and development process occur simultaneously. This condition is also experienced by children with spastic cerebral palsy. Spastic can be interpreted with stiffness, and spasms, furthermore, spastic children have stiffness in some or all of their muscles [5]. This will

have an impact on the mobilization function and experience a contradiction if the joints are bent [6]. Children with spastic cerebral palsy are divided into four types, spastic paraplegia, spastic hemiplegia, spastic diplegia, and spastic quadriplegia [5]. Spastic conditions have implications for the learning process, due to limited mobility, as a result of motor skills that have not been able to develop optimally.

Individual delays in motor development aspects certainly require training or coaching. The coaching that is carried out is through the motion development service. This service in the medical aspect is part of medical rehabilitation, namely Physiotherapy. Furthermore, the materials, methods, and evaluation models are also based on the fields of physiotherapy study. Movement development is an educational effort in the form of activities, development, and training in developing knowledge, skills, values, and attitudes for children with motor disorders to foster their movements in carrying out activities of daily living [7]. Cerebral palsy students require a series of coaching and training activities that are planned and programmed using Neuro-Developmental Treatment and Perceptual Motor Learning. Findings show that the impact of the application of tactile stimulation masgutofa neurosensorimotor reflex integration and perceptual motor learning on children's motor skills must be carried out regularly and controlled by anyone who implements it [8]. If there are no guidelines, the results will not be optimal, including in the activities of the movement development service other than teachers as well as parents who are responsible for family relationships. The Reality is that parents do not yet have a reference in development activities.

Defines people with quadriplegia as abnormalities or disabilities in the muscle, bone, and joint systems that can result in impaired coordination, communication, adaptation, mobilization, and developmental disorders [9]. Students with disabilities have the characteristics of difficulty in carrying out physical movements and have normal mental development like other regular students. Therefore, students with disabilities need special attention so that they do not feel discriminated against in the learning process and increase learning motivation regardless of their limitations.

The development of virtual Reality for the physically disabled is one solution in solving the problem of the lack of media as a movement development service that can meet the needs of children based on their characteristics. Virtual Reality or Virtual Reality is used to make it easier for physically disabled children with limited mobility. The existence of virtual Reality can help disabled children learn to build motion and directly interact with the object being studied. The development of Virtual Reality is based on the fact that the barriers to inclusive implementation have not been fully implemented, one of which is due to the lack of media that meets the needs of students with disabilities. In addition, students with disabilities will have difficulty learning movement development like regular students. The use of Virtual Reality is used for packaging motion development material into accurate illustrations for students with disabilities so that it helps to interact with objects that appear like the real world. Conclude that Virtual Reality media in teaching supports material that requires visualization, practice, and limited resources [10]. This is done to help the creation of a comprehensive education without discrimination. The low participation of students in the category of children with special needs is allegedly due to the absence of complete facilities to support their learning activities,

so they feel discriminated against. Conclude that Virtual Reality media in teaching supports material that requires visualization, practice, and limited resources [10]. This is done to support the creation of a comprehensive education without discrimination. The low participation of students in the category of children with special needs is allegedly due to the absence of complete facilities to support their learning activities, so they feel discriminated against. Conclude that Virtual Reality media in teaching is very supportive of material that requires visualization, practice, and limited resources [10]. This is done to support the creation of a comprehensive education without discrimination. The low participation of students in the category of children with special needs is allegedly due to the absence of complete facilities to support their learning activities, so they feel discriminated against.

Virtual Reality is glasses that allow students with disabilities to interact with an environment that resembles actual conditions. Virtual Reality contains motion-building material that is simulated through Virtual Reality technology. V.R. technology helps students with disabilities learn various movement forms by interacting with objects through observation and investigation.

1.1 Literature Review

a) *Cerebral Palsy*

Cerebral Palsy (C.P.) is a disorder caused by damage or disturbances in the brain. The part of the brain that is affected is usually only the part that regulates movement [11]. These abnormalities can arise before birth, in activities, and body postures detected in infancy or early childhood [12]. This is due to non-progressive damage to the brain either before, during, or shortly after birth [13]. C.P. is not a single disease but a name given to various static neuromotor disorder syndromes resulting from lesions in the developing brain [14]. Brain damage is permanent and cannot be cured but the consequences can be minimized.

Cerebral palsy covers a spectrum of motor disorders with varying degrees, anatomic distribution, and severity [15]. Motor disorders are caused by limited brain function to move muscles [16]. Children with cerebral palsy cannot survive long in proper movement or posture patterns (standing or sitting). In other words, children cannot perform movements like their peers who usually grow. This is because they can only perform a limited exercise pattern and attitude.

b) *Motion Building*

Motion Building Concept

Movement development is all efforts, assistance which can be in the form of guidance, then training, which is carried out in a planned and programmed manner so that later the ability to take care of yourself, help yourself, take care of yourself, and mobilize (moving and changing places) in your daily life is realized—optimally good day [17]. Movement development is a set of activities consisting of coaching and training implemented by professional teachers in the field of special education, then carried out in a planned and programmed manner for individuals who have disorders in muscles, joints, or bones so that the individual will experience disturbances and in carrying out activities—displacement [5].

Motion Building Function

Function Development of motion according to namely [17]:

- Develop the abilities of limbs that have difficulty moving so they can function optimally.
- Develop and train students on an ongoing basis so that they can cope with the needs of life.
- He is fostering students to understand and be aware of the relationship between the teacher and his personality so that a harmonious form of communication can be established.
- Develop harmonious, healthy, and intense muscle movements so that they can carry out activities according to their functions.

Movement Development Goals

While the goals of movement development for cerebral palsy students are:

- Harmonize muscle movements in a balanced, healthy, and robust manner so they can carry out movements according to their function.
- Able to adapt to the environment and overcome difficulties experienced in daily life.
- Have knowledge, attitude, or value as well as the ability to sensorimotor so that it can adapt to the environment.
- *Virtual Reality*

Virtual reality technology has been widely proposed as a significant technological advancement that can offer a new form of education. The potential of virtual reality technology can facilitate the learning process that goes beyond the main boundaries that characterize an education. Its main goal is to provide highly realistic, immersive, interactive simulation procedures and 3D virtual worlds [18].

Virtual Reality is the observation of a virtual environment through a system that displays objects and allows interaction, thereby creating a virtual presence. A virtual environment is defined by its content (objects and characters). This content is displayed through various modalities (visual, aural, and haptic), and perceived by the user through sight, hearing, and touch (Mihelj et al., 2013). Therefore, most V.R. systems make every effort to give users the ability to interact with the system in the same way they would interact with objects and events in the real world.

2 Method

The development of Virtual Reality applications for the physically disabled uses the Research and Development (R&D) method. The development model used is the ADDIE model with five stages, namely Analysis (analysis), Design (design), Development (development), Implementation (implementation), and Evaluation (evaluation) [19] (Fig. 1).

a. Analyze

In the first stage, an analysis of the development of the Virtual Reality model is carried out. This stage is the collection of information and needs then analyzed and defined needs that must be met by the application to be built. At this stage, the search

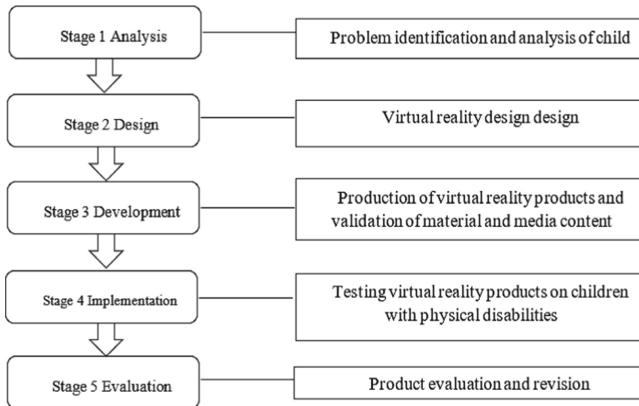


Fig. 1. The ADDIE model.

for references regarding the theories needed and how to apply them in Virtual Reality technology is carried out. After all the theories have been collected, the next thing to do is to do a needs analysis about the limitation of the problem from the application that is made by taking into account the availability of time and the ability to make the application, as well as what things are needed in making the application.

b. Design

At this stage do the design/design to make the design of the application. In the development of Virtual Reality applications for the physically challenged, software design boundaries, software functional models, software menu structure designs, application scenario designs, and software interface designs have been designed.

c. Development

At this stage, the researcher will develop a Virtual Reality application for the physically disabled. This application contains a guide for movement development activities to stimulate motor skills in children with disabilities.

d. Implementation

The implementation stage is the stage when the application is ready to be introduced and feasibility testing is carried out. At this stage, the implementation of Virtual Reality Applications for children with disabilities is carried out. This application will be implemented for children aged 5–6 years with physical disabilities in the city of Surabaya.

e. Evaluation

The evaluation stage is carried out after the implementation stage is complete. The testing phase is carried out to know the shortcomings and weaknesses as well as errors of the developed application so that the application can still be repaired to reduce errors that occur before the application is implemented in the wider community. At the evaluation stage, 2 types of tests will be carried out, namely the Whitebox Test and the Blackbox Test with two test cases, namely the correctness of the process on the application and the use of the application on 5 different devices.

3 Result and Discussion

The results of the evaluation of the research model are the process of running and evaluating software based on the research model that is used to test whether the software meets the requirements or not to determine the difference between the expected results and the actual results. The following will describe several stages of research related to the evaluation results of the Virtual Reality Application for the physically disabled which include:

1. Analyze

Researchers conduct problem analysis and need analysis of the application to be developed, as well as what things are needed in making the application which includes:

a. Problem analysis

Movement development learning for physically disabled people still uses improvised media and there is no use of I.T. technology in it.

The use of the same motion development learning media continuously of-ten makes students feel bored when doing movement-building learning.

With the rapid development of I.T. every year, it is felt that it is necessary to develop IT-based learning media so that the choice in the use of motion development learning media is more varied and innovative and students will be more enthusiastic about learning about new things.

b. Needs analysis

In the development of Virtual Reality applications for the physically disabled, can display several movement-building activities in the form of games that are equipped with audiovisual images so that it can make it easier for people with physical and motoric disabilities to exercise independently.

2. Design

The design stage is done by making the design results of the application. In the development of Virtual Reality applications for the physically disabled, the software menu structure has been designed, and the software interface design has been designed.

A. Application Scenario Design

The application scenario is the flow of using the application from the beginning to the Main Play. The scenario here is used so that the application feels easier to direct it does not widen. Scenarios are used by researchers as a flow of application material delivery to users so that they are easy to understand.

Stage Explanation

1. User can choose the type of motor game that can be used for the movement development service
 2. Users can see objects and games in 3D
- Software Interface Design

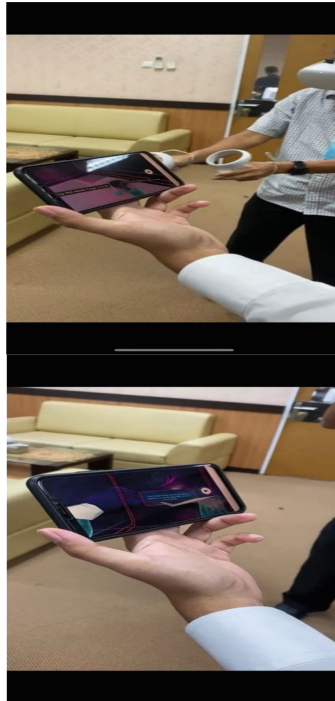


Fig. 2. The result of the development of Virtual Reality and the assets used in the Virtual Reality application for the physically disabled.

The process of building an application interface that will be used to interact between users and the software. In the interface design, dominant colors will be used to attract users who use the application. The design made is user-friendly which aims to make users feel interested, comfortable, and easy to use.

3. Development

In the development stage, it contains design activities that have been made previously implemented with customized software (Fig. 2).

- a. Music and Sound, the application used to develop is Audacity which is used to fill in the audio in the form of a back song in the application.
- b. Graphics, the application used to develop Adobe Photoshop used to create textures, and Blender to create 3D objects and animations in the form of objects on various objects which include objects in the living room, bedroom, kitchen, and bathroom.
- c. Virtual Reality, the application used to develop is Unity 3D as an application engine for developing Virtual Reality applications, Cardboard SDK as Library SDK for building Virtual Reality Applications, and GoogleVR For Unity SDK used to display V.R. features on smartphones.

4 Conclusion

Persons with disabilities have difficulty carrying out physical movements and have normal mental development. They have abnormalities in the muscles, bones, and joint systems that can result in impaired coordination, communication, adaptation, mobilization, and developmental disorders. Therefore, the disabled are assisted by students' movement exercises to train their muscles with virtual Reality, this tool can be used anytime and anywhere. So that in practice they do not feel discriminated against and after being able to independently use the tool, students can increase learning motivation regardless of their limitations.

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