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SenMoR-VR: A Sensory and Motoric Improving Function Tool for Children Development

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Abstract

Many children have delayed development related to sensory and motoric function. Virtual reality can be developed to stimulate activity to develop the sensory and motoric function and adjust the physiotherapy. It can be more efficient, effective, and interactive, especially in the Z generation that is familiar with the technology. The study aims to develop and evaluate the SenMor-VR, virtual reality as a sensory and motoric improving function tool. The research method was research and development (R&D), which was initiated with situation analysis using literature review, development of the product, and evaluation This VR software contains many features i.e front-page, interactive games, and environments, and evaluation. Based on the technology acceptance model (TAM), the total average from the aspect of benefit of use is 4.5 which shows most of the respondents agree that this technology has benefits for them. The aspect of ease of use is 3.9 which shows that most of the respondents agree that this technology was easy to use. This virtual reality app has potency as a sensory and motoric improving function tool, but it needs further clinical research to evaluate its implementation in children.

Keywords: virtual reality, sensory, motoric, screening tool

I. INTRODUCTION

Sensory and motoric were important aspects in children's development. The target achievement must be monitored continuously and regularly to initial screen the impairment of sensory and motoric development. Sensory and motor responses can make screening in child development one of which is Autism Spectrum Disorder (Autism). Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder of the brain that

causes sensory-motor disturbances in the sufferer. People with ASD can be hypersensitive or hyposensitive to surrounding sensory aspects.[1]

With the development of technology in the health sector, it is possible to carry out early detection to assess a child's sensory and motor skills. One of them is by using virtual reality. Virtual Reality can be a unique and appropriate medium because of some of the features presented in it. Some VR is developed to involve individuals feeling the sensations or virtual experiences they face as in the real world.[2] Virtual reality can have the advantage of performing simple computational studies of sensory and motor-related fields where one input is associated with a linear motion corresponding to a neural output. However, in some recent developments, VR has begun to be developed related to spatial navigation that reflects the integration of many sensory inputs. The resulting output is not linearly related to sensory perception, but rather expresses a cognitive abstraction.[2]

Virtual reality can be used for several activities related to sensory and motor aspects. Besides being used for screening, virtual reality can also be used for therapy. In a study conducted by Sveistrup (2004), virtual reality can be used for motor rehabilitation.[3] Bruin et al (2010) also developed virtual reality to train postural balance and prevent falls in older people by stimulating sensory-related balance and orientation.[4] Wuang et al (2011) developed virtual reality using Wii gaming technology (VRWii) in children with Down syndrome (DS). VRWii is used as a complementary therapy in occupational therapy.[5]According to Abdelhaleem et al (2022), virtual reality can be used as a safe supplement therapy to increase children's motivation related to therapy.[6]

II. RESEARCH METHOD

There are three stages in this research including the literature study stage, the VR development stage and the TAM test stage (Chart.1).

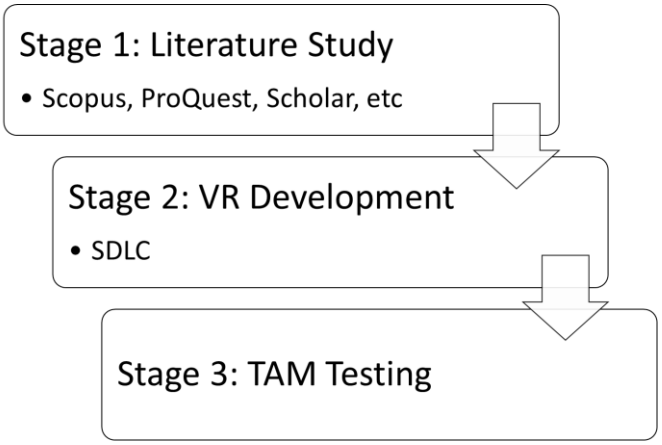

Chart 1. Research Method

Literature study stage

The literature review was done in July until August 2021 that collect and analyze articles that related to the benefit of virtuality to improve sensory and motoric function in the children from many journal databases i.e Scopus, ProQuest, and Google Scholar. In this step, it will be the identify the needs of virtual reality development and the feature that must be shown.

VR Development
Then, the Virtual Reality Development stage was using Software Development Life Cycle (SDLC) approach that contain of planning, analyze, design, implementation, and internal testing. The outcome from this step was VR-Sensmore Software. Developing the product was done in September 2021 until January 2022 that contain many features.

TAM Testing
In the third step Technology Acceptance Models (TAM) Software Testing stage was done on 6 respondents using a technology acceptance models (TAM) questionnaire. It was contained 12 items that can evaluate the perceived usefulness (PU) and perceived ease of use (PEU).

III. RESULTS

a. Literatur review

The process of development occurs simultaneously with growth so that each growth is accompanied by changes in function. Development is the result of interaction maturity of the central nervous system with the organs it affects. Phase development includes several aspects of functional abilities, namely cognitive, sensoric, motor, emotional, social, and language. Deficiencies in one aspect of development can affect aspects of another.[7]

In the sensoric aspect, there are many signs of sensory processing disorder (SPD). But, initial screening can be done to give the treatment as soon as possible. The initial signs i.e overall resistance to movement or motion from one position to another position, the resistance of head position that may present stiffness. The child also does not tolerate physical handling, avoids certain touch, appears sensitive to noise, is sensitive to visual stimulation such as avoiding eye contact, and emotionally can overreact frequently. [8]

Low motor development can be caused by several things, including muscle tone abnormalities or disease neuromuscular. Patients with cerebral palsy may experience limitations in motor development due to spasticity, athetosis, ataxia, or hypotonia. In addition, motor limitations can also be caused by spinal cord disorders such as spina bifida. Neuromuscular diseases such as muscular dystrophy show a delay in the ability to walk. However, not all motor development disorders are always based on the disease. Factor environment, as well as the child's personality, can affect delays in motor development, such as children who have the opportunity to learn will be different from children who often carried or placed in a baby walker.[9]

VR can potentially improve sensory and motor functions through various elements/features. This is related to repetitive movements, feedback and motivation. VR also provides an experience for trial and error implementation that requires a lot of repetition. However, to practice more and more movements, participants must be motivated. Unlike traditional exercise programs, VR not only allows repetitive practice but also engages cognitive functions in problem solving for better motor learning. In addition, VR enables training in a real-world simulated environment for better performance transfer.[6]

b. VR Development

SenMor-VR was developed to improve the sensoric and motoric function in children during therapy. This VR-software contains of many features i.e frontpage, interactive games and environments, and evaluation. In the frontpage, the user will have two choice, playing VR or exit. The user can choose one of them by placing the pointer according to the selected button (figure 1).

Figure 1. Frontpage of SenMor-VR

If the user selects the "play" button then they will enter into an interactive virtual environment. Users are expected to be able to pass the existing road according to virtual conditions to the finish line. In this case, balance, coordination, and accuracy-related to sensory and motor are needed (figure 2).

Figure 2. Virtual Environment of SenMor-VR

In the end of virtual environment, there were also many evaluations and the score. So that, the user can be evaluate but they act like playing a game (figure 3). It related with the cognitive function of the children.

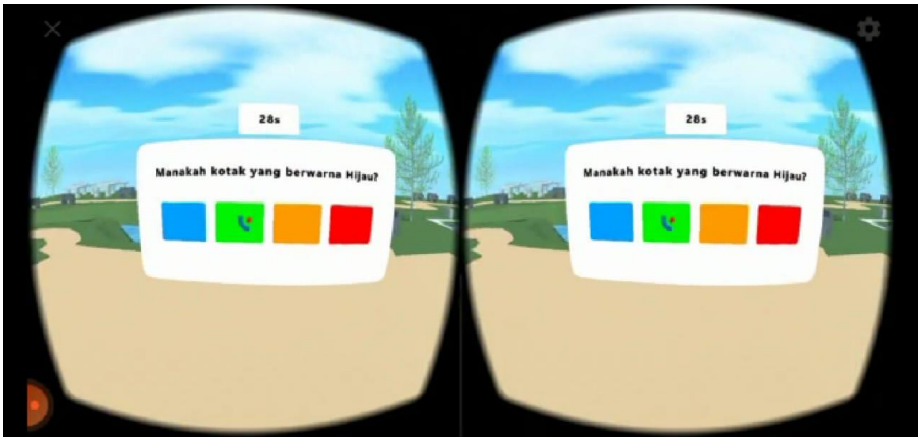

Figure 3. Evaluation page of SenMor-VR

c. Technology Acceptance Model (TAM)Software Testing

Based on the evaluation testing, respondents will be tried to use SenMor-VR and asked for opinions through a questionnaire regarding the experience of using SenMor-VR based on the aspects of usefullness and ease of use. The characteristics of the respondents in this study consisted of:

No	Gender	Age (years)	Employment	Education
1	Female	22	Medical Student	Bachelor Degree
2	Female	22	Medical Student	Bachelor Degree
3	Female	20	Medical Student	Bachelor Degree
4	Male	26	Lecturer in Medical Faculty	Master Degree
5	Male	24	Medical Student	Bachelor Degree
6	Female	21	Medical Student	Bachelor Degree

The evaluation was done on 6 respondents using a technology acceptance models (TAM) questionnaire. It was contained 12 items that can evaluate the perceived usefulness (PU) and perceived ease of use (PEU) and interpreted using Likert Scale that contains of 1= very disagree, 2= disagree, 3= netral, 4= agree, 5= very agree. The testing results has been showned in table 1 and table 2.

Table 1. Results of SenMor-VR Perceived Usefullness (PU)

Number Question	Question	Resp 1	Resp 2	Resp 3	Resp 4	Resp 5	Resp 6	Mean
Q1	By using this VR, my task will be helped, especially in conducting sensory and motor screening	4	5	5	4	5	4	4.5
Q2	By using this VR, my work performance will improve	4	5	5	4	4	5	4.5
Q3	By using this VR, my work productivity will increase	3	5	5	4	4	4	4.1
Q4	This VR makes my job of doing sensory and motor screening easier	4	5	5	5	5	4	4.6
Q5	In my opinion, VR is useful in supporting sensory and motor screening	4	5	5	5	5	5	4.8
Q6	This VR increases effectiveness in performing sensory and motor screening	4	5	5	5	5	4	4.6
Mean Total								4.5

Based on the research, the total average from the aspect of benefit of use is 4.5. This shows that respondents agree that SenMor-VR can provide benefits and help work if used.

Table 2. Results of SenMor-VR Perceived Ease of Use (PEU)

Number Question	Question	Resp 1	Resp 2	Resp 3	Resp 4	Resp 5	Resp 6	Mean
Q1	How to use VR is easy to learn	3	4	5	4	5	5	4.3
Q2	This VR is easy to operate according to the user's wishes	4	4	4	3	4	2	3.5

Q3	Interaction with VR is easy to do and understand	4	4	5	4	4	2	3.8
Q4	The features in this VR are easy to understand	3	4	5	4	5	5	4.3
Q5	I feel that VR is easy for anyone to use	4	4	5	2	5	4	4
Q6	I don't find any difficulty in using this VR	3	5	5	2	4	2	3.5
Mean Total								3.9

Based on the research, the total average from the aspect of ease of use is 3.9. This shows that most of respondents agree that SenMor-VR easy to use, altough many respondents have difficultness to operate the virtual reality.

IV. DISCUSSION

SenMor-VR contains of many features i.e frontpage, interactive games and environments, and evaluation. When the user selects the 'play' button, they will interact with virtual environment. There are many environments that can be shown in SenMor-VR such as walk-on plantations, cross bridges, jump to earn some coins, and so on. This movement need balance, coordination, and accuracy-related to sensory and motor function. The movements made by the user can also be replaced by the presence of an avatar in virtual reality. When the user moves, the avatar in virtual reality will also move like the user's body movements. [9]

Based on the research, the total average from the benefit aspect is 4.5 and the ease of use aspect is 3.9. This shows that the respondents agree that the SenMor-VR is useful for supporting examinations of motor and sensory functions and is easy to use. The easier and more profitable, technology will be more possible and acceptable to use. Nevertheless, research conducted by Sagnier *et al* shows that the intention to use VR is influenced by perceived benefits. Meanwhile, the perception of convenience does not have a significant effect on the intention to use. [10]

In the implementation of rehabilitation using VR in children with various sensorimotor deficits, it was found that VR is safe and has the potential as an effective assessment and treatment modality. However, further research using a larger population is needed before VR is applied in rehabilitation.[11, 12]

This research needs to be developed further to test the effectiveness of SenMor-VR in improving motor and sensory function in children. This requires clinical research and further trials to assess various related aspects and compare them with conventional therapy without virtual reality. Motivation, interest, and achievement of the development of sensory and motor functions of children need to be assessed.

V.CONCLUSSION AND RECOMMENDATION

SenMor-VR has the potency to improve sensory and motoric function during therapy. It contains many features i.e front page, interactive games, environments, and evaluation. The technology acceptance model (TAM) of this technology include the aspect of benefit of use with a total average is 4.5 which show more respondent agree that this technology has benefits and in the aspect of ease of use the total average is 3.9. It shows that this technology can be used easily. To assure this technology can be implemented and to identify its effectiveness of this technology, it needs further clinical research.

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