Virtual Reality Trainers for Students with Disability: Analysis of Students' Motivation and Motor Performance

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Abstract: There are few studies have examined the effective inclusion of Students with Learning Disability (SLD) in teaching and learning, despite the growing policy, educational, and political concern following the progressive trend towards enrolling students with disabilities in regular public schools. As inclusive education is a fundamental human right, educators should find more ways to include the SLDs. A highly motivating learning environment is provided by virtual reality (VR), which combines 3D virtual settings with technologically advanced modes of interaction. VR provides an interactive experience wherein one can become immersed in a computer-generated environment. Nonetheless, there is limited research on using VR for Students with Learning Disability (SLD). Physical Education (PE) has been a compulsory subject in Malaysia to develop skills, knowledge, values, and attitudes to stay healthy. Many studies have tested the use of VR in helping students learn PE. Thus, this study tested VR trainers in teaching PE to the SLDs. A VR application is being created as part of the study, and the users will be asked for their opinions. In this study, the motor performance and motivation of the experimental group were evaluated to measure the effectiveness of the VR trainers in helping the SLD to learn. The results proved that combining immersive technology with motor learning theory made it possible to motivate SLDs and increase their motor performance score in learning PE.

Keywords: Disabilities; Motivation; Physical Education; Sport; Virtual Reality

Introduction

An important component of the academic course that aims to enhance students' emotional, social, and physical development is Physical Education (PE). A person can learn about the body and how to maintain a healthy and

attractive body and how to keep our bodies free of injuries and illnesses through PE (Ravinder Kumar, 2023). Students with learning disabilities (LD) often face limitations when it comes to participating in physical activity and enjoying it. Coaching these students can be challenging as they require special attention and support to enhance their physical abilities while overcoming academic obstacles (Allam & Martin, 2021) and (Azlina & Rassy, 2022). In order to support students' physical, social, and emotional growth, PE is an essential component of the school curriculum. According to UNESCO, the educational environment should include opportunities for PE appropriate for kids with varied talents and interests, and inclusive education is a fundamental human right (Pocock & Miyahara, 2018).

Students with disabilities or SWD continue to be excluded in both conventional classroom settings and when the educational system is disrupted, for example during the COVID-19 epidemic, as the current research by Mullen & Hunt (2022). Teachers must be a key component of achieving the goals of the Malaysian National Education Philosophy by ensuring that SWD have the same access to education as other students (Noraini Abdullah et al., 2016). Physical activity is essential for a person's well-being and for preventing health problems, according to the World Health Organization (WHO) (Glance, 2020). School-based PE may provide essential opportunity for SWD to acquire the information required to promote a healthy lifestyle (Bertills et al., 2019). However, (Hildt, 2021) proved that when compared to healthy persons, In PE, SWD was six times prone to exhibit greater levels of self-efficacy and had a 57 percent greater chance of subsequently having health problems.

Despite the government's support for incorporating disabled students in the classroom, a research by Hss, (2016) found that just 41% of these students reported successful inclusion, while another 20% experiencing moderate success. Most students that require assistance go unnoticed or choose for different educational courses to reduce segregation. It is still unclear whenever the academic programmes were successful in Malaysian classrooms. According to (Wee & Chin, 2020), due to a shortage of teacher training, students' dislike of physical education, a lack of facilities and equipment, and certain schools replacing other topics for PE classes, implementing inclusive programmes is challenging.

One category of disability is a learning disability; by the year 2020, eighty-two percent of Malaysian students with special needs were classified into this category (SLD) (Bahagian Pendidikan Khas (Special Education Division), 2021). Due to the high percentage, this group of children deserves more attention. Physical educators must employ strategies to promote physical activity if they are to instruct students with learning disabilities effectively (Abdi, 2017). The crucial age group for PE is 13 to 17-year-old secondary school students. It's important to be mentally stable as well as physically well. According to studies, this group follows an unhealthy lifestyle and lacks desire for physical activity (Gaintza & Castro, 2020). Lack of educational resources that encourage SLDs to exercise and improve their motor skills may make the issue worse.

The effectiveness of learning experiences for children during traditional PE instruction may be affected by factors like space availability, equipment, and teacher skill (Laar et al., 2021). Fortunately, technology advancements have opened up new possibilities for improving PE teaching and learning (M. A. A. M. Hamizi et

al., 2022). One such emerging technology that shows promise for increasing physical education training is virtual reality (VR) (M. A. A. B. M. Hamizi et al., 2022). Virtual reality (VR) can revolutionise how students learn about movement, sports, and physical activity by imitating real-world surroundings and offering immersive and engaging experiences.

Technology advancements are growing more complex and modern as individuals become more accustomed to using digital gadgets both offline and online (Series & Science, 2021). To experience and interact with VR, specialised equipment is needed, such as VR glasses or a headset (Poetker, 2019). Utilising both VR gear and software, a multisensory experience must be created. Virtual reality (VR) technology brings together a number of different technologies to create multisensory, three-dimensional (3D) environments that allow users to completely immerse themselves in a virtual setting (Poetker, 2019). These tools include a head-mounted device (HMD) with a head-tracking system, headphones for sound or music and noise cancellation headphones, and manipulation/navigation tools.

VR creates new possibilities for inclusive and accessible physical education classes for students with disabilities. By providing virtual environments and interactive experiences, VR provides the potential to provide personalised coaching and adaptive learning opportunities, making PE more approachable and enjoyable for children with disabilities (Fu & Ji, 2023). This study investigated the possibility of VR as a tool for SWD PE training in order to enhance physical learning outcomes and support inclusive education.

Literature Review

Physical Education

Primary and secondary schools offer physical education classes that focus on the human body and psychomotor development (Tabuñar Fortunado, 2016). PE programmes can teach students how to live a healthy lifestyle, increase their physical fitness, and combine physical and mental activity (Dan et al., 2021). Direct teaching increases students' self-assurance and capacity to solve issues on their own, in groups, or in bigger groups (WHO, 2019). The encouragement of teamwork, sportsmanship, and physical togetherness as well as the teaching of basic body management techniques should be the goals of PE in schools. The lesson may spark the interest of students in physical education classes, attract in wandering students, encourage movement, and stress the value of exercise and good health (Speciality, 2019).

By taking into consideration students' intellectual, spiritual, emotional, and physical needs, Malaysia's educational system promotes students' overall growth (Wee, 2017). Thus, both primary and secondary schools must include physical education in the curriculum along with academic subjects. The main source of instructional materials for teachers in Malaysia's educational system continues to be textbooks. Pendidikan Jasmani dan Pendidikan Kesihatan (PJPK) is the name of the physical education programme used in Malaysian

schools (Mustaffa et al., 2019), and It must cover the following five areas of study: (i) physical ability; (ii) application of physical skill; (iii) fitness for health; (iv) application of fitness capability; and (v) sports.

Students with Learning Disability

The Malaysian Ministry of Health estimates that 10% to 15% of students struggle with a learning disability. Statistics from the Division of Special Education indicates that almost all of SWD across Malaysia struggle with learning disabilities (LD). There are several terms for learning disability used globally, namely intellectual disabilities, learning difficulties (in the UK) or Down syndrome (in the US) (Mokhtar et al., 2022). In 2020, children with LD comprised about 82 percent of SWD. According to Abdullah and Hanafi (2017), the government's Ministry of Women, Family, and Community Affairs (KPWKM) now recognises six different kinds of disabilities as specific impairments: visual, communication, physical, learning difficulties, psychological, and other disabilities (Nurhidayah Abdullah & Hanafi, 2017). When IQ does not correspond to biological age, there is said to be a learning disability. This category also covers conditions involving autism (Autism Spectrum Disorder), Attention Deficit Hyperactivity Disorder (ADHD), and specific cognitive difficulties like dysphagia, dyslexia, and writing difficulty that affect a person's ability to learn (Radzi et al., 2019). LD students usually face learning issues that are complex, linked, and invisible (Adesokan, 2023). When creating appropriate learning resources for LD students, we should consider the distinct personalities of each LD child (Radzi et al., 2019). Motivating SWD with LD to learn may be difficult since they frequently lose interest in what they are learning.

Motivation in Physical Education

Kueh et al. (2019) pointed out that maintaining the health of Malaysian adults relies in large part on motivation for physical activity. Hidrus et al. (2020) and Mokmin, (2020) discovered that PE motivation is crucial for maintaining Malaysian adults' health. Any physical activity requires desire and incentive to get people to participate. The lack of good-quality physical activity in school environments may be the reason for the drop in physical activity among high school students (Kurniawan et al., 2022). Users' motivation for fitness activities may depend on a variety of things. Ennis & Ennis, (2017) found that motivation improved students' capacity to learn physical activity. Ferriz-valero (2023) stated that designing an effective strategy to improve student's motivation is the primary goal for educational systems including PE. Additionally, a great application design for physical activity could boost users' motivation to exercise (Pasco et al., 2017).

Therefore, practitioners should employ useful techniques to facilitate learning particular physical tasks. Fisher et al., (2019) state that there are numerous key components to making sure that children master particular skills. Making sure students obtain the right training they need, which may be divided into three different types: (i) randomly practice, (ii) blocked practice, and (iii) varied practice, is the most significant aspect to think about. Unlike the variable practice, which involves having students repeat similar actions or skills with varied parameters, random practice demands that the students alternate between various tasks that constantly call for

diverse skills. In another research, the students employed random practise to put the teaching strategy suggested by Haji Vosoogh et al., (2022) into practise after viewing the motions of the virtual model. The sensation of enthusiasm to do something, which we will do deliberately and not as a result of other things, is known as motivation. High motivation levels for any action result in more effort and persistence in performing that one thing until it becomes ingrained (Molanorouzi et al., 2015).

Therefore, this study also looked into how well fitness programmes engaged the intended users, primarily students with learning difficulties. To support their learning activities, children who exhibit some challenges in their learning processes involved approaches that are specialized and flexible Omar & Sulaiman, (2018), and technology, also known as assistive technology, can support the educational process. Both educating and motivating students are aided by these materials. Playing is very important for children's cognitive and emotional development, since it promotes reflection and practical thinking (Rocha et al., 2019). This research suggests that all these factors can be developed through an interactive environment.

Virtual Reality

The fast growth of diverse technologies gives opportunity for the advancement of fresh innovations in the field of education (Zeng, 2020) and sports (Félix et al., 2019). VR technology usually comes in three flavors (Poetker, 2019). Firstly, the greatest real world conceivable is fully immersed in for users, including hearing and seeing. The second style is semi-immersive, which combines real items with a sizable projector. This sort of VR is frequently used in instruction and training. Neither in a video game, the last choice is not immersive VR. Due to its potential to offer an exciting learning experience and the fact that users' learning effectiveness can be greatly increased by being immersed in a virtual environment, VR technology has become particularly popular in the field of education (Jiawei & Mokmin, 2023). It is straightforward to record and monitor performance when using VR for practical education of nursing (Shorey & Ng, 2021). Nurses can experience VR training, giving students a legitimate and unique atmosphere to study.

Due to the rise in fitness app popularity, VR technology is now used for health-related apps, PE, and training. According to studies by Guo et al. (2017) and Liu et al. (2017), using an agent to help with exercise activities is helpful. Senior users of a guided virtual Tai Chi training program gave it high ratings (Liang et al., 2018).VR technology can assist in displaying proper and incorrect swimming strokes, preventing injuries (Guo et al., 2017). It has been suggested that a VR simulation can motivate pregnant women to work out frequently to improve the flexibility of their muscles and joints. Practical and theoretical investigations indicate the effectiveness of virtual trainers in improving individual health (Vollrath, 2021).

VR has countless potential applications in PE. Jiao & Qian, (2020) employed VR in their study to teach PE by using the flip learning technique. According to their research, when VR and flip learning combine, students' satisfaction with physical education is considerably higher than in a typical classroom setting. It was demonstrated in Lee's 2020 study that Badminton coaching might make benefits of the technology. According to

the results of Lee et al. (2021) study, VR-based PE instruction could: (i) enhance comprehension; (ii) teach repeated practice; (iii) foster teamwork and mutual support; and (iv) boost motivation. These findings demonstrate that VR might be used to practice or teach PE skills.

In their study on the usefulness of Virtual Reality for Physical Education, Porter et al. (2016) suggested that if the VR system enables the training of significant invariant elements of behavior, underlying skill structures can be taught in VR and applied to the real world. This agreed by Syed-abdul et al. (2019) who believed VR may improve PE lessons, modernize the teaching approach, and enhance the effectiveness of PE instruction. Before deploying fully VR-based PE instruction, developers and teachers should consider a few application-specific difficulties.For students with learning difficulties, PE can be a difficult subject (Mokmin & Rassy, 2022). The students might not be adequately engaged by traditional coaching techniques, which would lower their drive and interest in the subject. VR coaching can offer a more individualized and engaging approach to PE by offering immersive and interactive experiences. This paper aims to analyze the motivation, opinions of SLD toward VR coaching in physical education.

Methodology

Study Design

This mixed-mode study measured students' motivation when learning using VR technology. The respondents were from a special needs school that specialized in teaching students with disabilities. The teacher selected all the respondents from the school using selected inclusive criteria such as: (i) guidelines must be understandable by students; and (ii) no underlying health issues. Despite the fact that the inquiries came in the format of a survey and an interview, the researchers and the teachers assisted in asking them directly one at a time.

Research Procedure

This study is divided into three main phases. In the first phase, the students were given a pre-test to know their motivation level. A group of 20 students with five teachers from the school were invited to the experiment center. They were first given instructions on the experiments and seated in a room. For the experiment to run well, the students were grouped into five students per group and were given the HMD to try on first. They could proceed to the experiment if they had no problem using it. Their motivation was assessed using a Pelletier et al. questionnaire (2013). Table 1 shows the questions from the questionnaire. The experiment ran for an hour and was facilitated by experienced school teachers who were certified to work with SLDs. In the second phase, an interview was conducted to know the students' opinions on learning lessons with virtual trainers. The students' response patterns were collected from observation in the third phase. The ethical committee has cleared this study by the university.

Research Instrument

For the first phase, a set of questionnaires was given to the student to measure their motivation before and after using the VR trainer. The questionnaire was divided into three parts assessing the students' intrinsic regulation, introjected regulation, and motivated regulation. Table 1 further describes the items included in the questionnaire. These questions have been validated and checked by an expert in the field.

Table 1. The Questionnaire

Types of Motivation	Pre- and Post-Motivation Questions
Intrinsic regulation	For the pleasure it gives me to know more about the sport that I practise.
	For the pleasure of discovering new training techniques.
	For the satisfaction I experience while I am perfecting my abilities.
	For the excitement I feel when I am really involved in the activity.
	Because I like the feeling of being totally immersed in the activity.
Integrated regulation	Because practising sports reflects the essence of whom I am.
Identified regulation	Because it is important to me to get better at my sport.
	Because, in my opinion, it is one of the best ways to meet people.
Introjected regulation	Because it is absolutely necessary to do sports if one wants to be in shape.
	Because I must do sports to feel good about myself.
External regulation	To show others how good I am at my sport.
	I play sports of my own choice.
Motivated regulation	I have the impression that I am incapable of succeeding in this sport.
	I can't seem to achieve the goals that I set for myself.

The second phase used a set of interview questions based on the technology acceptance model (TAM) and adapted from Kwak (2014). The interview was divided into four parts: (i) Item 1: perceived ease of use (PEU); (ii) Item 2: perceived usefulness (PU); (iii) behaviour intention (BI); and (iv) attitude (AT).

Design and Development

The App Design

The design and development follow the guide from the ADDIE model. For the analysis part, trainers' movement information was obtained from a secondary source. The movement followed the guidance from the special needs school. The app was validated by an instructional technology expert and content expert in PE for students with disabilities. Figures 1 and 2 are screenshots from the app.

Analysis

For the analysis at the beginning of the study, we interviewed a group of teachers and students from a special needs school. We assessed the ability of the students to understand 3D objects, use technologies, and follow steps listed in a certain task. The preliminary study showed that SLDs can understand 3D objects and have no issue using technology in learning. However, several students do need guidance from their teachers. Several documents and books were also used to get more information on SLD learning materials. Their module and textbook were used with permission to understand the required PE activity.

Design

A storyboard was constructed by following the instructions and movements guided by the textbook. Figure 1 displays the exercise training from the Malaysia textbook.
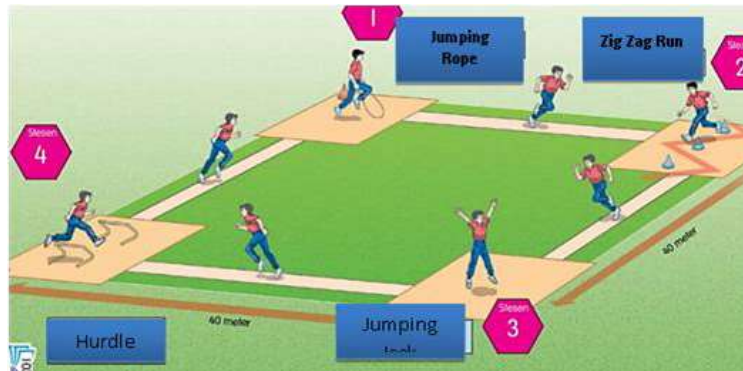

Figure 1. The PE Activities from Textbook

Development

The VR trainer was developed using Unity 3D software, a popular open-source software for VR app development. It was tested and deployed to the Steam platform and was then ready to be tested using an HTC Vive HMD.

Implementation

Implementation involved setting up the data collection lab with the track for the fitness activities. Figure 2 shows the HMD used in the data collection.
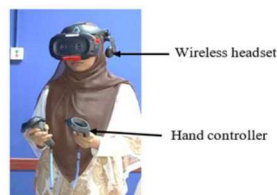

Figure 2. The HMD used for the data collection process

Evaluation

The evaluation process was carried out in a lab and is explained further in the methodology section. Figure 3 displays a screenshot from the app.

Figure 3. The VR trainer shows the Jumping Jack movement in the app
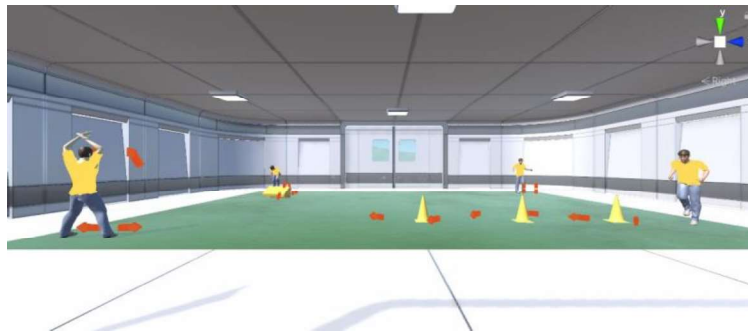

Figure 4. The VR trainers show the movement in the app

Results

Phase 1: Assessing the SLDs' Motivation

A total of 20 students with learning disabilities were involved in this study. Eight of the respondents were female and 12 male. The age range was from 16 to 21 years. None of the students had prior experience of using VR. Information on PE results was obtained from their school to know their understanding of PE. Their PE exam results showed very low achievement. Please bear in mind that these students are special needs students and cannot be compared with the normal classroom. They were given training by the virtual trainer that was personalized according to their profile. Table 4 displays the demographic profile of the students.

Table 4. Students' demographic profile

Data*	Gender	Age	Experience	PE exam grade	Trainer
Data 1	Female	21	No	E	Trainer 3
Data 2	Male	17	No	D	Trainer 3
Data 3	Female	18	No	D	Trainer 2
Data 4	Female	18	No	D	Trainer 2
Data 5	Female	17	No	D	Trainer 3
Data 6	Male	17	No	D	Trainer 2
Data 7	Male	17	No	D	Trainer 2
Data 8	Male	18	No	D	Trainer 1
Data 9	Male	17	No	C	Trainer 1
Data 10	Male	16	A little	D	Trainer 1
Data 11	Female	17	No	C	Trainer 4
Data 12	Female	17	No	D	Trainer 4
Data 13	Female	18	No	D	Trainer 1
Data 14	Female	16	No	C	Trainer 4
Data 15	Male	16	No	D	Trainer 3
Data 16	Male	16	No	D	Trainer 3
Data 17	Male	16	No	D	Trainer 3
Data 18	Male	16	No	D	Trainer 3
Data 19	Male	16	A little	D	Trainer 3
Data 20	Male	17	No	D	Trainer 3

A paired sample t-test was used to test the means of the two tests of the same group. A paired sample t-test was performed to compare the pre-test and post-test motivation. There was a significant difference in motivation between pre-test (M = 4.18, SD = 0.41) and post-test (M = 5.69, SD =0.60); t(19) = -8.34, p = 0.00. Table 5 shows the paired t-test statistics from SPSS, and Table 6 shows the significant results of the sample test.

Table 5. Paired t-test statistics

		Paired sample statistics			
		Mean	N	Std. deviation	Std. error mean
Pair 1	Pre-test	4.18	20	0.41	0.09
	Post-test	5.69	20	0.60	0.14

Table 6. Paired t-test results

						t	df	Sig. (2-tailed)
Paired sample test								
			Paired differences					
	Mean	Std. deviation	Std. error mean	95% confidence interval of the difference				
				Lower	Upper			
Pair 1 Pre-test – Post-test	-1.52	0.81	0.18	-1.90	-1.14	-8.34	19	0.00

Phase 2: Interviews to Investigate Opinions

Eight interview questions were asked to help understand the students' opinions on doing the activities using VR. Table 7 displays the interview results. The results show that most of the students informed the researchers that the VR coaches did help them to understand the movements in PE. They also found it to be fun and agreed that it could improve their performance. However, after the learning session, the students still preferred training in the outdoor setting. Table 7 shows the information that was extracted from the interviews.

Table 7. The interview results

Questions	Conclusion
What is your opinion on the VR trainer?	Most commented that it helped them to understand the steps because it showed step-by-step movements
Is the technology easy to use?	It was difficult to use at the beginning, but it became easier after some time
Do you think this VR technology is suitable to use in PE?	All the respondents said it was suitable
Do you like using VR for learning?	All except one student preferred VR to normal class
Why do you think it is good to use in learning?	Most said because it was fun. However, one respondent said he preferred to learn in the field
Do you feel satisfied and motivated?	All felt satisfied and agreed that it could improve their movements

Item 1: Perceived Ease of Use (PEU)

Question: Is this technology easy to operate and easy to understand?

"Easy to use and can view the demo."

"Being able to play sports in another world, can see examples."

"Easy to use and take anywhere, can be used inside and outside of class."

Question: Do you like this VR technology?

"I like it because it is great like in the game. This is the first time I have used it."

Question: Based on your answer (do you like this VR technology), please state your opinion.

"Because the graphics are the best. It feels like in a game."

"Because it feels fun like in a game, like entering another world."

"Because I feel like I am in another place."

Item 2: Perceived Usefulness (PU)

Question: How do you feel about the virtual trainer?

"He (virtual trainer) helped me by showing an example to do the activity."

"He is so sporting because he shows how to jump."

"He was helpful and did not bother me."

"He bothers me a little, like he is distracting and I cannot focus."

Question: Can virtual trainers improve your motor performance results?

"It helps because after watching it, I understand how to do it."

"Yes, at first I was not sure how to jump using virtual reality, but after watching the teacher (virtual trainer) I knew the steps."

Item 3: Behavioural Intention (BI)

Question: Would you recommend the use of Virtual Reality in PE to others?

"Yes, I will recommend others to use VR for PE because it is so great."

"Yes, everyone should try using VR in PE."

Item 4: Attitude (AT)

Question: Do you feel satisfied after successfully doing the given activity?

"I am so satisfied to be able to do 60 jumps."

"Very satisfied because this is the first time I used VR and I managed to complete the given number of jumps."

Discussion

The motivation of the students is crucial when educators and learning material creators evaluate a suitable design for PE instruction. The results from this study find an increase in motivation for the post-test when the students learn using the VR coaches. The motivational aspect is what keeps the students working on the activity until certain goals are met (M. A. A. M. Hamizi et al., 2022). This idea claims that in order to motivate students, they need to have control over their education and autonomy so that they may finally concentrate on their objectives. It has been demonstrated that giving students some control over particular activities or assistance technology might improve their motor learning. Students must be motivated and persistent in order to complete training in order to maintain exercise and physical fitness during periods of movement restriction when they must primarily stay at home.

The ideal approach for PE in online education at home is to complement the instruction with materials that have

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been imaginatively created and tailored to the requirements of the students. However, several more tests and improvements should be added to the subsequent development process to ensure correct and efficient training in PE, which can then be delivered to the target student and help to increase their health and improve their fitness. This study has also shown how observation is useful for PE instruction. Demonstration or observing is one of the most popular teaching strategies for acquiring motor skills observation (D'Innocenzo et al., 2016). The student's ability to learn by observing increased when various skill levels were raised (Mokmin & Ridzuan, 2022). Previous studies such as those by Bashabsheh et al., (2019) and Fu & Ji, (2023) described the effectiveness of VR for students with disabilities. However, in this study, we can see that there was still a mixed response among the students when VR coaching was introduced. The SLDs may have personal preferences regarding the type of coaching they receive. The results from the interviews supported this, where some of the students still preferred in-person coaching or a combination. Added to that, the accessibility of VR coaching is still very low for SLDs in Malaysia and some technical issues can cause frustration for SLDs during learning. This can impact their overall experience when using VR coaching.

Conclusion

The study investigated the best virtual trainer designs from the students' point of view, as well as how students may acquire physical education using virtual trainers. The outcomes proved that with a proper design, VR could function as an additional learning material and increase learning motivation. Although there was a mixed response among the students on the use of a VR coach for PE, most of the students agreed that the VR coach was a fun and great way to learn PE. The results from this study can increase understanding of the process of learning PE using VR and how the technology can help in learning motor skills. The study examines the effectiveness of VR coaching in improving students' motivation, participation, and overall performance in PE. The investigation's findings shed light on the potential of VR coaching as a tool for promoting PE for SLD. However, this study was only limited to a few workout routines. The study also ran for a limited time, and the results can only be applied to specific students.

Recommendations

We encourage researchers to look at how VR-based instructional materials affect students' interest and enjoyment. There should be an increase in the number of exercise treatments and respondents.

Acknowledgements or Notes

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