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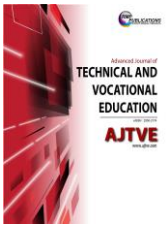

Applying Artificial Intelligence Algorithm through Immersive Technology for Physical Education

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Abstract: Inclusive education is a fundamental human right. However, students with learning disabilities are sometimes excluded from physical education. Virtual Reality (VR) and Augmented Reality (AR) technology are the type of immersive learning that have provided better learning experiences. Personalized learning makes its way towards inclusion in the classroom due to its effectiveness in individualized learning materials by considering the students' different attributes. Thus, this study aims to redesign a personalized and immersive trainer application to facilitate the learning process for the students with learning disabilities (SLD) in physical education using an Artificial Intelligence (AI) algorithm and immersive technologies. This qualitative study assesses ten teachers and 30 students from a special needs school via observation and interviews to design a personalized, immersive physical education learning app. Experts' views and secondary data are also used as supplementary material for the construction of the app. From the interviews and observations done with the students and teachers, it can be concluded that the SLD can learn visually with suitable guidance from the teacher and trainer. The end output of this study is the design of a Personalized Learning System (PLS) that hopefully can be beneficial for developer and educator that wanted to design a good PLS for SLD. Educators and developers can use the result to create a suitable customized app for students with disabilities in learning physical education.

Key words: *Augmented reality, Virtual reality, Physical education, Vocational, Disabilities, Intelligent system*

INTRODUCTION

Inclusive education is a fundamental human right [1], and the education environment should provide students with various abilities and interests with appropriate Physical Education (PE) opportunities [2]. Learning disability is one type of disability, and approximately 82% of students with disabilities (SWD) in Malaysia for 2020 are Students with Learning Disabilities (SLD) [3]. Noor [4] suggested using immersive technology to help schools include SLDs in standard PE classes.

This study redesigned a PLS that includes a VR and AR Trainer specializing for SLD students in PE based on evaluating developed PLS and opinions from the teachers and SLDs. The research objectives are as the following: (i) To investigate the potential of applying the immersive technology as the suitable learning material for SLD in the secondary school setting and (ii) To redesign a suitable PLS for learning PE based on the input from the interview, secondary data, experts' opinions and observation of the teachers and students from the special needs school. This paper describes the related terms and studies about special education, physical education, personalized learning, and immersive technologies. The construct of the app is then discussed in detail, and the methodology of this two-phase study is elaborated. The result and discussion are arranged according to the two-phase method.

1.1 Special Education in Malaysia

Despite the growing policy, academic, and political interest following the gradual trend towards including students with disabilities in mainstream national schools, few studies have described the successful inclusion of SLD in physical education [5].

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1.2 Physical Education

PE in the Malaysian school system refers to Pendidikan Jasmani dan Pendidikan Kesihatan (PJPK) [6] and covers applied knowledge in movements, fitness for health, movement skills, the applied ability for fitness, and sports.

1.3 Students with Learning Disabilities and Physical Education

Speciality Education [7] has suggested the following guideline for the inclusion of the SLD in PE classes, which are (i) Assistance from a partner when doing the activities, (ii) There should be no time limit for certain activities, or the students can learn at their own pace, (iii) Set-up a stationary ball lesson, (iv) The activity learning outcomes should be modified accordingly, (v) Models are used to show certain activities that are hard to understand, (vi) Activities should be done in small numbers, (vii) There should be a good amount of rest between activities. Based on this suggestion, it is essential to modify the class setting for conducive PE classes and prepare a lesson plan that the students can follow based on their predefined needs.

1.4 Virtual Reality in Physical Education

Liu [8] pointed out that VR can enrich physical education classrooms, update teaching methods, and improve the quality and efficiency of physical training. However, there are some issues related to the applications design that developers and educators should consider before implementing complete VR-based PE education.

1.5 Augmented Reality in Physical Education

AR is a new set of mobile technologies in which you can view digital media simultaneously to enhance objects or environments in the real world [9]

1.6 Personalized Learning System

There are various examples of PLS that assisted in learning, such as a PLS coined as CRISTAL created by [10] has been used to personalized mathematics learning by using the students' learning attributes such as learning achievement and learning style to determine the most suitable learning material.

1.7 The PLS Modules

Based on the study by Li & Zhai [11], the following are the six modules of a PLS :

i. Content Delivery Module - Personalized learning content that satisfies the learner's learning behavior

i. Learner Database - Learner input and learning behavior stored in the system

ii. Prediction Module- The learner's behavior and future action were predicted using algorithms that produce data processing and analysis

iii. Display Module - Visualization of the result through the forecasting module

iv. Adaptive Module - By referring to the learner's database, the Prediction module, and the learner's behavior, the content is pushed to the learners.

v. Intervention Module - Intervention from human education should be applied here to update the process with a better result.

1.8 Case-based Reasoning

Case-based Reasoning (CBR) is one of the Artificial Intelligence (AI) technologies widely used in many studies for Personalized Learning System such as [12] [13] and [14]. The first phase is the Retrieval Phase, in which the most identical case is identified to calculate the similarity of the new case provided to the database instances. The second phase is the Revision Phase, which involves testing the proposed solution. At the end of the cycle, the system's operation result will be Retained and referred to again in the last phase of the operation. In this study, a personalized learning system that utilizes the CBR algorithm gives a personalized recommendation of a suitable virtual fitness trainer for students with disabilities.

App Design and Development

The app has the following specific goals (i) To personalized the virtual reality trainer based on the predefined learning attributes of the students, (ii) to enable the students to learn PE augmented using the AR marker and overlay. The users are expected to experience personalized training of PE by the specifically designed trainer and learn about the physical activities related to fitness augmented whenever they wanted by using the app and the book.

1.9 Theoretical Framework

For this study, the Content Delivery Module is based upon the students' lesson plan of the Parcourse training based on their official textbook. For this study, the Case-based Reasoning algorithm is used and works as an "engine" that ensures personalization is carried out by the app accordingly. The Display Module then displayed the forecasting result, and the recommendation of personalized training will be presented to the students using the Adaptive Module. The last phase is the essential part, where the Intervention Module used the evaluation data from the users to update the system and continue the PLS iteration. With more cycles, the PLS will get better over time. The Cognitive Theory of Multimedia Learning is based on the theory designed by Meyer [15]. The theory is applied in this study by

presenting multimedia pieces using multimedia learning techniques.

The PLS Design

[16] defined the domain model as to where all the depository of the learning materials is located. In this study, the domain model consisted of virtual and augmented trainers for all the PE activities related to this study. The Tutorial Model determined which trainer is assigned to the specific students based on the information that was constructed from the Student model. The last model, the User-interface module, is where the pedagogical aspects are applied to ensure all the intended learning materials are presented effectively to the students. In this study, the learning materials are presented to the students via a virtual trainer interface and AR interface. Fig 1 displayed the Models applied for the app development.

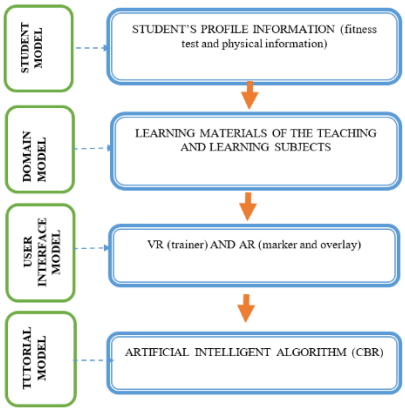

Fig 1 The Models applied for the App

METHODOLOGY

This qualitative study objectively intended to observe the students' acceptance of learning using technology and get an overview and opinion of the best way to teach physical education from the teachers of the special needs students. Firstly, the study measures how the teacher and students will react to the immersive technology applied in learning PE. Secondly, it described the best design of a PLS for learning PE by using secondary data, interviews from the experts, and result from the first phase of the study.

2.1 Population and Sample

The data collection involves the students and teachers in a special needs school which 30 students (15 to 16 years old with minor disabilities) and ten teachers were selected. Based on discussion with the special needs teachers and experts, the inclusion criteria for the sampling are that the students must: (i) be able to understand instructions, (ii) can be directed to use the VR and AR technology, and (iii) have no physical issues. Added to the data collection, ten teachers were also selected from the same school. The teacher has at least three years of teaching experience in the teaching and learning process with SLD.

Two research instruments used for this study are (i) observation and (ii) interview. For the interview, the teachers were asked about the following questions: (i) From their point of view, can the students learn visually with the help of a facilitator?, (ii) What is the best way to design a suitable learning material for SLD?, (iii) What is the most suitable number of students per session, (iv) What is the time limit for each activity to ensure the students' engage with the activities and (v) What is their suggestion for a good design of personalized learning app. Thematic analysis is a way of analyzing qualitative data in the initial phase. It is commonly used in a series of texts, such as interview transcripts, and it will be employed in this study to achieve the second research goal. For the observation, the activities run for two days, and the students were divided into a small group of four to five students. Each group was assigned with a teacher to assist them, and one instructor coordinates the session. There are two activities that the students must do: (i) They have to create a simple 3D design using the graphic given to them, and (ii) They must be able to understand the concept of the 3D object and how 3D objects interact with each other. In the second phase, secondary data and expert interviews were a guideline to design and develop an immersive PLS for learning PE.

RESULTS

As mentioned in the Methodology section, there are two phases involved in this study. For the first phase, the study intended to answer "How does the students and teacher interact with the immersive technology applied for learning?".

Phase 1: The interaction of the students and teacher with immersive technology for learning.

Based on the interview with the teachers and observations done, the following results were collected. An interview was held with six male and four female participants. The themes were identified as 'Technology Experience,' 'Acceptance,' and "Visual Learning."

"Technology Experience"

All respondents agreed with the same statement, and the SLD students need guidance when learning with technology. But to ensure a successful application, the students needed to be guided first by the teachers before continuing to do their lesson when using technology. They can use computers very well, but there are some issues now, and when they can get frustrated when the tools aren't working.

"Acceptance"
When discussing the acceptance of immersive technology, the respondents agree that the approval of the technology in learning is high among the students. It is because they are familiar with smartphones and computers.

"Visual Learning"
The students do prefer hands-on learning and like to try new things. The observations with the 30 students, which consist of three females and 27 males age from 15-16 years old, displayed the following results: (i) The students can be instructed with simple instructions, (ii) They can understand 3D objects visualized in front of them and can imitate the movements illustrated, (iv) They can follow the trainer's instruction very well but with a slower duration than a regular classroom, (v)They have the required capability to construct simple 3D objects and produce 3D objects, (vi) They were comfortable learning using technology and (vii) They can learn very well when the time limit is eliminated and learn at their own pace.

Phase 2: The Design and Development of Immersive PLS for PE.
The second phase collected data from the interview of the two experts in the field of physical exercise. One is an academician, and the other is a certified trainer that has more than three years of experience in Physical Education.
Fig 2 shows the Personalized Immersive Physical Education app's design that resulted from the previous two earlier phases. In the figure, the first box refers to the setup of the CBR reference database where the students' motivation, fitness level, AR and VR fitness trainer recommendation, and motor performance score for every training is calculated and stored in the reference database. The second box represents the activities done during the personalization for every student. These activities constructed the complete personalized, immersive trainer for SLD. When the personalization activity ends, the CBR and motor performance scores are measured, and the iteration continues for the following process.
Fig 3 displays the animation of the fitness trainer showing the parcourse fitness training in an indoor gym setting, and Fig 4 displays the outdoor setting of the fitness activities.

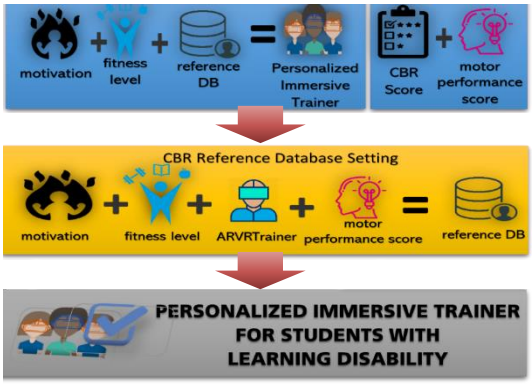

Fig 2 The Design of Personalized Immersive Trainer for SLD

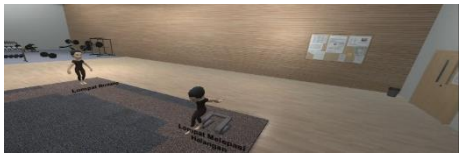
Fig 3 The Training in a Gym


Fig 4 The Training in a Sport Field

DISCUSSION
Phase 1: The interaction of the students and teacher with immersive technology for learning
From the interviews and observations done with the students and teachers, it can be concluded that the SLD can learn visually with suitable guidance from the teacher and trainer. In this study, the selected group of students was given several tasks to be completed. The results show the SLDs can follow instructions very well and are comfortable learning with technology. We suggest that immersive technology can be designed and developed to assist the SLD in their learning process.

Phase 2: A suitable design of an effective personalized learning immersive app for PE for SLD
Based on the result and analysis from Phase 1, we can conclude that a personalized, immersive learning app can be beneficial to upgrade the learning experience of SLDs and, at the same time, and solve issues concerning the teaching and learning of students with learning disabilities. Thus, in phase 2, the method of a personalized, immersive learning app for physical education is illustrated by combining the personalized learning model, VR and AR technology model, and physical education learning materials. The next step of the design process is developing and testing before the

fully functional app can readily meet the targeted user. This study managed to get a better view of how a physical education learning material should be developed for a practical lesson from the perspective of the teachers and students. Hopefully, the result can be used to improve the quality of special education.

CONCLUSION

This is a two-year study involving testing a personalized virtual physical education trainer, careful observation and interview with the targeted end-user, and redesigning a new personalized, immersive learning trainer for physical education. The end output of this study is the design of a PLS that hopefully can be beneficial for developer and educator that wanted to design a good PLS for SLD. For future research, the complete development process and comprehensive testing should be carried out to ensure the app functions as needed and bring good results to the targeted users, the students with disabilities.

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