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Augmented Reality (AR): An Assistive Technology for Special Education Needs

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ABSTRACT

Since 2017, the Ministry of Education has introduced Basic Vocational Skills subjects that able special students to master basic living skills in their schooling years underlying Secondary School Standard Curriculum – Special Education (KSSM –PK). The biggest challenge for individuals with ASD is to be independent and get jobs after schooling. Hence, beginning in 2017, Secondary School Standard Curriculum – Special Education (KSSM –PK) has introduced the Basic Vocational Skills subject, which students must master during their schooling years. From the preliminary study, many teachers revealed that they face difficulty delivering lessons primarily related to teaching and learning materials to enhance ASD students mastering living and vocational skills. Designing and developing effective teaching and learning aids, especially for children with special education needs are in alarming stages. Parents and caregivers indicated they face insufficient enhancement and practice learning tools for their children, especially after school hours. The guidebook and extra exercise books are essential for them to master their learning while at home. In response to the gap mentioned earlier and decipher the myriad of potential uses of Augmented Reality (AR) as an assistive educational technology, the current study aimed to design and develop a differentiated instructional pedagogical kit (Kit-MASAK) with AR to assist children with special education needs especially ASD students master in basic vocational skills Preparing and cooking skills). Methodologically, a total 3 students were involved in the phenomenological study. The preliminary analysis of the data summary across the case studies revealed that the Kit MASAK successfully brought contemporary content into the classroom, leading to an exciting teaching and learning environment among students. Furthermore, this study also provides several significant implications for the research and practice.

1. Introduction

In Malaysia, students with ASD are categorized as having underprivileged learning disabilities (Department of Social Welfare [JKM], 2019). Even though ASD students are assessed as children with special needs, they are still entitled to access quality education on par with mainstream students,

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aligning with the Malaysian Ministry of Education (KPM) principle, Education for All. This KPM principle is also supported by the policy of the Persons with Disabilities Act 2008, which states that "the disabled cannot be excluded from the education system general based on disability, and children with disabilities cannot be excluded from primary, secondary and higher preschool education, on the basis of equality with disabled people or children, including vocational training and learning lifetime." (p. 26). With that, they are not only educated in pure academics. Still, they should receive life skills education and vocational to increase their potential and enable them to be independent and get a job later. Based on this, MoE has introduced the subject of Vocational Skills in the Special Education curriculum to expose the career paths available in the market for children with special education needs. The number of children with special education needs has increased dramatically in Malaysia, especially for ASD. ASD is identified as a neurological development disorder where they are unable to communicate and show repetitive movements and tendencies [1].

The use of learning applications based on AR technology is increasing because it provides a learning process that is easier to understand and more interesting [2]. This AR technology can educate students in ordinary classrooms and students with special needs. It is proven by various efforts that have been made to involve the use of technology in special education needs in teaching and learning, especially for ASD students [3]. Martono *et al*., argues that the application of AR technology is handy to children with special education needs because of its ability to help them in learning, especially related to objects and activities daily [4]. AR can potentially connect the real world with 3D effects [5] and is a suitable technology for helping children with special education need especially related to ASD students solve challenges faced in the classroom [6]. AR is also a technology that can help individuals with special needs improve their functional skills [7].

The significant impact of ICT The National Key Result Areas (NKRA) and Malaysia Education and Development Plan (PPPM – 2013-2015) remains committed to preparing the children with special education needs who can be more independent and get jobs after schooling.

However, the country is still facing the problem of educating children with special education needs, especially students with autism spectrum disorder problem, who seems to be the most potential to be prepared to join the Inclusive Education Program (PPI). Indeed, PPPM targeted 75% of students with children with special education needs to be absorbed in the PPI by 2025. Consequently, the core challenge is to design and develop the most suitable pedagogical practices for individuals with ASD while preparing them for inclusion classes. Research contends that ASD students learning in their preferred learning styles can dramatically improve performance in various aspects [8-12]. By providing the best pedagogical practices to children with special education needs especially related to ASD student's means that these children are better prepared for the total inclusion education program in the mainstream and, after that have access to the same curriculum as normal children.

2. Research Methodology

This study also applies the following elements for Augmented Reality Animation (ARA) applications, as shown in Figure 1. In the startup phase of the ARA application, the user will install and run the application. Next, overlay the mobile deviser on the flash card to form the 3D image. The application is followed by frame calibration through the image tracker, and finally, the image will be converted and sent to the frame converter. Eventually, the camera will produce a 3D image on the screen. The AR-integrated technology has been inserted in many studies related to education technologies [13].

Methodologically, a pre-post research design will be carried out on this teaching new ways of teaching; (compare before and after treatment) towards children with special education needs especially. Methodologically, 4 phases are involved in the study. Phase 1 is a systematic literature review, developing Learning Styles Profile (LSP) checklist for ASD, developing the Kit-MASAK based on visual, auditory, tactile/kinesthetic, and creating a teacher-parents' guidebook. Phase 2 verifies the usability and suitability of Kit-MASAK and its guidebooks. Phase 3 is the implementation stage. Phase 4 is the evaluation stage using a comparative - assessment approach based on the criteria in KSSM-PK and conceptualizing and refining the Kit-MASAK (Appendix 1-Photos during the implementation).

The pre-post assessments have been conducted to identify the effectiveness of the new pedagogical practices via AR. The more significant differences between the pre-test and post-test scores obtained, the greater the effectiveness of the new teaching aid with integrating AR features. The scores obtained from the post-test will prove the student's ability to achieve basic living skills after the treatments of using AR interactive pedagogical practices. If there is a significant difference before and after using teaching aids, the more significant and the higher the level of student character achievement.

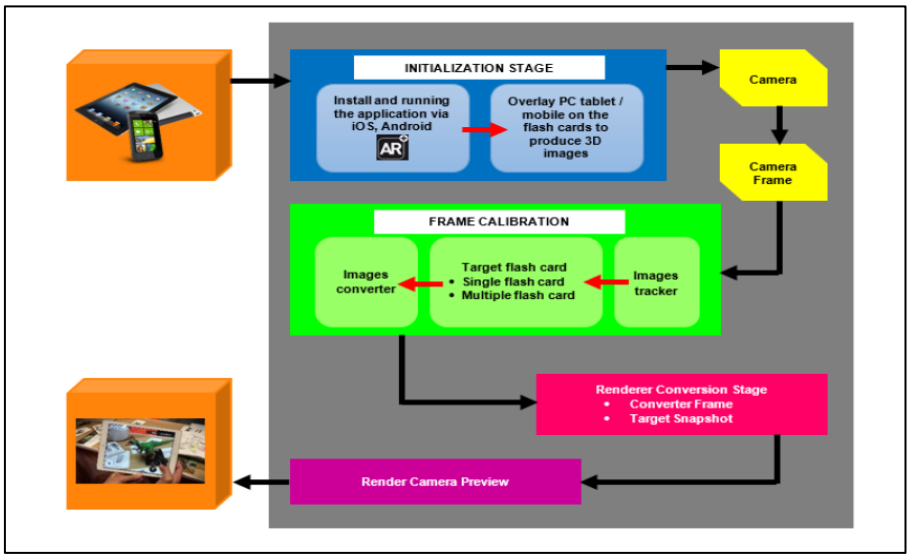

Fig. 1. The Core Components of Augmented Reality Animation Application

The study used the purposive method to select Special Education teachers and children with special education needs as respondents. The selection of the teachers is based on their experience in teaching Special Education. Based on teaching experience, they will give opinions and feedback on research questions. The teachers and students voluntarily agree to be the sample of this study. The researcher met all the respondents individually and conducted interviews using semi-structured questions. Methodologically, the study has collected, analyzed, and compared the pre and post-test results from special education students who taught using KIT-MASAK. Besides that, the usability of the new pedagogical practices with the integration of AR was carried out to understand Special Education Teachers' perceptions after they went through the teaching process.

3. Literature Review

The literature studies indicated that AR could help make the teaching and learning process more meaningful [14,15,36]. Much research has significantly indicated assistive technologies' contributions

to teaching and learning among special needs students. Although its use is growing, related research and findings about its effects are still limited [16-19]. Similar studies are also supported by the statement of Khan's study [20] that research on the application of AR in the field of education is still needed to understand the contribution of AR among teaching and learning. According to study conducted by Lorenzo *et al*., [19], it indicated the importance of assistive technology for students with special needs and other subjects such as Mathematics [21].

Assistive technologies provide exciting possibilities among students with special needs also been highlighted in many previous studies [10,13,22-25]. Indeed, empirical studies on the role of technology-assisted learning via Augmentative and Alternative Communication (AAC) have shown its relevance and contribution to individuals who can communicate and interact with peers and family [26-29].

However, in Malaysia, the integration of assistive technologies into special education has yet to keep pace with technological advancements [30,31]. Studies on what works and what does not and how to implement it remain unclear. For example, integrating Augmented Reality (AR) among ASD students is still immature. Systematic studies of AR as assisted pedagogy for ASD are yet to be accomplished. However, AR has become a seemingly ubiquitous part of technology in education these days and ushered the new area of assistive technology [32]. AR is believed to have a huge impact and could bring many advantages to special education, especially for ASD learners, bridging the gap between the virtual and the real world. Consequently, AR as an assistive technology appeal to people with ASD. According to [33], students who learn with augmented reality integrated into a mobile learning will be more motivated to study. The participating students engaged in learning as they were interested in using augmented reality for further learning for example, using a magic wand to associate with the augmented reality technology.

The following are some of the features in the Kit MASAK developed using AR based on the Core Components of the AR Application in this study.

4. Discussion of Common Themes and Overall Findings

The significant contributions of assistive technologies for teaching and learning have produced the most support and were recognised in this study. KIT-MASAK has proven that it can become an assistive technology for students with special education needs especially for ASD, as most have intrinsic attitudes and preferences toward or aptitude for technology. The study has indicated and supported the empirical studies on the importance of related technology-assisted learning via Augmentative and Alternative Communication (AAC), proving its benefit to individuals with a means to communicate and discuss with classmates. Researchers have summarised the pedagogical practices and benefits of using Kit-MASAK in teaching and learning among special education students based on the participating teachers and students using KIT-MASAK.

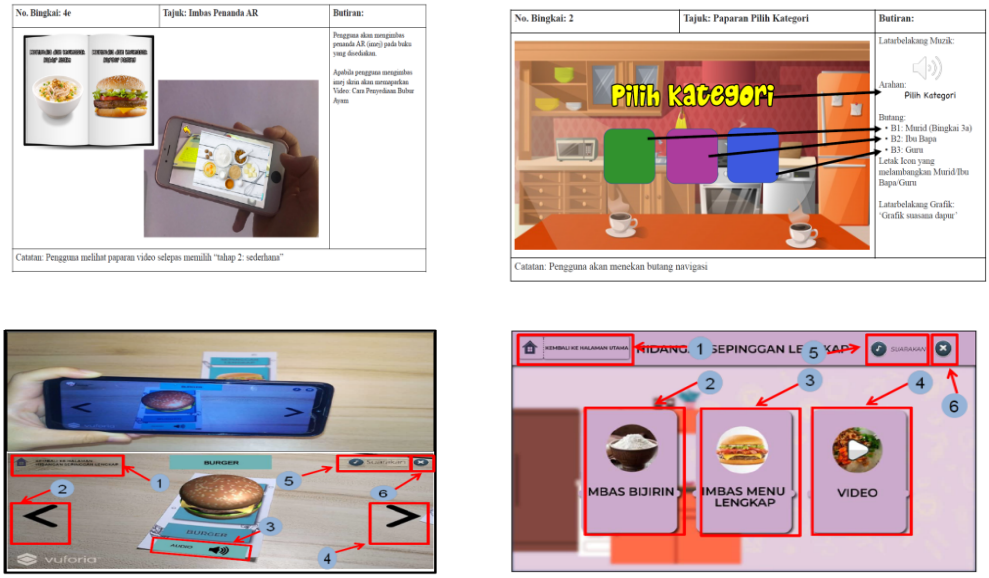

Fig. 2. Interface of *Hidangan Sepinggan Lengkap*

The interviewed teachers have shown their enthusiasm in many ways to incorporate assessment using and integrating Augmented Reality (AR) among students with special education needs especially for ASD students. Researchers believed that KIT-MASAK could provide an excellent channel to assess their children efficiently and effectively in the form of diagnostic, formative, or summative. The study has demonstrated the effectiveness of new teaching and learning practices through a comparative approach based on the pre-post analysis. The data for students' academic performance is collected from a post-test checklist. The findings align with the previous study [10,27].

The study has indicated that the use of KIT-MASAK was able to assess the engagement (engage children and elicit prior knowledge - diagnostic), exploration (provide hands-on experience of the phenomenon-formative), explanation (consider current scientific explanations formative), elaboration (investigating outcomes-summative) and evaluation (conceptual outcomes-summative) among special need students.

Besides that, teachers revealed that using KIT-MASAK successfully increased and captured and elicited students' interest in AR to assist students with special education needs in mastering basic vocational skills. The Kit-MASAK also serves as the practice or enrichment materials after school hours and a guidebook for parents or caregivers to educate their special children. Participating teachers noted that the new pedagogical practices via AR successfully capture and spark students' interest, stimulate their curiosity, and elicit their existing beliefs about the topic. The findings related to the previous study on using technology to assist special education [27,36]. These are because the features of KIT-MASAK with AR integration successfully invite special needs students' curiosity. Furthermore, children could have a better understanding and clearer picture of the topics or subjects especially related to *Jenis-jenis Bijirin, Contoh Menu Lengkap*, and *Cara Menyediakan Hidangan Lengkap* (types of cereals, examples of complete menus, and how to prepare complete meals) as listed in the special education syllabus in the Standard Secondary School Curriculum for Special Education (KSSM-PK).

Another teacher prompted that using the KIT-MASAK with AR integration, many pictures and videos can be found easily in the Apps. The teachers noted that they could bring to sharing ideas and generating new learning through spin-out questions. Furthermore, this will enhance children's retention and, as a result, increase students' motivation. The finding is related to the study by [17,24,33,36] noted that the importance of educational technology for teaching and learning.

One of the interviewed participants revealed that new ways of teaching pedagogy via KIT-MASAK with AR integration could teach multi-sensory lessons, seamlessly changing from different media types to one another. It can scan the card and be prompted in the mobile phone in a 3D context. Text, sound, video, and graphics can simultaneously explain better scientific ideas and concepts to the students. These support several different learning styles, visual-spatial, auditory and kinaesthetic. The KIT-MASAK provides teachers and students with a new interactive learning environment to share ideas, information, images, animations, audio, or video. The new pedagogical practices significantly impact children with children with special educational needs especially who face learning difficulties in the form of disorders and disabilities such as dyspraxia, dyslexia children and dyscalculia.

One of the most obvious distinctions between the features of KIT-MASAK with AR integration technology and other technologies is the facility to allow students to touch mobile technology. Interviewed teachers revealed that having a touch screen enabled them to explain and teach with more focus. Students with ASD or neurological differences must be shown and pointed out while explaining certain concepts to ensure they can follow the lesson. With touch screen facilities, we can perform explanations without neglecting them compared to textbooks. The touch-sensitive nature of AR facilitates a more efficient presentation and its resources.

Furthermore, teaching materials can be used and revised for further use in future teaching and learning activities. That brings immediate benefit during the lesson, as teachers can return to earlier pages or screens to help them who need extra explanation or for reinforcement purposes. This feature inserted in the KIT-MASAK with AR can be re-accessed to make links between ideas or used to recall or reflect on whatever has been taught at the beginning of the next lesson. Indeed, the extra information added during the lessons can act as an invaluable prompt or source of ideas on a future date. A teacher mentioned using the apps to bring the previous information and pictures into her lesson again. Having this has made her teaching more effective. The study has contributed and proven the importance of educational technologies in teaching and learning [36-40].

Most participating parents and caregivers also have positive reviews of the Apps that believe they can help their children or child under their care. They viewed that having the Apps has reduced or solved the problem of insufficient enhancement exercise materials for their children. They could do their learning independently after school hours without any hassle. This is because the apps use the same syllabus as taught in school. The special education children can interact with the apps by choosing the AR card or dragging and dropping on the material shown on the mobile with AR-integrated cards.

5. Conclusion

Augmentative and Alternative Communication (AAC) has proven its benefit individuals with a means to communicate among students and enhance the teaching and learning process to assist children with special education needs to master in basic living skills. Being challenged to improve students' mastery of basic living skills and achievement of students with disabilities, educators must implement different types of teaching pedagogical practices to enhance the learning process, especially related to research-based methodologies that have the potential to bridge the research-to-practice gap.

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