Overcoming the challenges of English vocabulary learning for students with autism spectrum disorder (ASD) through the development of virtual reality technology

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Abstrak

Penggunaan Virtual Reality terhadap siswa dengan kebutuhan khusus seperti ASD, memiliki kesempatan yang lebih adil untuk berkembang dalam pembelajaran kosakata bahasa asing, dalam hal ini Bahasa Inggris. Metode Penelitian yang digunakan adalah Human Centered Design melalui tahapan seperti: Analisis Konteks Penggunaan, Analisis Kebutuhan Pengguna, Perancangan Desain Solusi dan Evaluasi Desain Solusi. Hasil penelitian setelah pelaksanaan Uji Coba kepada siswa ASD diperoleh hasil spesifikasi produk yaitu produk VR berupa aplikasi pembelajaran kosakata bahasa Inggris berbasis VR untuk anak ASD dengan konten kosakata dasar, navigasi sederhana, desain ramah anak ASD, serta dukungan progress tracking untuk guru/terapis. Kemudian, Validisasi Teknologi Virtual Reality yang telah dikembangkan berdasarkan validitas dari Ahli media, Ahli materi dan Terapis dinyatakan Sangat Valid. Hal ini didasari dari hasil angket validitas yang diberikan kepada para ahli dan Penguasaan Kosakata siswa ASD setelah melakukan pembelajaran bahasa inggris menggunakan teknologi Virtual Reality yang telah dikembangkan adalah mereka mampu untuk mengucapkan kosakata dan melafalkan nya dengan baik. serta mampu mengingat kembali bahasa inggris dari objek yang diamati

Kata Kunci: Virtual Reality, Siswa Autism Spectrum Disorder, Kosakata, Bahasa Inggris

Abstract

The use of Virtual Reality for students with special needs, such as ASD, provides a fairer opportunity for them to develop in learning foreign language vocabulary, in this case English. The research method applied was Human-Centered Design, carried out through stages such as: Context of Use Analysis, User Needs Analysis, Solution Design, and Solution Evaluation. The results of the study, after conducting trials with ASD students, produced a product specification in the form of a VR-based English vocabulary learning application for ASD children, featuring basic vocabulary content, simple navigation, ASD-friendly design, and progress tracking support for teachers/therapists. Furthermore, the validation of the developed Virtual Reality technology, based on assessments from media experts, content experts, and therapists, was declared Highly Valid. This conclusion was drawn from the results of the validity questionnaires given to the experts, as well as from the vocabulary mastery of ASD students after learning English using the developed Virtual Reality technology—showing that they were able to pronounce and articulate the vocabulary correctly, as well as recall the English words of the observed objects.

Keywords: Virtual Reality, Autism Spectrum Disorder Students, Vocabulary, English

Background

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by difficulties/differences in social communication, interaction, language, cognition, and behavioral activities in various contexts (1) English is one of the language areas that can be accessed by anyone including autistic children because English has become a necessity for Indonesia in the current era of globalization and the level of need for English is getting stronger (2) and inclusive education can help children with autism to survive and thrive in the future (3). Vocabulary is the main aspect in learning English besides learning grammar without having to pay attention to the main skills that must be mastered (4).

In English language learning, students with ASD have special challenges in the vocabulary learning process (5). These difficulties are often related to communication and social disorders, lack of focus and concentration during the teaching and learning process and speech delays (6). However, they have visual memory so they are included in the category of visual learners which makes it easier for them to memorize easily and process a lot of material at a fast pace (7). The use of Virtual Reality significantly helps in improving children's visual memory and understanding of new words and helps learn English vocabulary and finds positive results (8) VR can be used to meet the educational needs of children with ASD, especially in language learning, training social skills including communication skills. such as vocabulary recognition in everyday situations (9).

English vocabulary can be taught through relevant and repetitive VR scenarios (10). Therefore, VR has shown great potential in supporting students with ASD, particularly in English language learning, by utilizing a controlled, interactive, and hands-on visual approach. This way, they will have a fairer opportunity to develop foreign language vocabulary, in this case English, interact with a more dynamic learning environment, and develop their social communication skills.

Several studies on English language learning for ASD students have been conducted (11)(12). However, the use of Virtual Reality Technology as a medium for learning English vocabulary for ASD students is still very minimal, even though the use of visual aids increases the motivation of ASD students to learn and makes teaching these special students easier (13). Therefore, the novelty/advantages that distinguish this study from previous studies are: First, Integration of VR Technology in English Vocabulary Learning: This study developed a VR application specifically designed to help ASD students in learning English vocabulary. This application presents 3D objects that can be rotated, providing an interactive and immersive learning experience, which is different from traditional learning methods. Second, Individual Approach and Personalization: The developed VR application allows for the adjustment of learning materials according to the individual needs and abilities of ASD students. This feature provides flexibility in the learning process, allowing students to learn according to their own pace and learning style.

Third, Improving Social and Communication Skills: In addition to focusing on vocabulary learning, the VR application is also designed to train the social and communication skills of students with ASD. Through simulated interactions in a virtual learning environment, students can practice and develop their social skills in a safe and controlled context. By combining VR technology, a personalized approach, and the development of social skills, this study provides a new contribution to learning methods for students with ASD, which is expected to improve the effectiveness and quality of their English vocabulary learning.

The urgency of this research is reinforced by the fact that using technologies like VR can help create personalized, interactive, and individualized learning environments. Through VR, students can learn vocabulary in more realistic and relevant contexts, enabling them to understand words through direct experience. For example, vocabulary about the school environment, home, or nature can be taught through simulated real-life situations in VR, providing a deeper understanding than through text or images alone. This technology gives students the opportunity to visualize and interact with the objects they are learning about, thereby strengthening their understanding and memory of new vocabulary.

Problem Statement

Based on the background above, the problem formulation in this research is as follows:

1. What are the product specifications resulting from the development of VR technology in English vocabulary learning for students with ASD?
2. What is the validity of VR technology in English vocabulary learning for students with ASD?
3. What are the results of the user experience questionnaire (UEQ) after using VR in English vocabulary learning for students with ASD?
4. What is the English vocabulary mastery of students with ASD after using VR?

Objective of Research

The objectives of this research are through the use of virtual reality, students with special needs, such as ASD, have a fairer opportunity to develop foreign language vocabulary, in this case, English.

Significance of Research

This research is expected to provide the following benefits:

Theoretical Benefits: Contributes to the development of educational science, particularly in the field of foreign language learning for students with special needs. then, Enriches the literature on the application of immersive technology (Virtual Reality) in English vocabulary learning. And serves as a theoretical foundation for further research integrating the Human-Centered Design (HCD) approach with inclusive education.

Practical Benefits:

For Students: Provides a fairer opportunity for ASD students to develop their English vocabulary skills. Then, Increases learning motivation and engagement through interactive and enjoyable VR-based activities. and helps students understand and memorize vocabulary more effectively by using visual, auditory, and contextual cues.

For Researcher: Provides direct experience in implementing design-based research using the Human-Centered Design approach. Then, nnhances researchers' competence in the field of technology-based learning media and special education and becomes a foundation for further studies, such as developing VR for social communication skills or other language materials.

For Therapist/Teachers: Acts as a supporting tool for language therapy in ASD students, helping to strengthen communication-based interventions then, facilitates therapists/teachers in delivering English vocabulary through immersive virtual environments

Method

This research is a Research and Development (RnD). The subjects were students with ASD at Pohuwato State Special Needs School, Pohuwato Regency, Gorontalo. The study was conducted from June to August. The research procedures were as follows:

1. Literature Review: Collecting literature related to VR for English vocabulary learning for students with ASD, including interviews with practitioners at autism schools.
2. Context of Use Analysis: Analyzing the users and system environment. The users of this VR technology are students with ASD accompanied by teachers. This involves identifying users and stakeholders, as well as identifying the product's objectives.
3. User Needs Analysis: Interviewing stakeholders to identify the needs of autistic students in English learning, particularly vocabulary.
4. Solution Design: Designing the materials, content, design, interface, and storyboard for the VR application to be developed.
5. Solution Design Evaluation: Testing to determine whether it meets user expectations and needs. This stage is considered crucial, so researchers can only proceed to the next stage after the design is deemed satisfactory.
6. Development: All multimedia objects or materials are created. Application development is based on the design

stage. This stage also includes expert validation by multimedia experts, material experts, and autism experts.

7. Evaluation: The completed VR product is evaluated using a user experience questionnaire (UEQ) to measure user experience when using the product and to evaluate its strengths and weaknesses.

8. Conclusion: Summarizes the findings and results of the entire process.

Instrument in this research is Questionnaire to Expert Media, Content Expert and Therapist. Technique Analysis Data:

Instrument: Validation questionnaires from media experts, material experts, and therapists using a 4-point Likert scale SI = 1, I = 2, V=3, VV = 4).

Process:

Assign numerical scores to each response.

Calculate the total score obtained for each item.

Determine the maximum possible score.

Calculate the percentage using the formula:

$$Percentage = \frac{Total\ Score\ Obtained}{Maximum\ Score} \times 100\%$$

Classify results into four categories:

0–25 = Strongly Invalid(SI)

26–50 = Invalid (I)

51–75 = Valid (V)

76–100= Very Valid (VV)

Result and Discussion

A. The Development of Virtual Reality Technology in English Vocabulary Learning for Students with Autism Spectrum Disorder (ASD)

The development of Virtual Reality Technology aims to overcome the challenges of learning English vocabulary for students with Autism Spectrum Disorder (ASD), the use of Virtual Reality significantly helps in improving children's visual memory and understanding of new words and helps learn English vocabulary and find positive results (1). Virtual Reality can be used to meet the educational needs of children with ASD, especially in language learning, training social skills including communication skills. such as vocabulary recognition in everyday situations (2). English vocabulary can be taught through relevant and repetitive VR scenarios (3). Therefore, VR shows great potential in supporting students with ASD, especially in terms of English learning, by utilizing a controlled, interactive visual approach and direct experience.

The content development and simulation stages in this research involved the MilleaLab application. MilleaLab provides a virtual reality platform that allows users to create interactive and easily accessible learning content.
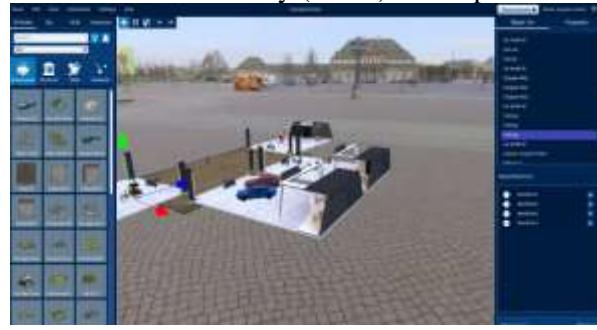

Picture 1: MilleaLab Application

Picture 2: Virtual Reality Technology Scene Vocabulary (Things in the Classroom) developed

Picture 3: Virtual Reality Technology Scene Vocabulary (Fruits) developed

Picture 4: Virtual Reality Technology Scene Vocabulary (Transportation) developed

Picture 5: English Vocabulary Materials

The vocabulary materials designed for the developed Virtual Reality content are as follows:

1. Transportation
2. Things in the Classroom
3. Fruits
4. Animals

Picture 6 : One of the scenes of Virtual Reality Technology that was developed (Animals)

B. Validation of the Virtual Reality Technology that has been developed

Validation activities aim to ensure that the developed virtual reality technology is effective, feasible and in accordance with the research objectives, namely overcoming the challenges of learning English vocabulary for students with autism spectrum disorder (ASD). The selection of validators for the development of Virtual Reality technology to overcome the challenges of learning English vocabulary for students with Autism Spectrum Disorder (ASD) is carried out by considering several important aspects to ensure that the developed Virtual Reality technology meets technical, pedagogical and ASD quality standards. The First Validator is a Material Expert, the Second Validator is a Media Expert and the Third Validator is a

Therapist who specializes in Children with Autism Spectrum Disorder (ASD).

a. Results of Validation by Material Experts:

No	Aspect	Indicator	Score	Exp
1.	Material Suitability	Developmental Level	94	Very Valid
		Relevance		
		English Language skill		
		Learning Curriculum		
2.	Presentation of Material	Use of Audio Visuals	87	Very Valid
		3D Object		
		Consistent		
		Allow repetition		
3.	Clarity and Understanding	Stable operation	85	Very Valid
		Comprehension		
		Memorization Ability		
		Object Clarity		
		Fast		
	Average		**89**	**Very Valid**

Table 1: Results of Material Expert Validation

Based on Table 1, it can be concluded that the average validation score by the material experts was 89, categorized as very valid. Furthermore, the results from the media experts are as follows:

b. Media Expert Validation Results

No	Aspect	Indicator	Score	Exp
1.	Media View	Attractive	87,5	Very Valid
		Color Selection		
		Interface		
		Visual Effects		
		Animation		
		Graphic Quality		
2.		Clear Audio	81,3	

No	Aspect	Indicator	Score	Exp
	Audio and Interactivity	Synchronization		Very Valid
		Sound Effects		
		Media Interactivity		
3.	Technical	Stable operation	80	Very Valid
		Compatible		
		Media Instruction		
		Power capacity		
		Smooth Operation		
	Average		**83**	**Very Valid**

Table 2: Media Expert Validation Results

Based on table 2, it can be concluded that the results of the media expert validation for the development of VR technology for ASD students obtained an average score of 83, which means it is very valid.

c. Therapist Validation Results

No	Aspect	Indicator	Score	Exp
1.	Student Engagement and Behavior	Focus	81,2	Very Valid
		Enthusiasm		
		English Proficiency		
		Avoidance Behavior		
		Student Interaction		
2.	Ease of Use	Easy to use	93,7	Very Valid
		Barriers		
		Self-study		
		Vocabulary Repetition		
3.	Vocabulary Material	As needed	91,6	Very Valid
		Easy to understand		
		Easy to remember		
4.	Development and Effectiveness	Language development	100	Very Valid
		Vocabulary pronunciation		
		Communication skills		

No	Aspect	Indicator	Score	Exp
		Therapy media		
5.	Comfort and Security	Overstimulation	75	Valid
		Duration of Use		
		Physical Disorders		
		Therapist/Teacher Involvement		
	Average		**88,3**	**Very Valid**

Table 3: Expert Therapist Validation Results

Based on table 3 above, the results of the validation by therapists for the development of VR technology in learning English vocabulary for ASD students are declared Very Valid.

C. Virtual Reality Technology Evaluation (Trial)

Based on the results of this trial, the following are the evaluation results of the application:

a. Technical: The application's stability is very good, with device comfort and visual and audio quality being excellent.

b. Usability: In terms of navigation, some students with ASD still felt confused about navigation and the legibility of the icons.

c. Learning Effectiveness: Vocabulary mastery, as evidenced by the students with ASD being able to recall vocabulary displayed in the developed Virtual Reality Technology Application.

d. Engagement and Motivation: The students with ASD appeared enthusiastic and excited when using virtual reality technology.

e. Psychological and Sensory Comfort: Two students experienced dizziness after using VR technology.

Based on the findings above, revisions were made to the developed virtual reality technology to address the technical issues identified and minimize disruptions or impacts on students with ASD, ensuring greater effectiveness on a larger scale. This trial is crucial to ensure that the virtual reality technology developed for English vocabulary learning for students with ASD is feasible and effective for classroom use before broader implementation.

Conclusion

Product specifications resulting from the development of Virtual Reality (VR) technology

in English vocabulary learning for students with ASD include a VR product in the form of a VR-based English vocabulary learning application for children with ASD, featuring basic vocabulary content, simple navigation, a child-friendly design, and progress tracking support for teachers/therapists. Validation of the developed Virtual Reality technology, based on the validity of media experts, material experts, and therapists,

was declared Very Valid. This is based on the results of a validity questionnaire administered to the experts. and vocabulary mastery of ASD students after learning English using the developed Virtual Reality technology is demonstrated by their ability to pronounce and pronounce vocabulary correctly, and by their ability to recall English from observed objects.

References

Shahab M, Taheri A, Mokhtari M, Shariati A, Heidari R, Meghdari A, et al. *Utilizing social virtual reality robot (V2R) for music education to children with high-functioning autism*. Educ Inf Technol (Dordr) [Internet]. 2022;27(1):819 43. Available from: https://doi.org/10.1007/s10639-020-10392-0 Gronlund, N.E. & Linn, R.L. (1990). *Measurement and evaluation in teaching. (6thed.)*. New York: Macmillan.

Mulyanti, E., & Sya, M. F. *Pemerolehan Kosakata Bahasa Inggris dengan Media Kartu Bergambar di Sekolah Dasar*. Karimah Tauhid. 2023; 2(2): 409 504 Daniel, W.W. (1980). *Statistika nonparametrik terapan*. (Terjemahan Tri Kuntjoro). Jakarta : Gramedia.

Md Yunus M, Suliman A, Szee Huei L, Fang Kai T, Kiew S. *The Use of Voca Lens to Enhance the Students Vocabulary* Repertoire. International Journal of English Language and Literature Studies. 2020;9(3):172–84.

Edyyul, IA, Earnestly, F. *Peningkatan Kemampuan Kosakata Bahasa Inggris Anak Autis Melalui Permainan Kartu dan Gerak Lagu*. JPD: Jurnal Pendidikan Dasar. 2023; 14(2): 146-157

Annisa Aulia Rahma, Akifah Humaira Salsabila. *Gangguan Berbahasa pada Anak Autis Ringan. Pragmatik* : Jurnal Rumpun Ilmu Bahasa dan Pendidikan . 2024 Aug 1;2(4):01–8. Suyanto, S (2009). Keberhasilan sekolah dalam ujian nasional ditinjau dari organisasi belajar. *Disertasi*, tidak dipublikasikan. Universitas Negeri Jakarta.

Maysuroh S, Dwimaulani A, Wati L, Nurhayati, Yusri Nurul. *Teaching English to Students with Autism Spectrum Disorder (ASD)*. Journey: Journal of English Language and Pedagogy. 2024; 7(1): 161-167. Retnawati, H. (2014). *Teori respon butir dan penerapannya*. Yogyakarta: Nuha Medika.

Puspitaningtyas, A. R., & Pratiwi, V. *Pengaruh Media Visual (Gambar) Terhadap Kemampuan Kosakata Anak Autis*. Al-Aulad: Journal of Islamic Primary Education. 2020; 3(1).

Tsai CL, PYC, & HPW. *Using virtual reality to facilitate vocabulary learning for children with autism*. Interactive Learning Environments. 2020;28(5):582–98

Ke F, Moon J, Sokolikj Z. *Virtual Reality–Based Social Skills Training for Children With Autism Spectrum Disorder*. Journal of Special Education Technology. 2020 Sep 15;37:016264342094560.

Cobb S, & SP. *The educational needs of children with autism spectrum disorders and the potential of virtual reality to meet those need*s. J Assist Technol. 2013;7(2):66–72

.Susanti RRD. *How to Improve English vocabulary for Students with Autism?*. IJAER [Internet]. 2024 Feb. 28 [cited 2025 Apr. 8];2(1):1-16. Available from: https://journal.multitechpublisher.com/index.php/ijaer/article/view/1143

Sari, D. F., Gea, E. R., & Fajrina, D. *The listening skill of autistic students in learning english through total physical response. Studies in English Language and Education*. 2021; 8(1), 34–46. https://doi.org/10.24815/siele.v8i1.18131

Gladfelter, A., Barron, K. L., & Johnson, E. *Visual and verbal semantic productions in*

children with ASD, DLD, and typical language. Journal of communication disorders. 2019; 82, 105921. https://doi.org/10.1016/j.jcomdis.2019.10 5921

Curriculum Vitae

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