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ORIGINAL

Bibliometric Mapping of Trends of Project-Based Learning with Augmented Reality on Communication Ability of Children with Special Needs (Autism)

Mapeo bibliométrico de tendencias de aprendizaje basado en proyectos con realidad aumentada sobre la capacidad comunicativa de niños con necesidades especiales (autismo)

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ABSTRACT

Autistic children have the right to education. Education helps them develop their communication skills. Using a project-based learning model can improve communication skills. Currently, there is a lot of research discussing the use of project-based learning for children with special needs. Therefore, this study aims to analyze the use of project-based learning with augmented reality on the communication skills of autistic children. The method used is a systematic literature review and theoretical bibliometric analysis of research on communication skills of children with autism sourced from Scopus from 2013 to 2022. The research stages are determining i) research questions; ii) inclusion criteria; iii) quality assessment; iv) data collection; and v) bibliometric analysis. The results of this research note that research on the communication skills of autistic children is still a research trend that is of great interest to researchers with an increase in research occurring from 2015 to 2022. Countries in the Americas and Asia contributed the most to research on this research theme. There is a relationship between project requirements (P), communication skills (CS), and autism spectrum disorder (ASD). This relationship is indicated by the strength of the P→CS link of 2 and the strength of the CS→ASD link of 4. This review shows that the characteristics of project-based learning can help train the level of communication skills of autistic children and will be better if assisted by the use of AR.

Keywords: Autism Spectrum Disorder; Augmented Reality; Bibliometrics; Communication; Project Based Learning.

RESUMEN

Los niños autistas tienen derecho a la educación. La educación les ayuda a desarrollar sus habilidades comunicativas. El uso de un modelo de aprendizaje basado en proyectos puede mejorar las habilidades de comunicación. Actualmente, existen muchas investigaciones que analizan el uso del aprendizaje basado en proyectos para niños con necesidades especiales. Por tanto, este estudio tiene como objetivo analizar el uso del aprendizaje basado en proyectos con realidad aumentada en las habilidades comunicativas de niños autistas. El método utilizado es una revisión sistemática de la literatura y análisis bibliométrico teórico de investigaciones sobre habilidades comunicativas de niños con autismo provenientes de Scopus del 2013 al 2022. Las etapas de investigación son determinantes i) preguntas de investigación; ii) criterios de inclusión; iii) evaluación de la calidad; iv) recopilación de datos; y v) análisis bibliométrico. Los resultados de esta investigación señalan que la investigación sobre las habilidades comunicativas de los niños autistas sigue siendo una tendencia de investigación que es de gran interés para los investigadores, con un aumento en la investigación entre 2015 y 2022. Los países de América y Asia fueron los que más contribuyeron a la

investigación sobre este tema de investigación. Existe una relación entre los requisitos del proyecto (P), las habilidades de comunicación (CS) y el trastorno del espectro autista (TEA). Esta relación está indicada por la fuerza del vínculo P→CS de 2 y la fuerza del vínculo CS→TEA de 4. Esta revisión muestra que las características del aprendizaje basado en proyectos pueden ayudar a entrenar el nivel de habilidades comunicativas de los niños autistas y Será mejor si cuenta con la ayuda del uso de AR.

Palabras clave: Trastorno del Espectro Autista; Realidad Aumentada; Bibliometría, Comunicación; Aprendizaje Basado en Proyectos.

INTRODUCTION

Communication is one way for each individual to interact. Communication is a skill that is definitely practiced in social life.[1,2] Communication helps humans to be able to drink, eat, talk to other humans, and treat other humans in a civilized manner.[3] Basically, every human being uses communication skills in building social relationships with other humans. However, not everyone can communicate using good language, meaning that there are some people who experience problems in their social interactions. Children with special needs, especially children with autism spectrum disorder (ASD) or autism, are people who experience communication difficulties.[4]

Autistic children are children with special needs who experience obstacles in emotional development, social interaction, behavior, and communication.[5,6] Autistic children have characteristics related to the repetition of an activity.[7] Autistic children are usually related to habituation by doing a movement repeatedly.[8] The obstacles possessed by autistic children result in the difficulty of social interaction with other people. Lack of awareness in autistic children causes autistic children to be unable to understand facial expressions and express their feelings.[9] Autistic children have several problems, therefor basically every child, including autistic children, has the right to get an education. Education can help autistic children develop their skills, including communication skills. There are several learning models that can be used to improve the communication of children with special needs, one of which is a project-based learning model.

Project-based learning can improve students' communication skills both in groups and with other groups.[10] Currently, there are many studies that discuss the use of learning in children with special needs. Kurniawan[11] conducted research on the development of project-based learning models for slow-learner students. In the research conducted by Kurniawan[11], it is known that the use of PjBL in children with special needs can increase children's learning activities. In addition, Zakiah et al.[12] conducted research on the ability of deaf children to build sentence structures from project-based learning. Based on research by Zakiah et al.[12] it is known that project-based learning has a significant effect on increasing the ability to construct sentence structures in deaf children.

The use of project-based learning can be used by integrating with current technological developments so that learning outcomes are maximized. One of the commonly used technological developments to help integrate the digital world and 3D components is Augmented Reality (AR).[13] AR can help and support students to think critically.[14] In addition, AR can be used to make learning more realistic with the help of technology. This is because AR can help visualize abstract concepts to understand the structure of object models. The use of AR in project-based learning can help children with special needs in carrying out one of the therapies that stimulate children's movement, mindset, concentration.[15] This is because children with special needs, especially autism, feel happy with therapy while playing visually.

Therefore, this research was conducted with the aim of analyzing the use of project-based learning through augmented reality (AR) on the communication skills of autistic children through a systematic literature review and through theoretical and bibliometric analysis of the communication skills of autistic children. The novelty of this study is i) review of the literature on the factors of using project-based learning on the communication skills of autistic children; ii) bibliometric analysis to determine trends in communication research on autistic children.

METHODS

The method used in this study is Bibliometric Theoretical analysis using mapping visualization and R language analysis. Bibliometric analysis in this study was carried out using two software tools, namely VOSviewer and RStudio. VOSviewer was used for bibliometric mapping analysis, while RStudio was used to analyze research progress, country distribution, journal distribution, affiliation distribution, and author distribution in research that discussed the communication skills of autistic children.

Search Process

The search process is used to obtain information according to the research topic based on sources relevant

to the research question (RQ). The search process was carried out using the Google Scholar and Scopus search engines. A search on Scopus was conducted to answer questions RQ1: How are the results of the bibliometric analysis based on research developments regarding the communication skills of autistic children?. A Google Scholar search was conducted to answer questions RQ2: What are the characteristic requirements that must be met by autistic children in order to use project-based learning? and RQ3: What is the relationship between the characteristics of project-based learning and the communication skills of autistic children?. The search keywords used in the Google Scholar search engine are "PjBL" OR "Project Based Learning with Augmented Reality" AND "Student with Special Needs" OR "Autism". Meanwhile, the search keywords on Scopus are "Communication Skill" AND "autism spectrum disorder".

Inclusion Criteria

At this stage, a decision is made whether the data found is suitable for use in research or not? The eligibility criteria determined in this study are:

- The data used are articles published from 2013 to 2022
- The data obtained came from the pages https://scholar.google.com/ and https://www.scopus.com/
- The data used relates to project-based learning, augmented reality, communication skills, children with special needs, and children with autism.

Data Collection

Data collection was carried out on July 15, 2023. Based on the results of the data search, 290 articles were found sourced from the Google Scholar database and 2 533 articles were sourced from the Scopus database. In the Scopus database, re-sorting was carried out based on the publication source of the article, the appropriate keywords, and the language used in the article, as many as 165 articles were found that matched the predetermined data collection criteria.

RESULTS

Research Developments Per Year

Figure 1 shows the development of research on the communication skills of children with autism from 2013 to 2022 from Scopus indexed journal articles. Based on the data shown in figure 1, research on the communication skills of autistic children has increased from 2015 to 2022. In 2013 there were 5 articles and increased to 15 articles in 2014. In 2015 it decreased to 10 articles. However, the interest and trend of researchers to research the communication skills of autistic children from 2015 will continue to increase until 2022, with 35 articles in 2022. These results indicate that research on the communication skills of autistic children is still a research trend that is of great interest to researchers.

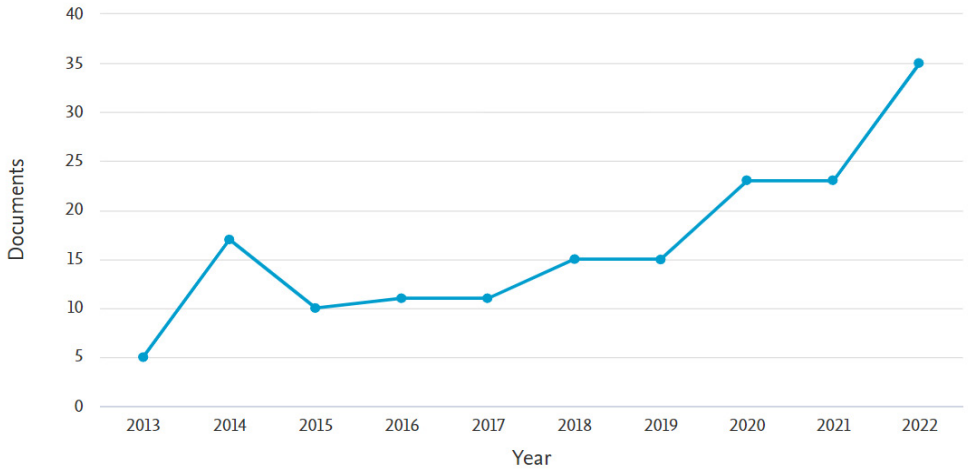

Figure 1. Research developments per year (2013-2022)

Table 1 shows several variables using project-based learning that has been carried out in previous research. Based on the previous research, it is known that there have been many previous studies that discussed the use of problem-based learning models in children with special needs. However, previous studies were limited to direct application research in the field, there was no research on systematic literature review and bibliometric analysis in previous studies that discussed project-based learning in children with autism. In addition, research is still rare that examines the use of project-based learning through augmented reality as an effort to integrate information and communication technology in learning.

Table 1. Previous Research on the Application of Project-Based Learning to Children with Special Needs

Ref	Research purposes	Variable	Sample	Media	Findings
(16)	Describe the implementation of PjBL for Special School Teachers in distance learning for Children with Special Needs	Learning outcomes	22 teachers from 11 special schools in West Java	Focus on delivery by the teacher	The use of PjBL in children with special needs can increase children's learning activities, critical thinking, the intensity of cooperation between teachers, parents and students
(11)	Development of Guided Project Based learning learning models	Study ability	Slow Learner student with IQ in the range of 80-89	Guided PjBL and Peer Assistance	The use of the Guided Project Based Learning model has an increasing impact on both the process and learning outcomes of slow learner students
(17)	Improving the self-efficacy of students with special needs using a project-based learning model	Self-efficacy	Students with special needs studying in inclusive schools	Focus on delivery by the teacher	The use of the PjBL model can increase the self-efficacy of students with special needs including vocational, personal, social and academic skills
(18)	Seeing the level of effectiveness of classical guidance services using the PjBL technique in increasing the discussion of deaf students' career choices	Understanding of career options	Deaf Students Class IX SLBN	Focus on delivery by the teacher	The use of Classical Guidance with PjBL makes the classroom atmosphere livelier and more colorful because learning is student-centered
(19)	Analyzing the effectiveness of PjBL in improving the weaving skills of students with mild mental retardation	Creative Thinking Ability	Children with mild mental retardation at SLB Ummi Khaira Pasaman Barat	Focus on delivery by the teacher	The PjBL method is effective in improving skills in making woven plates from palm sticks in children with mild mental retardation
(20)	Finding appropriate learning strategies for slow learners in elementary schools	Student with slow-learner	Elementary School Students with Slow Learner Ability	Focus on delivery by the teacher	The PjBl method can overcome the problems of slow learner children such as low achievement, low memory, slow learning speed compared to their friends
(21)	Knowing the effect of the PjBL method on the cooperative ability of autistic children	Cooperation ability	Group B Autistic Children	Focus on delivery by the teacher	The PjBl method has a significant effect on the cooperative ability of autistic children
(22)	Reporting collaborative case studies on project-based learning models between small groups in schools with special needs	Development of training equipment for students with special needs	Engineering students with special needs at Tottori University	-	Project-based learning has played an important role in engineering education and shows a significant change in their awareness and behavior
(23)	Discusses the impact of the STEM curriculum on children with learning disabilities to improve their learning outcomes and creativity	Learning outcomes and creativity	Students with special needs at an elementary school in Taichung, Taiwan with learning disabilities	Micro: bit	The use of project-based learning in the STEM curriculum has an immediate and retention effect in fostering creativity and problem-solving abilities

Journal Sources, Affiliations, and Research Countries Distribution

Figure 2 shows the 10 Scopus-indexed journal sources that are most numerous and relevant in publishing articles on the communication skills of autistic children. The Journal of Developmental and Physical Disabilities is the journal source that publishes the most articles on the communication skills of autistic children in Scopus with a total of 2 articles from 2014 to 2016. Meanwhile, several other journal sources publish 1 article each, namely Education and Treatment of Children, Frontiers in Communication, Frontiers in Virtual Reality, International Journal of Child Care and Education, International Journal on Recent and Innovation Trends, Journal of Applied Rehabilitation Counselling, Journal of Intelligence, and Journal of Special Education Technology.

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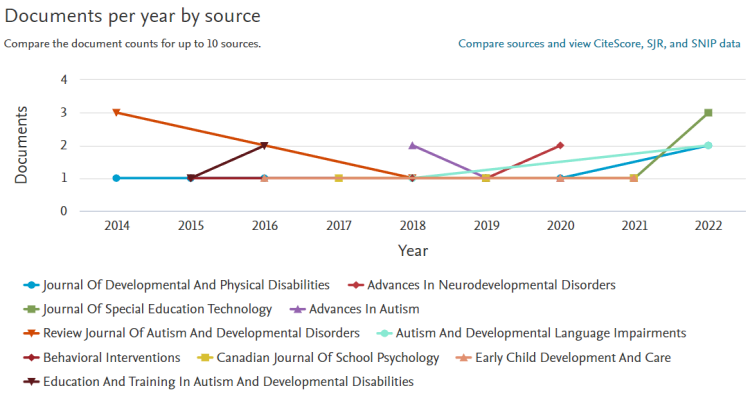

Figure 2. Journal sources that publish the most articles on the communication skills of autistic children

Figure 3 shows several affiliates or universities that have contributed to research and writing articles on the communication skills of autistic children in Scopus. There are 10 affiliates that are most relevant in contributing to research on the communication skills of autistic children, namely the University of Central Florida, American Institutes for Research, American Institutes for Research (AIR), Center for Autism Research, Hacettepe University, Harvard Medical School, King Saud University, Lehigh University, National Institute of Mental Health and Neurosciences, and National Taiwan Normal University.

The University of Central Florida is a university with the highest research contribution on the communication skills of autistic children in Scopus. This is because the University of Central Florida is a university that focuses on a research-based education system (see https://www.ucf.edu/). University of Central Florida earned recognition from the Carnegie Foundation thanks to the high level of research activity carried out by students, both in the curriculum and activities outside of lectures.[24]

Affiliates who have contributed to research on the communication skills of autistic children consisting of various countries in the world. There are 10 countries that have contributed to research on the communication skills of autistic children, namely the United States, United Kingdom, Malaysia, Canada, Iran, China, Israel, Saudi Arabia, Turkey, and India. The United States is the country with the most contributions to studying the communication skills of autistic children, namely 78 articles. The United Kingdom is in second place with 11 documents. The results of the distribution of countries can be seen in more detail in figure 4.

These results show that countries from the Americas and Asia have contributed the most to research on the communication skills of autistic children when compared to countries in other continents. According to the results of a National Research Studies survey, there are 161 people with autism per 10 000 children in Japan. Meanwhile, the United States occupies the fifth position as a country with the highest number of children with autism, namely according to the results of a National Research Studies survey, there are 66 people with autism per 10 000 children in the United States. The prevalence of ASD in several Asian and American countries is the United States (90 per 10 000), South Asia (1 in 93), Japan (13 per 10 000), and China (9,8 per 10 000).[25]

Figure 3. Affiliates who have published articles about the communication skills of autistic children

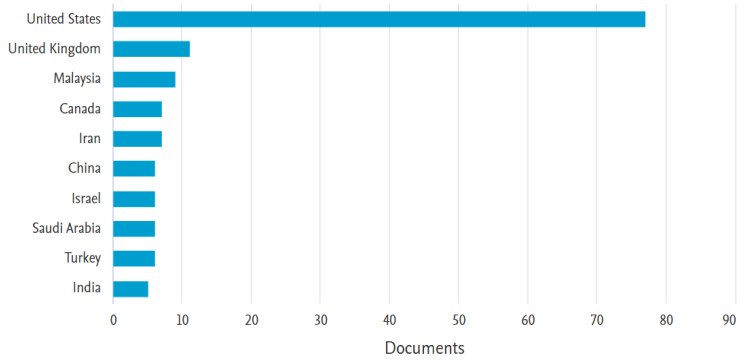

Figure 4. Countries contributing to research on autistic children's communication skills

Distribution of Subjects in Previous Research

Figure 5 shows the subject of the research area regarding the communication skills of autistic children. Based on figure 5, it is known that research on the communication skills of autistic children is taken from 10 appropriate subject areas, namely Psychology, Social Science, Medicine, Computer Science, Health Professional, Arts and Humanities, Engineering, Neurosciences, Mathematics, and Nursing. The subject areas of psychology and social science are the subject areas with the most contributions in researching research on the communication skills of autistic children, each of which is 22 % of the 165 articles found. In the third place there is the subject area of medicine with an article contribution of 14 % and computer science and health professionals in the order of five and six with an article contribution of 8 %. These data indicate that research on the communication skills of autistic children is not limited to one subject area, but covers a wider range of subject areas.

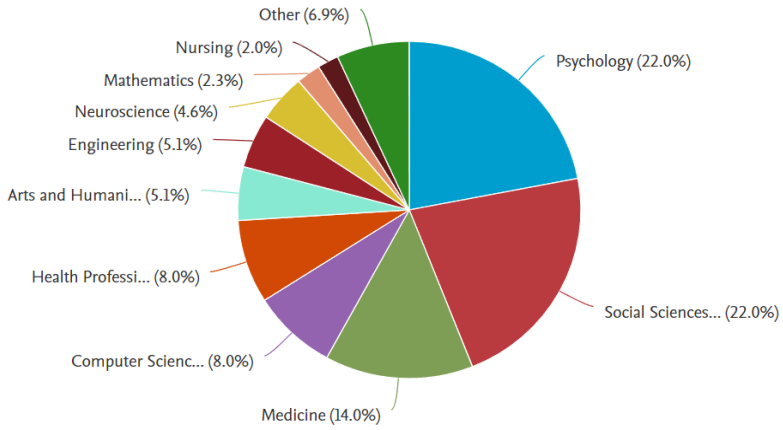

Figure 5. The subject of the research area is the communication skills of autistic children

Bibliometric Mapping Analysis

Figure 6 shows the network visualization on the relationship between project-based learning and improving the communication skills of autistic children. This visualization network shows the strength of the relationship between keywords.[26] In this study, network visualization is divided into 3 clusters namely:

- Cluster 1 with red color has 7 items, namely ASD, autism, communication, communication skills, parent, project, and social communication.
- Cluster 2 with green color has 5 items, namely attitude, cognitive, language skills, social communication skills, and treatment.
- Cluster 3 with blue color has 2 items, namely ASD and social interaction.

Based on figure 6 it is known that the term project, communication skills, and ASD are related. The term project has a relationship with communication ability with a link strength of 2 out of a total link strength of 9. Meanwhile, communication ability with ASD is connected with a link strength of 4 out of a total link strength of 20. This link strength indicates the strength of the connectedness between items, the greater the value of the link strength, the stronger the connectedness between these items.[27]

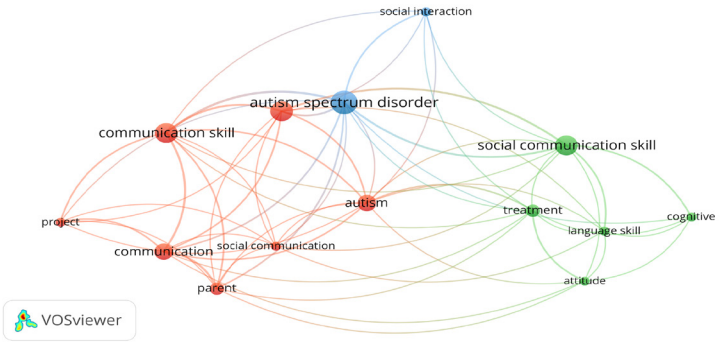

Figure 6. Network visualization of project-based learning relationships and improving the communication skills of autistic children

DISCUSSION

The research results show that research on the communication skills of autistic children is still a research trend that is of great interest to researchers. These results are in line with the results of Hernández-González[28] who stated that the results of his research highlight the state of research published in WoS regarding traumatic experiences and ASD becoming a research trend. Based on the bibliometric mapping analysis, it can be concluded that previous studies have linked the creation of a project with the communication skills of autistic children.

Characteristic Requirements that Must be Met by Autistic Children in Order to Use Project-Based Learning with AR

Based on several previous studies implementing project-based learning with AR in children with special needs, there are several characteristics of children with special needs that make it possible to carry out project-based learning including research conducted by Kurniawan[11] that children with physical and social characteristics do not show a special difference from normal children in general, but these children have criteria for below average test results, with IQ scores in the range between 80-89, it is very likely to do project-based learning. In addition, according to Fajri et al.[19] it shows that mild mentally retarded children or autistic children with characteristics of mild intellectual retardation but are still able to be trained to read, write, and count within certain limits are very possible to carry out simple project-based learning.

Another characteristic according to Aulia[29] states that autistic children who can use project-based learning are autistic children who are in the middle class. This is in accordance with interviews conducted with informants on special education expertise that autistic children make it possible to use project-based learning if all of their basic learning has been fulfilled.

According to Aulia[29], the characteristics of autistic children in the middle class are that the child's ability is on average good, the child's behavior is indeed hyperactive, but the child can already be directed and has good concentration when learning.[30] In addition, the child must be able to speak and the language used by the child can also be understood. Autistic children also have to be able to communicate with other people well, even though sometimes they only speak as needed and leave immediately. In the aspect of reading, fine motor and counting children are quite good.

Connecting the Characteristics of Project-Based Learning through AR with the Communication Skills of Autistic Children

Project-based learning has learning characteristics that require comprehensive learning, where the learning environment for students is designed so that students can carry out an investigation of authentic problems including deepening a material.[31,32] AR helps support the use of object-based learning in teaching children's mindsets to think critically, helps visualize an object, so that children can learn how to express and communicate visual objects displayed on AR. The characteristics of project-based learning through AR are linked to a learning approach based on the characteristics of autistic children.

The characteristics of autistic children based on Leo Kanner's theory include aspects of intelligence, emotions, communication, behavior, and perception.[33] These aspects can be overcome by the process of habituation to autistic children through learning. Especially the communication aspect can be overcome by using a learning model based on Edgar Dale's Theory.[39] Learning models that can be used for autistic children are Contextual Teaching Learning, Problem Based Learning, Cooperative Learning, Project Based Learning, Service Learning, Work Based Learning, and Concept Learning.

Focusing on the characteristics of middle-class autistic children, the use of project-based learning models

helps autistic children to practice their skills in communicating well with peers, parents and teachers. In addition, the project learning model can help autistic children to practice critical thinking skills in solving a problem. Project-based learning provides students with learning experiences that consist of planning, design, production, and product assessment processes.[19] Therefore, the characteristics possessed by project-based learning can help in training the level of communication skills of autistic children.

CONCLUSION

This research analyzes the use of project-based learning through augmented reality (AR) on the communication skills of autistic children through theoretical studies. The results of this research note that research on the communication skills of autistic children is still a research trend that is still of interest to researchers. Research continues to increase consistently from 2015 to 2022. Research on the communication skills of autistic children is taken from 10 appropriate subjects, namely Psychology, Social Sciences, Medicine, Computer Science, Health Professions, Arts and Humanities, Engineering, Neuroscience, Mathematics, and Nursing. Psychology and social science subjects were the subjects that contributed the most, namely 22 % of each of the 165 articles found. There is a relationship between the terms project (P), communication skills (CS), and ASD based on bibliometric mapping analysis of research data. The characteristics of the requirements for autistic children for project-based learning through AR are middle class autistic children. The characteristics of project-based learning that require comprehensive learning can help train the level of communication skills of autistic children. The use of project-based learning through augmented reality can help train object recognition through more realistic visualization in autistic children. This causes children's communication skills to improve through the introduction of these objects.

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