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Research Article

Analysis of Assistive Technology Needs for Inclusive Education in the Early Childhood Education Development Sector of the East Kutai Regency Education Office

Achmad Yoyon* **& Hermanto**

Master of Special Education, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia, 5528
*Corresponding Author: achmadyoyon.2024@student.uny.ac.id | Phone Number: +6282338550168

ABSTRACT

This study aims to analyze the need for assistive technology to support inclusive education in early childhood education institutions in East Kutai Regency. The main focus includes educators' understanding of assistive technology, identification of the types of technology needed, availability of facilities and infrastructure, and obstacles faced in implementing inclusive learning for students with special needs. The approach used is descriptive quantitative with a survey design. The research subjects consisted of teachers and early childhood education staff directly involved in inclusive learning. Data collection was carried out through the distribution of questionnaires and documentation of assistive technology policies and facilities. The instruments used measured teachers' understanding, availability of facilities, and the need for assistive technology. Data were analyzed using descriptive statistics in the form of frequencies and percentages. The results of the study indicate that although teachers' understanding of assistive technology is relatively high, their technical skills in using assistive devices are still limited. The availability of facilities and infrastructure is at a moderate level, and not all institutions have adequate devices. The main obstacles include limited infrastructure and minimal social support. This study recommends technical training, strengthening inter-institutional collaboration, and policies and budget allocations that support the optimal use of assistive technology in inclusive early childhood education.

Keywords: Assistive Technology; Inclusive Education; PAUD; PDBK

1. INTRODUCTION

Education is the primary foundation for developing superior human resources with character and preparedness to face global challenges (My et al., 2024). Through education, individuals acquire not only knowledge but also life skills, social values, and adaptive attitudes needed in a dynamic society. Therefore, improving the quality of education is a top priority in achieving Indonesia's golden generation.(Agusniatih & Manopa, 2019)In the era of digital transformation, the urgency of strengthening an adaptive and inclusive education system is increasingly emerging as a national need. One strategy to realize fair and equitable education is to develop an inclusive approach, namely an education system that guarantees the active participation of all students without discrimination, including children with special needs.(Farah et al., 2022)Inclusive education goes beyond simply opening access; it also creates a learning environment that values diversity and accommodates individual needs holistically. This aligns with Law Number 20 of 2003 concerning the National Education System, which emphasizes the importance of equal access to education for all citizens without exception.

To support the effective implementation of inclusive education, flexible learning strategies, adequate teacher competency, and the provision of appropriate facilities and infrastructure are needed. Among these tools, assistive technology plays a central role in bridging the accessibility gap and helping students with special needs learn independently and meaningfully.(Suwahyo et al., 2022)Assistive technology includes tools such as Braille devices, screen readers, hearing aids, speech-to-text translation apps, adaptive study tables, and interactive learning apps designed to meet the cognitive and motor needs of students.(Jaya, 2017; Lutfio et al., 2023; Paramansyah & Parojai, 2024)Unfortunately, in some areas, such as East Kutai Regency, the availability of assistive technology is still very limited. Preliminary studies indicate that many early childhood education institutions do not yet understand the types of assistive technology relevant to the characteristics of students with special needs and are unable to provide such devices due to budget and access limitations.(Fionita & Nurjannah, 2024)Data from the East Kutai Regency Education Office in 2024 showed that there were 409 children with special needs in early childhood education (PAUD), the majority of whom experienced specific learning difficulties and

behavioral challenges. This fact highlights the need for concrete steps to provide assistive devices to support these children's learning.

Various previous studies have shown that the use of assistive technology can increase the effectiveness of learning and the active participation of students with special needs.Rohmah & Harsiwi (2024)revealed that devices such as screen readers, hearing aids, and interactive applications enable learners with visual and hearing impairments to optimally participate in the learning process.Sholihah (2024)emphasizes the importance of educator training and collaboration with parents to ensure appropriate use of technology. However, research specifically addressing the need for and availability of assistive technology in early childhood education (PAUD) settings in remote areas remains very limited. The gap between national regulations and local implementation poses a real challenge to the implementation of inclusive education in Indonesia. Although government policy mandates the provision of equal education services, the reality on the ground shows uneven distribution of assistive technology and low educator understanding of assistive technology (Zakiah et al., 2024). This situation presents obstacles to achieving inclusive and quality learning, particularly in PAUD institutions, which serve as a crucial foundation in the early stages of a child's education.

Based on this background, this study aims to analyze the need for relevant assistive technology to support inclusive learning in early childhood education institutions (PAUD) in East Kutai Regency. The study focuses on identifying the types of assistive devices needed, the users and their roles, challenges in technology distribution and utilization, and the level of educator understanding of its use. This research also aims to formulate strategic solutions that can be practically implemented to strengthen the implementation of inclusive education in areas with limited infrastructure and resources.

2. RESEARCH METHOD

This study uses a descriptive quantitative approach that aims to systematically and objectively describe the condition of assistive technology needs for students with special needs (PDBK) in Early Childhood Education (PAUD) institutions in East Kutai Regency. This approach was chosen to obtain numerical data that can be analyzed statistically to provide an overview of the needs, availability, and educators' understanding of assistive technology. The study was conducted at several PAUD institutions in East Kutai Regency that provide inclusive education services. The locations were selected purposively based on the institutions' involvement in the inclusive education development program run by the Education Office. This study lasted for three months, namely from March to May 2025. The population in this study was all early childhood education (PAUD) teachers who handle students with special needs in East Kutai Regency, totaling 45 people according to data from the Education Office. Given the relatively small population size and the ability to reach all students, a total sampling technique was used for sample drawing. The main variable in this study was the need for assistive technology in inclusive learning. This variable was analyzed based on several aspects, namely the type of assistive technology needed, the level of device availability, educator understanding and competence, barriers to technology procurement and use, and the role of institutional support and policies. The data collection technique was carried out through a Likert-scale questionnaire, which included indicators related to the need for assistive devices for various disability categories (such as blindness, deafness, intellectual disability, and physical disability), the availability of assistive devices, and the level of teacher mastery of assistive technology. This questionnaire was validated by inclusive education experts and piloted on a limited sample to ensure its validity. The collected data were analyzed using descriptive statistics, by calculating percentages to measure the frequency of responses, averages (means) to determine general trends, and standard deviations to see the distribution of data relative to the average. The results of the analysis were presented in tables and diagrams to facilitate interpretation. The interpretation of the results also took into account the level of need and the gap between existing conditions and the desired ideal conditions.

3. RESULTS AND DISCUSSION

3.1 Result of Research

This section of the study examines the understanding, needs, and challenges associated with the implementation of assistive technology in Early Childhood Education (PAUD) institutions within East Kutai Regency. Through the analysis of various indicators, the study evaluates the readiness of educators, the availability of necessary facilities, and the barriers faced in integrating assistive technology into inclusive education. The findings highlight both strengths and areas for improvement, with significant emphasis on the need for ongoing educator training, enhanced infrastructure, and strategic collaborations to overcome the existing obstacles. The data also reveals a strong demand for assistive technology that meets the specific needs of students with special needs, which can greatly contribute to inclusive learning environments across the region.

3.1.1 Understanding of Early Childhood Education Assistive Technology, East Kutai Regency Education Office

This section delves into the understanding of assistive technology among Early Childhood Education (PAUD) educators at the East Kutai Regency Education Office. By analyzing key sub-indicators, this study provides a detailed overview of how well educators grasp the concepts and applications of assistive technology. The analysis takes into account various aspects such as general knowledge, skills in using technology, and access to support, aiming to provide a comprehensive assessment of the current state of understanding. The results of this analysis are summarized in Table 1, offering a clear picture of the level of proficiency and areas requiring further development to enhance the use of assistive technology in PAUD institutions.

Table 1. Conclusions on Understanding of Assistive Technology among Early Childhood Education Teachers at the East Kutai Regency Education Office

No	Measured Aspects	Average Percentage	Category
1	General Knowledge about Assistive Technology	75.91%	Tall
2	Skills in Using Assistive Technology	69.00%	Tall
3	Access and Support for Assistive Technology	72.09%	Tall
	Average	72.33%	Tall

Source: Research Data Analysis Results (2025)

Table 1 shows that early childhood education educators in East Kutai Regency generally have a high understanding of assistive technology, with 72.33% achieving high levels of understanding. While knowledge and access to support are already high, challenges remain in technical skills, indicating the need for ongoing training programs to optimize and equitably utilize assistive technology across all early childhood education units.

The Need for Assistive Technology in Early Childhood Education Institutions in East Kutai Regency

This study explores educators' perceptions of various types of technology considered relevant to assisting students with special needs. The following table presents data on the number of children with special needs (ABK) at the kindergarten level in East Kutai Regency in 2024. This data is organized by sub-district, providing an overview of the distribution of ABK across various regions in East Kutai Regency. This data presentation aims to help understand the needs for inclusive education in each sub-district and serve as a basis for planning and developing educational policies for ABK.

Table 2. Data on Special Needs Students at Kindergarten Level in East Kutai Regency

No	Subdistrict	Number of crew members
1	North Sangatta	204
2	South Sangatta	16
3	Bengalon	37
4	Pulung Region	9
5	Pandan Bay	8
6	Kaliorang	5
7	Kaubun	16
8	Essay	15
9	Backrest	6
10	Sangkulirang	9
11	Telen	19
12	Kongbeng	10
13	Wahau Estuary	25
14	Batu Ampar	7
15	Bengkal Estuary	8
16	Ancalong Estuary	4
17	Long Mesangat	5
18	Busang	6
	Total	409

Source: Research Data Analysis Results (2025)

Based on **Table 2**, the North Sangatta sub-district has a very significant number of children with special needs, namely 204 children, which constitutes more than half of the total number of children with special needs in East Kutai Regency (409 children). This indicates that this sub-district may have a greater need for inclusive education facilities and support for children with special needs. On the other hand, sub-districts such as Muara Ancalong and Long Mesangat have relatively small numbers of children with special needs, 4 and 5 children, respectively, which may indicate a more limited need for inclusive education programs or limitations in data accessibility. Thus, this data can be used as a basis for planning and allocating educational resources more accurately and equitably across all sub-districts in East Kutai Regency. Overall, to describe the specific needs of relevant assistive technology in supporting inclusive learning in PAUD institutions, this study analyzed three main aspects, namely: (1) the type of assistive technology needed, (2) the suitability of technology to students' needs, and (3) the integration of technology in the curriculum and learning. These three aspects provide a comprehensive picture of the priority needs, actual conditions, and institutional readiness in supporting technology-based inclusive learning in East Kutai Regency.

Table 3. Summary of Specific Needs for Assistive Technology for Inclusive Learning in Early Childhood Education (PAUD) in East Kutai Regency

No	Aspects Analyzed	Average Percentage	Category
1	Types of Assistive Technology Needed	82.07%	Tall
2	Suitability of Technology to Student Needs	55.70%	Currently
3	Technology Integration in Curriculum and Learning	83.41%	Tall

Source: Research Data Analysis Results (2025)

The data analysis results from **Table 3** show that, in general, the specific need for assistive technology to support inclusive learning in early childhood education institutions in East Kutai Regency is high, with an overall average of 73.73%. This indicates that teachers are highly aware of the importance of assistive technology and have begun integrating it into learning activities. The most pressing need lies in the availability of interactive and multimedia devices that are adaptive to the characteristics of early childhood.

3.1.2 Availability of Assistive Technology Facilities and Infrastructure in Early Childhood Education Institutions in East Kutai Regency

As part of an evaluation of the readiness of early childhood education institutions to support inclusive learning, this study examines the extent to which assistive technology is available and accessible to teachers and students. This sub-indicator focuses on educators' perceptions of the availability of assistive devices, the adequacy of devices, and the appropriateness of the technology provided to support children with special needs.

Table 4. Availability of Assistive Technology Facilities and Infrastructure in PAUD in East Kutai Regency

No	Aspects Analyzed	Average Percentage	Category
1	Availability of Assistive Technology	54.07%	Currently
2	Availability of Supporting Facilities	53.93%	Currently
3	Quality and Sustainability of Facilities	57.63%	Currently

Source: Research Data Analysis Results (2025)

The results presented in Table 4 offer a snapshot of the current state of assistive technology facilities and infrastructure within Early Childhood Education (PAUD) institutions in East Kutai Regency. The data shows that while there is some availability of assistive technology, it remains limited and uneven across institutions. Specifically, the availability of assistive technology devices scored 54.07%, and supporting facilities such as access rooms and professional staff scored 53.93%, both categorized as "Currently." This indicates that, although some resources are in place, they are not sufficient or consistent across all institutions. Furthermore, the quality and sustainability of these facilities, as reflected by a 57.63% score, suggest that there are ongoing challenges in maintaining and renewing the infrastructure, which is crucial for supporting inclusive learning environments. Overall, the average percentage of 55.21% highlights that while progress has been made, significant improvements are still needed to ensure that assistive technology and related infrastructure are adequately provided and sustained for effective use in PAUD institutions.

3.1.3 Obstacles to Implementing Assistive Technology in Inclusive Education at Early Childhood Education Institutions in East Kutai Regency

The implementation of assistive technology in inclusive education is inextricably linked to resource challenges, including funding, affordability of assistive devices, and training support. Therefore, this study analyzes the resource constraints faced by early childhood education institutions in East Kutai Regency in implementing assistive technology. Three indicators examined include budget constraints, expensive devices, and limited funding for teacher training.

Table 5. Summary of Indicators of Obstacles to the Implementation of Assistive Technology in Early Childhood Education in East Kutai Regency

No	Constraint Indicator	Percentage	Category
1	Resource Constraints	73.63%	Tall
2	Educator Skills Constraints	78.81%	Tall
3	Infrastructure and Facilities Constraints	75.41%	Tall
4	Social and Structural Constraints	74.52%	Tall
5	Regulatory Constraints	62.81%	Currently

Source: Research Data Analysis Results (2025)

Based on the data recapitulation results from the previous analysis, it can be concluded that the implementation of assistive technology in inclusive education at PAUD institutions in East Kutai Regency still faces various significant obstacles. One of the biggest obstacles lies in the limited skills of educators, with the highest percentage reaching 78.81%. On the other hand, infrastructure and facility constraints also recorded a high figure of 75.41%, which reflects the lack of physical facilities such as access rooms or supporting devices appropriate to the needs of students with special needs. Another equally important obstacle is the social and structural aspect, with a percentage of 74.52%, where community and parental support for the use of assistive technology is still limited. Many institutions also face constraints in terms of resources, both in terms of budget and affordability of assistive devices, as seen in the percentage of 73.63%. Finally, regulatory constraints are in the moderate category with a percentage of 62.81%, indicating that policies or guidelines for implementing assistive technology are still not fully available or clear at the institutional level.

3.1.4 Strategic Solutions to Overcome Obstacles and Meet the Needs of Assistive Technology in Inclusive Learning at Early Childhood Education Institutions in East Kutai Regency

To address funding constraints, which have been a major obstacle to the implementation of assistive technology, one proposed solution is strengthening resources and allocating more specific funds. The three indicators examined include funding provision, allocating a dedicated budget, and prioritizing assistive device funding.

Table 6. Solutions to Support the Implementation of Assistive Technology in Early Childhood Education in East Kutai Regency

No	Solution	Average Percentage	Category
1	Strengthening Resources and Funds	78.96%	Tall
2	Educator Competency Training & Development	89.78%	Very high
3	Increasing Social & Cultural Awareness	75.56%	Tall
4	Strengthening Collaboration and Partnership	84.44%	Tall

Source: Research Data Analysis Results (2025)

Based on the data analysis results in Table 6, it can be seen that the four strategic solutions to support the implementation of assistive technology in Early Childhood Education (PAUD) institutions in East Kutai Regency received strong support from respondents. The Educator Training and Competency Development solution received the highest score with an average percentage of 89.78%, which is in the very high category. Furthermore, the Strengthening Collaboration and Partnership solution ranked second with a score of 84.44%, demonstrating the importance of synergy between schools, the government, and external partners in providing technology and policy support.

3.2 Discussion

3.2.1. Understanding of Assistive Technology in Early Childhood Education (PAUD) in East Kutai Regency

The results of the study indicate that early childhood education (PAUD) educators in East Kutai Regency have a relatively high level of understanding of assistive technology, with an average achievement of 72.33%. The three aspects examined general knowledge, user skills, and access and support for assistive technology indicate that most teachers are familiar with the role of this technology in inclusive education. Basic knowledge of the types of technology for the blind and deaf has been mastered, with the highest score being 75.91%. However, in more technical aspects, such as technology for children with physical disabilities and learning disabilities like ADHD, teachers' understanding is still less than optimal.(Ramya & Shanthi, 2024). Skills in operating assistive devices were slightly lower, at 69.00%. This indicates a gap between conceptual understanding and practical skills, which can impact the effectiveness of technology implementation in learning. Although teachers feel conceptually prepared, they still require further training to master the operation of specific and complex assistive devices. Access to technology and support from external parties showed a good figure (72.09%), primarily due to the attention from local governments, which have demonstrated a commitment to supporting technology-based inclusive education. This reflects a systemic awareness of the importance of ecosystem support in implementing inclusive learning (Akhlan et al., 2024; Damayanto et al., 2021).

3.2.2. The Need for Assistive Technology in Early Childhood Education Institutions in East Kutai Regency

The need for assistive technology was recorded as quite high, with an average score of 73.73%. The majority of educators felt that multimedia, visual, and interactive technology were essential to support the learning process for children with special needs. The types of technology identified included low-tech categories such as Braille boards and hearing aids, mid-tech such as visual or emotion-regulating devices, and high-tech such as interactive applications, learning support software, and speech-to-text. The greatest need was for high-tech technology, particularly to support the learning of children with autism and other behavioral disorders.(Chanana et al., 2022; Courtad & Bouck, 2013). However, there is a gap between the need for and availability of devices. The match between available technology and children's actual needs is only 55.70%, which is considered moderate. Even low-tech technology still does not fully support the needs of blind and deaf children optimally. This reflects the need for systematic mapping of individual needs in each institution, so that the procurement of assistive devices is truly based on student characteristics. Despite these limitations, there is enthusiasm among educators to begin integrating assistive technology into learning, as evidenced by the achievement of curriculum integration of 83.41% and the appropriateness of learning approaches of 85.33%.(Ainsworth et al., 2020).

3.2.3. Availability of Assistive Technology Facilities and Infrastructure

The availability of facilities and infrastructure in early childhood education institutions remains moderate, with a score of 55.21%. The availability of technology devices is only 54.07%, indicating that many institutions lack adequate tools. The distribution of devices is also uneven and the quality varies. The availability of supporting facilities such as access rooms, assistive media, and professional support is also suboptimal, with a score of 53.93%. Without these supporting facilities, the use of technology in the classroom will be merely symbolic and less effective in assisting children with special needs.(Hata et al., 2023; Rosita et al., 2020). The quality and sustainability of the technology used were recorded slightly higher (57.63%), but still in the moderate category. The sustainability indicator scored 62.22%, indicating that teachers have hope for the continued use of technology. However, the lack of a structured maintenance system and device updates has resulted in many technologies becoming obsolete or not functioning optimally. The fact that 60% of teachers who have received training have not yet implemented assistive technology indicates that device availability alone is not enough; it must be accompanied by system support and ongoing training.(Hanifah Salsabila et al., 2022).

3.2.4. Obstacles to Implementing Assistive Technology in Inclusive Education

Four of the five categories of obstacles were recorded as high. The most prominent obstacle was educator skills (78.81%). Teachers lacked the confidence to use technology independently. This highlights the importance of practical and ongoing technical training. Inadequate infrastructure was the second largest obstacle (75.41%), with institutions lacking access space, adequate tools, or a physical environment that supports technology use.(Dell & Newton, 2014). Social and cultural barriers were also high (74.52%). Lack of understanding from the community and parents led to resistance to technology use, both due to fear of technological dependency and a lack of digital literacy. Meanwhile, limited budgets and high device prices were significant resource constraints (73.63%). The majority of institutions lacked a dedicated position for technology procurement and maintenance. Finally, regulatory constraints also contributed, albeit to a moderate degree (62.81%). The lack of technical regulations and specific policies made it difficult for institutions to legally and systematically procure and use technology.(Courduff & Duncan, 2017).

3.2.5. Strategic Solutions in Utilizing Assistive Technology

Based on the study results, the proposed solutions received very high support from respondents, particularly regarding teacher training (89.78%). Targeted, practice-based, and sustainable training programs are key to addressing the skills gap. In addition to technical training, emotional support is also needed to boost teacher confidence. This strategy reinforces the findings.Sulaimani & Bagadaood (2023), that trained teachers are more likely to adopt technology for inclusive learning. Cross-sector collaboration is another important strategy. Local governments, education offices, businesses, and NGOs need to work together in procuring and distributing devices, training, and monitoring implementation. This collaboration allows for budget efficiency and policy integration in the field. Research bySula (2023)stated that cross-stakeholder collaboration is an important requirement in strengthening technology-based inclusive education. Increasing budget allocation is also a priority. The procurement, maintenance, and updating of assistive technology must be included in medium- and long-term budget planning. Without adequate financial support, the entire strategy will be hampered.Aziz & Rosdiana (2024)stated that without fiscal commitment, the adoption of assistive technology will stagnate. Finally, social change also needs to be fostered through public education, awareness campaigns, and parental involvement. Technology-based inclusive literacy can begin with community forums and parent training.Mamatha et al (2022)revealed that parental involvement in understanding assistive technology significantly increases the effectiveness of its use. Therefore, the success of inclusive education depends not only on the availability of technology but also on systemic readiness, cross-sector collaboration, and strong social support. A multidimensional approach that addresses human resources, infrastructure, regulations, and socio-cultural aspects is essential to ensure the sustainability of inclusive, assistive technology-based education in early childhood education (PAUD).

4. CONCLUSION

Based on the results of data analysis and discussion of the five problem formulations, several important conclusions can be drawn. First, early childhood education (ECE) teachers in East Kutai Regency demonstrate a relatively high level of understanding regarding the concept and role of assistive technology in inclusive learning, with an average score of 72.33%. Although they generally understand the functions and types of assistive technology, their technical skills in operating such devices remain limited. Second, the need for assistive technology in ECE institutions falls into the high category, particularly for interactive devices, multimedia tools, and visual aids that align with the developmental characteristics of young children. Third, the availability of assistive technology facilities and infrastructure in ECE institutions across East Kutai Regency remains moderate (55.21%). Supporting devices and facilities are not evenly distributed and do not fully meet inclusive learning standards. Aspects such as accessibility, professional staff, and facility maintenance systems still require strengthening to ensure the optimal and sustainable use of assistive technology. Fourth, both ECE teachers and institutions face significant obstacles, especially in terms of teacher skills (78.81%), limited infrastructure (75.41%), and low social support (74.52%). Resource-related challenges, such as budget limitations and the high cost of equipment, also pose considerable barriers. In addition, regulatory constraints, though categorized as moderate (62.81%), continue to hinder effective implementation due to the lack of clear technical guidelines and budgetary arrangements. Fifth, the most anticipated solution among educators is training and competency development (89.78%), indicating an urgent need to enhance teachers' technical skills. This is followed by strengthening collaboration and partnerships (84.44%), improving resources and budgeting (78.96%), and fostering greater social and cultural awareness (75.56%). These findings highlight the importance of adopting a comprehensive and collaborative approach in developing an inclusive education ecosystem that can sustainably support the use of assistive technology.

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