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Exploring Effective ICT Use for Communication Support in Students with Severe Physical Disabilities: A Descriptive Qualitative Study

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Risa Takashima is a lecturer in occupational therapy at Hokkaido University, Japan, where she teaches and mentors students in occupational therapy and qualitative research. She holds a PhD in Nursing from Hokkaido University. Her research interests include occupational therapy, occupational science, occupational justice, professional development, community development, and health promotion. She is particularly committed to promoting inclusion, diversity, and social justice, with a specific focus on addressing loneliness and social isolation among older adults and marginalized communities, including the LGBTQ+ population. She has published papers on qualitative research methodologies and is actively involved in participatory action

research projects aimed at empowering communities. She serves as a board member of the Japanese Society for the Study of Occupation and is a member of the Japanese Association of Occupational Therapists, contributing to the development of inclusive research practices and the advancement of occupational therapy and occupational science in Japan.

Data Availability

The data from this study consist of interview transcripts from ten participants, which contain identifying information and are, therefore, sensitive to privacy issues. As participants agreed to take part in the interviews under the assurance of anonymity, the full content of the interviews could not be made publicly available.

Abstract

Purpose: This study aims to identify the key conditions necessary for the effective use of information and communication technology (ICT) in educational settings, considering the perspectives of students with physical disabilities, their families, teachers, and rehabilitation professionals.

Materials and methods: The study employed a descriptive qualitative approach, combining semi-structured individual interviews and participant observations at two special-needs schools in northern Japan. Participants included two students with physical disabilities, two family members, three teachers, and three rehabilitation professionals. Data were analyzed using Braun and Clarke's thematic analysis framework. Triangulation of data sources and the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist were utilized to enhance credibility and transparency.

Results: Ten participants contributed to the study. Four key themes were identified: (1) Supportive environmental factors; (2) Safety considerations in ICT use; (3) Purposeful and goal-oriented use; and (4) Balanced functional demands. The findings highlight that meaningful ICT implementation requires not only the provision of appropriate technology but also comprehensive environmental support, consideration of physical and cognitive burdens, goal-directed application, and gradual developmental preparation.

Conclusions: ICT is not a panacea. To achieve its maximum potential, it must be introduced in specific contexts, tailored to the developmental stage of the child's communication abilities. Additionally, ICT must be applied in a safe environment with a supportive and collaborative network to ensure its effectiveness in enhancing communication skills.

Keywords: physical disabilities, ICT, communication, social participation, special-needs education, qualitative research, rehabilitation

Implication for Rehabilitation

•Assistive technologies should not only be usable but should actively support children's participation in activities and social interactions.

•The evaluation and introduction of ICT must prioritize alignment with the child's actual needs and abilities, beyond mere technological capabilities.

•Rehabilitation professionals play a central role in facilitating collaborative and individualized support systems through ICT.

Introduction

Children with physical disabilities or motor impairments often experience difficulties with speech [1,2], which may limit their opportunities to communicate their intentions and needs [3]. Such limitations can hinder their participation in meaningful everyday activities, such as learning and social interactions, potentially affecting their development and the formation of

social relationships [4]. Participation—defined as engagement in culturally and socially meaningful activities—is considered essential for the development, health, and quality of life (QOL) of children [5]. However, restrictions on spontaneous speech may result in communication that is largely initiated and controlled by others. Therefore, children may not only lose opportunities to express their own intentions but also face limitations in cognitive processes such as thinking and decision-making.

Information and communication technology (ICT) has attracted attention as a powerful means of overcoming these barriers. It includes a range of assistive technologies that support communication, such as eye-tracking devices, switch-operated aids, speech recognition software, and devices or applications designed to enhance accessibility. Interventions utilizing ICT have been reported to improve communication clarity and strengthen interactive exchanges [6,7]. Moreover, the digitalization of education prompted by the COVID-19 pandemic has further expanded the possibilities for ICT-based support [8,9].

On the other hand, the implementation of ICT is accompanied by several challenges, including the cost of devices, the need for technical proficiency among supporters, and inadequacies in the surrounding environment [10]. While ICT holds significant potential to support people with communication needs, the success of communication is also greatly influenced by the understanding and responsiveness of those interacting with the students [11,12]. In special-needs schools, education tailored to the diverse needs of individual students

is required [13], and within this context, the role of ICT is becoming increasingly important [14]. ICT not only broadens the possibilities for students with physical disabilities to engage in learning and social interactions, but also serves as a tool for teachers and families to better support and foster the students' abilities. Nevertheless, practical insights into how ICT specifically supports student participation within school contexts remain limited.

Against this background, the present study aims to identify the key conditions necessary for the effective use of ICT to support communication among students with physical disabilities attending special-needs schools. Specifically, we examined the perspectives of students, their families, teachers, and rehabilitation professionals to understand what environmental, personal, and contextual conditions facilitate or hinder meaningful ICT use. By clarifying these conditions, this study seeks to provide practical guidance for creating supportive educational environments that enhance communication and participation for students with physical disabilities.

Methods

Research Design

We employed a descriptive qualitative approach to comprehensively summarize the target phenomenon—in this case, perceptions of effective ICT utilization in educational settings—using everyday language [15]. This approach is particularly suitable for succinctly describing

phenomena and for consistently conveying the meanings attributed to participants' experiences in a manner agreed upon as accurate by multiple observers, including researchers and participants [15]. To deepen understanding of the phenomenon, triangulation involving multiple data types (e.g., interviews and observations) and diverse respondents (students with physical disabilities, their parents, teachers, occupational therapists, and physical therapists) was employed [16]. This approach enhanced the credibility and trustworthiness of the findings by enabling comparative analysis across different perspectives and data sources, including individual interviews and classroom observations related to ICT utilization [17]. In addition to conducting individual interviews with participants, classroom observations involving ICT utilization were performed. This approach allowed for the verification of patterns across different data sources and perspectives, enabling a more comprehensive and reliable understanding of the phenomenon. The Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist was utilized to ensure the quality and transparency of the research (see Appendix).

Study Participants

A purposive convenience sampling method was used. Cooperation was obtained from two special-needs schools (School A and School B) for students with physical disabilities located in northern Japan. To explore the realities of ICT utilization from multiple perspectives, an occupational therapist at School A who was known to the authors was first contacted to

introduce teachers, rehabilitation therapists, and students with experience of using ICT, as well as their families from School A. This occupational therapist also introduced an occupational therapist at School B. After receiving an explanation of the study, the occupational therapist at School B independently identified and coordinated the participation of relevant individuals from School B, including teachers, rehabilitation therapists, students who had used ICT, and their families. For student participants, eligibility criteria included the ability to respond verbally to interview questions and experience communication limitations due to physical disabilities. Student participants were first selected by occupational therapists at Schools A and B based on the eligibility criteria. The authors then confirmed whether these students met the criteria before making the final decision on participation.

At the time of data collection, the first author was an undergraduate student at a school for training occupational therapists. The second author was a university researcher with extensive experience in qualitative interviewing and clinical experience supporting individuals with disabilities. The authors were acquainted with the occupational therapists at Schools A and B but had no prior relationship with the other study participants.

Institutional Context of the Present Study

Special-needs education in Japan is provided through special-needs schools, special classes in

156 elementary and junior high schools, and resource rooms, depending on the type and degree of
157 disability. Disabilities accommodated in special-needs schools include visual impairments,
158 hearing impairments, intellectual disabilities, physical disabilities, and health impairments.
159 These schools offer a tailored curriculum, small class sizes, specially designed textbooks,
160 teachers with specialized knowledge and experience, and facilities and equipment adapted to
161 the needs of students with disabilities. Additionally, professionally trained staff, such as
162 independent activity teachers—who are often certified occupational or physical therapists—
163 provide support within the schools.

164 In 2019, the Ministry of Education, Culture, Sports, Science and Technology
165 (MEXT) launched the GIGA (Global and Innovation Gateway for All) School Program to
166 promote equitable, individualized, and creative learning without leaving anyone behind [18].
167 This initiative accelerated the development of advanced communication infrastructure in
168 schools, including the distribution of one computer per student and the installation of high-
169 speed, high-capacity networks. Consequently, the use of ICT in educational settings has
170 expanded significantly.

171 **Data Collection**

172 From September 2022 to January 2023, the first and second authors observed classroom
173 scenes in which the students involved in the study received one-on-one instruction from their
174 teachers, focusing on how ICT was used during the lessons and taking field notes. They also

conducted semi-structured individual interviews with each participant, including students, their families, and supporting school staff. Each interview lasted approximately 40 to 80 minutes and was conducted in private rooms within the schools. In School A, ethical considerations required that the classroom teacher be present during interviews with students. During the interviews, the teacher stood behind the student, confirming or correcting the interviewer's understanding when necessary. When students' speech was unclear or when the interviewer was uncertain about their understanding, the content was reconfirmed with both the student and the teacher.

The interviews were conducted in Japanese based on the interview guidelines shown in Table 1, but the conversations were driven by participants' spontaneous responses. Interview topics included students' communication difficulties, the actual use of technologies such as eye-tracking devices in educational settings to support communication, and prospects for future ICT utilization. Teachers and rehabilitation professionals were also asked about previous cases in which ICT was used to support communication for other students. All interviews were recorded with an IC recorder and transcribed verbatim.

〔Table 1 here〕

Data Analysis

We followed Braun and Clarke's [19] six-phase approach to thematic analysis as the guiding framework for data analysis. This iterative process involved continuous movement back and forth across the entire dataset to identify patterns and themes [19]. In the first phase, all transcripts were repeatedly read to become familiar with the data and to identify initial meaning units and codes. Coding primarily relied on the transcripts, but when necessary, field notes were consulted to reconstruct the actual classroom scenes and were also utilized in the qualitative analysis. Data were organized using Microsoft Excel to facilitate a systematic coding process. In the second phase, initial codes were generated. Both descriptive coding and "in vivo" coding were applied to meaning units identified through transcript review, keeping the research question at the forefront to ensure that only relevant data were coded.

The third phase focused on theme identification. Codes were grouped into similar concepts, and candidate theme names were proposed. Phases four and five involved iterative theme review, refinement, definition, and naming. The first author sought feedback from the second author, who reviewed the themes, subthemes, and corresponding meaning units, leading to further refinement through collaboration. The final phase involved comprehensive analysis and report writing, during which the first author's interpretations regarding the identified themes and subthemes were clarified. Data analysis was conducted in Japanese, and the results were translated into English during manuscript preparation.

Rigor

To enhance the trustworthiness of the data analysis [17], triangulation was employed. Multiple data sources (semi-structured interviews and participant observations) and diverse types of respondents (students, families, teachers, and rehabilitation professionals) were utilized to enable comparative analysis alongside the previously described qualitative content analysis process. Member checking was conducted by sharing summaries of interview content and provisional interpretations with a subset of study participants, who confirmed the appropriateness of the interpretations.

Ethical Considerations

This study was approved by the Ethics Committee of the authors' affiliated institution (Approval No. 21-94). Participants were informed both verbally and in writing about the background and purpose of the study and the publication of the results. They were assured that participation was voluntary and that data would be anonymized and kept confidential. Written informed consent was obtained from each participant. For two students with physical disabilities who had difficulty signing, consent was provided by their mothers on their behalf. One of the interviewers had practical clinical experience and extensive experience conducting interviews for qualitative research, which enabled highly considerate interviewing practices.

Results

Ten individuals—six from School A and four from School B—participated in the study. Participants' characteristics are presented in Table 2. Two of the participants were students, two were their mothers, two were homeroom teachers, three were rehabilitation professionals, and one was a teacher who promoted ICT in school. Students with experience using ICT in educational settings and the ability to respond to verbal interviews were limited in the special-needs schools, with only one student in School A and one student in School B meeting these criteria during the study period.

After exploring ICT use in special-needs schools from the perspectives of students, families, teachers, and rehabilitation professionals, four themes were identified regarding the use of ICT in educational settings for communication and education of children with physical disabilities: Supportive environmental factors, Safety considerations in ICT use, Purposeful and goal-oriented use, and Balanced functional demands. Table 3 shows each theme and its subthemes.

[Table 2 here]

[Table 3 here]

Supportive Environmental Factors

Communication was supported through the presence of attentive individuals and flexible physical environments. A participant with athetoid cerebral palsy (A-1) indicated that using an

eye-gaze input device increased the likelihood of clearly conveying their intentions. However, this required teachers and staff to arrange the physical environment and develop appropriate support skills. The teacher of self-reliance activities (A-6) expressed concern that a lack of receptive communication skills among those surrounding the students could lead to disruptions in communication.

> A key factor is increasing the variety of communication methods available to the students. In fact, the students want to communicate or express something, but we, as the recipients, can't understand them, so we can't receive the message. … Because we can't understand them, communication can be cut off. I believe it's necessary for us to keep our antenna up, and for the recipients to understand how these students are trying to communicate and study how to understand them (A-6, teacher of self-reliance activities; registered occupational therapist)

Another teacher of self-reliance activities (A-5) pointed out that changes in the support environment affect the use of ICT. They discussed cases in which ICT that had previously been effective suddenly became unusable due to changes in the students' surrounding environment, such as the replacement of supporters.

> Even when we've reached the point where ICT can be used, we sometimes see cases where the student is suddenly left behind. When ICT experts provide ICT to the students, but the student's mother or people at the facility after graduation say,

"We don't understand; we can't do it," then ICT comes to a standstill. (A-5, teacher of self-reliance activities; registered physical therapist)

It was emphasized that for students to effectively use ICT, it is essential for the surrounding environment to recognize its benefits and share the necessary knowledge to create conditions that support students' ICT use.

Safety Considerations in ICT Use

ICT was used in a way that protected the students and allowed for safe experimentation. A participant with athetoid cerebral palsy (B-1), who used an iPad through voice input, stated, "When using the iPad, I sometimes end up typing in places I didn't intend to… the other day, I almost accidentally bought something." The mother of a student using eye-tracking input (A-1) shared, "With eye-tracking input, when my child blinks, it clicks. But even when he stares at the screen, sometimes he still blinks. That can cause accidental clicks. That's a concern." Participants expressed concerns about the safety of internet use due to the possibility of being directed to inappropriate educational sites or accidentally purchasing items they did not intend to buy. At the school attended by student A-1, precautions were taken to prevent such misoperations, and teachers were always nearby to provide support during ICT use.

Additionally, the student (A-1) shared his experience with the physical burden of prolonged ICT use.

> It gets tiring. I can manage if I take breaks, but if I use the eye-tracking device for a long time, my body starts to break down—so that's a disadvantage. (A-1, student with a physical disability)

He worked with teachers and parents to set reasonable parameters for ICT use, such as time limits, to help manage the physical burden. Similar concerns about physical strain were also expressed by both parents and teachers.

> When he uses the eye-tracking device, he uses his eyes a lot, so I worry about his vision. If he uses it for an hour, he gets sweaty and exhausted, so I wish it could be easier for him to use. (B-2, mother)

> When using the eye-tracking device, I ask if it's putting any strain on his eyes or if his body can tolerate using it for long periods.(A-3, homeroom teacher)

From these accounts, while the introduction of ICT provided new learning opportunities, ongoing monitoring and adjustments to ensure safety and manage physical burden were deemed essential by participants. The importance of flexible, individualized responses by supporters was emphasized.

Purposeful and Goal-Oriented Use

ICT use was guided by clear goals aligned with students' values and contexts. When asked about a memorable case of communication using ICT, a homeroom teacher (B-3) stated, "For

[Student X], ICT is the only means to have conversations with the opposite sex, and that purpose drove the use of ICT." (Note: [Student X] refers to a former student of B-3 who graduated prior to the study period.) For this student, ICT was essential and served as the only means of establishing communication. In contrast, a student with a physical disability (B-1), who had been practicing voice input, did not experience significant difficulty with everyday verbal communication and was still exploring the true purpose of the device, resulting in slower progress with ICT utilization. Regarding this student's situation, the teacher of self-reliance activities (B-4) explained as follows:

> They have not yet reached the stage of 'utilizing ICT.' Although there is hope to eventually use ICT skillfully, for now, they are in an exploratory phase… In this student's case, it's quicker to speak on their own rather than using ICT. So, relying solely on ICT to conduct lessons is not efficient. (B-4, teacher of self-reliance activities; registered occupational therapist)

Another teacher of self-reliance activities (A-5) expressed concern about the increase in purposeless ICT use in educational settings, stating:

> If we buy ICT devices simply because of subsidies, they end up being used just for watching YouTube, even without a specific purpose. It's not good for students to use ICT without a clear reason. We need to explain the rationale for using ICT. (A-5, teacher of self-reliance activities; registered physical therapist)

These findings suggest that the clearer the objective for using ICT, the more effectively it can be utilized. Sharing such goals between students and supporters was essential for maximizing the benefits of ICT and realizing its full potential in educational and communicative contexts.

Balanced Functional Demands

ICT was more effective when its physical and cognitive demands matched the students' abilities. Adjustments such as simplifying operations and giving sufficient time were important for making ICT accessible and meaningful. For example, the teacher of self-reliance activities (A-5) explained, "People who can use ICT are often those who can use their hands, individuals with acquired disabilities, or those with ICT experience." Participants reported that students with higher physical abilities or prior ICT experience found it easier to use ICT, even if they did not need it specifically for communication.

Since adapting to the demands of ICT often requires significant effort and time, its use tends to be postponed before students reach the stage of mastering it. Regarding this situation, the teacher (B-3) stated:

> With the current schedule, there is hardly any time for breaks, so there's no room for doing something troublesome (using ICT)… He (student B-1) seems to strongly resist this new approach. (B-3, homeroom teacher)

Given such circumstances, it was necessary to deepen the understanding of resistance related to the effort and cost of using ICT and to work toward alleviating that resistance.

Additionally, the teacher of self-reliance activities (A-6) emphasized the developmental aspect of communication and ICT acquisition. He expressed concern that introducing ICT during the early stages of communication development could potentially hinder the student's communication skills in the long term:

> The "thinking" part before "expressing" is often neglected. Without the ability to think, ICT cannot be used effectively. If therapists and teachers had focused more on communication from an early age, it would have been better. (A-6, teacher of self-reliance activities; registered occupational therapist)

Several participants emphasized that to effectively use ICT as a communication tool, students needed not only the physical ability to operate ICT devices but also the cognitive ability to understand information and think about what they want to communicate. Before introducing ICT, rehabilitation therapists and teachers were reported to foster students' ability to consider their intended messages, provide comprehensive communication instruction tailored to their developmental stages, and offer support to help realize their individual potential. By doing so, students could acquire the prerequisite skills necessary for effective use and eventual mastery of ICT.

Discussion

This study aimed to explore the conditions necessary for the effective use of ICT to support communication among students with physical disabilities in special-needs schools. Using semi-structured interviews and participant observation, we gathered perspectives from students, their families, teachers, and rehabilitation professionals. The findings identified four key areas that influence meaningful ICT utilization: (1) supportive environmental factors; (2) safety considerations in ICT use; (3) purposeful and goal-oriented use; and (4) balanced functional demands. In the following discussion, we examine these themes in relation to previous research and consider their practical implications for enhancing participation and communication opportunities for students with physical disabilities.

While ICT is considered to have high potential in educational settings, participants pointed out that technologies developed without consideration for users with disabilities [20,21] often impose excessive functional demands on children. Furthermore, participants emphasized that not all children can make equal use of ICT, and that its effectiveness can be limited by the design and operational demands placed on the user. This issue is particularly evident among students with severe physical disabilities, for whom ICT tools may not function effectively—not because of a lack of ability on the part of the child, but due to inadequacies in the design of the technology itself. As ICT becomes more integrated into educational

environments, cases were observed in which devices were selected or used in ways that were misaligned with the specific needs of children with disabilities. In such instances, technologies imposed demands without adequate consideration, thereby increasing the burden on the child.

In this multifaceted investigation, all participants referred to the physical burden associated with prolonged use of ICT, including fatigue. For example, children with cerebral palsy tend to experience increased muscle tone and are significantly more prone to fatigue than their typically developing peers [22]. The use of ICT may further exacerbate this physical strain, potentially increasing the overall burden on the child.

Such excessive functional demands and the accumulation of physical strain can deprive children of opportunities to engage in meaningful activities. In other words, rather than supporting children's participation, ICT tools may in fact restrict it. Assistive technologies should not merely be "usable"; they should function as tools that enable children to actively engage in desired activities and connect with others [5]. These challenges highlight that approaches such as universal design and human-centered design, while valuable, are insufficient in the development of assistive technologies. Instead, they underscore the necessity of co-design processes that involve individuals with disabilities as active collaborators [23,24].

Concerns were also raised by families and school staff regarding the safety of internet-connected ICT environments. Previous studies have highlighted the potential for users to experience both psychological and physical burdens in such digital settings [25]. Parents and

395 educators are therefore required to possess a high level of internet literacy and to understand
396 how digital technologies may influence children's development [26]. Rehabilitation
397 professionals should play a key role in guiding both caregivers and school personnel,
398 emphasizing the importance of internet literacy education to ensure that children can use ICT
399 safely and effectively.

400 Furthermore, some rehabilitation professionals expressed concerns that ICT is often
401 introduced as a "compensatory approach." The statement made by a special education teacher
402 (A-6)—"The 'thinking' aspect before 'communicating' is often left behind. Without the ability
403 to think, ICT cannot be used effectively"—offers particularly important insights for those
404 involved in rehabilitation during developmental stages. In particular, the unilateral introduction
405 of ICT during periods of immature functional development may not always be the optimal
406 approach for a child's learning and growth. This suggests that, for ICT to be effective, a child's
407 cognitive and physical readiness must be considered, and that the purpose and timing of its
408 introduction should be carefully evaluated. The mere act of teaching ICT should not be the goal
409 of education. Instead, ICT skills and knowledge should be integrated into learning as needed
410 and at a level appropriate to the child's overall communication abilities and goals [27].
411 Campbell et al. [28] emphasize the importance of rehabilitation professionals providing
412 individualized services that gradually adapt to changes in students' functional abilities and
413 needs. In educational settings, rehabilitation professionals play a crucial role in assessing how

ICT use contributes to a child's development and learning, and in supporting the learning activities and social exchanges of children with physical disabilities.

To effectively utilize ICT in educational settings, not only the efforts of the child but also appropriate interactions from those around the child—and adjustments to the physical environment—are necessary. These adjustments should be based on the child's disability characteristics, ICT utilization skills, and physical and functional abilities. Both social conditions, such as the knowledge and attitudes of those surrounding the child, and environmental conditions, such as the physical setting, are essential for the effective use of ICT [29]. Previous studies have indicated that, to promote ICT use among students requiring special support, initial teacher education and ongoing professional development are necessary [8,9]. It has also been argued that teachers need a deeper understanding of the attitudes and psychological factors that influence their decisions to use ICT [30]. Furthermore, for individuals and families to derive the maximum benefit from ICT, greater support from knowledgeable professionals is essential [31].

Based on the above, it is necessary to reassess the introduction of ICT not merely by focusing on its technical functionalities, but by evaluating whether those functionalities truly align with the individual needs of the student. Rehabilitation professionals and educators must carefully consider the balance between the physical and cognitive demands of ICT tools and the abilities that the student can realistically demonstrate, ensuring that the tools can be

used effectively and without strain. As suggested by the results of this study, whether the introduction of ICT becomes a meaningful resource that supports student participation depends on whether its design, implementation, and environmental adjustments enable the student to actively engage. In educational settings, rehabilitation professionals can play a key role in facilitating collaboration among educators and in supporting the development of individualized and coordinated ICT use. Their contributions may help ensure that the technology is not only accessible but also meaningful and sustainable for students with physical disabilities.

Limitations and Future Directions

Although the number of student participants with physical disabilities in this study was small, purposive sampling enabled the exploration of diverse perspectives, including those of students, their families, teachers, and rehabilitation professionals. However, the findings should be interpreted with caution, as the transferability of the results may be limited due to the small sample size and the specific cultural and educational context of northern Japan. This study focused on students who were able to participate in interviews using verbal communication through ICT. Therefore, the experiences of students who use non-verbal communication methods, such as eye-tracking or switch-based input, may not be fully represented. Future research should explore the diverse experiences of ICT use among non-verbal users as well.

The effectiveness of ICT is highly individualized and dependent on the specific needs, developmental stages, and communication abilities of students. Future research should further investigate variations across different demographic groups, such as age, prior ICT experience, and the types of ICT equipment used. Studies with larger and more diverse samples will help clarify how these factors influence ICT utilization in educational settings.

This study also highlights the critical role that rehabilitation professionals can play in supporting students with communication challenges through ICT. A comprehensive and individualized assessment process is necessary to determine whether, and how, ICT should be introduced as a communication aid. Although this study offers a preliminary framework by identifying four key conditions for effective ICT use, further work is needed to develop structured assessment tools and intervention models based on these findings. Future interdisciplinary research involving both education and rehabilitation professionals will be essential for creating environments that genuinely promote participation and communication among students with physical disabilities.

Conclusions

This study explored the conditions necessary for the effective use of information and communication technology (ICT) to support communication among students with physical disabilities in special-needs schools. Drawing on the perspectives of students, their families, teachers, and rehabilitation professionals, four key areas were identified: supportive

environmental factors, safety considerations, clear goal-setting for ICT use, and the functional demands placed on students by ICT technologies.

Our results show that ICT devices are not a panacea; they will not automatically or necessarily remove the communication barriers that children with physical disabilities face in inclusive education. To make ICT effective in eliminating such barriers, it is essential to establish a supportive and safe environment and to appropriately calibrate ICT use to each child's physical abilities, developmental stage, and communication needs.

As the findings of this study indicate, for ICT to be truly effective, it must function as a medium that supports the participation of children and students, rather than merely serving as a tool for information transmission. To achieve this, it is important for occupational therapists and other supporters to adapt ICT to the context of children's lives and learning, and to continue making practical efforts to create opportunities for participation.

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Declaration of Conflicting Interest

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Table 1

Interview Guides

Group	Interview items
Physically disabled children/students	1. What communication difficulties do you have? 2. Do you have any memorable moments or memories about communication? Please tell us more about the occasion, whether it was good or bad. 3. Please feel free to share your thoughts on the good and bad aspects of using ICT. 4. Can you tell us what you expect or hope for in terms of communication?
Their families (mothers)	1. What difficulties or challenges do you face when communicating with your child? 2. What do you pay special attention to or value when communicating with your child in daily life? 3. Have you ever used ICT to communicate with your child? If so, what are the positive and negative points of using ICT?

	4.	Please tell us about your concerns, expectations, and hopes regarding your child's education, especially in terms of communication.
Their teachers and rehabilitation professionals	1.	What ICT is currently used at this school?
	2.	Please tell us, in as much detail as possible, about your communication with the target child, including specific situations in which you experienced difficulties or challenges.
	3.	What changes—quantitative and qualitative—does the use of ICT bring about in communication? Please provide as much detail as possible about the perceived changes, both positive and negative.
	4.	If you have any impressive examples of the use of ICT in communication, regardless of the target child, please tell us about them in as much detail as possible.
	5.	As a teacher, is there anything you pay attention to or value when communicating with children/students with physical disabilities?

6. Please tell us about any future communication challenges you expect, or any communication improvements you would like to make in the education of children/students with physical disabilities.

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Table 2

Characteristics of Participants

ID	Group	Age	Career/ Special characteristic	Relationship with the child/student
A-1	Student with physical disability	Late teens	12th-grade student; athetotic cerebral palsy; ADL: maximum assistance; can speak, but unclearly; began using eye-tracking device in 11th grade.	—
A-2	Mother	Late 50s	Employee of a company owned by her relative	She spends all day with the child on weekends
A-3	Homeroom teacher	Early 30s	Teaching experience: 8 years;	He has known the student since the

			belongs to the high school department.	student was in 7th grade and is deeply involved in the student's daily classes and life situations.
A-4	Teacher promoting ICT in the school	Late 50s	Teaching experience: 34 years; belongs to the elementary school department.	He has little relationship with the student, but helped to install the student's eye-tracking device
A-5	Teacher of self-reliance activities (registered	Mid 50s	Registered physical therapist for 34 years; teaching experience: 21 years	She is involved in class activities about once a week or when the student has a

	physical therapist)			problem.
A-6	Teacher of self-reliance activities (registered occupational therapist)	Late 30s	Registered occupational therapist for 14 years; teaching experience: 7 years	He is involved in class activities about once every two months.
B-1	Student with physical disability	Early teens	7th-grade student; athetotic cerebral palsy; ADL: maximum assistance; usual form of communication: uses speech, but has been using iPad's voice input	—

			for half a year.	
B-2	Mother	Late 30s	Part-time job (twice a week)	She spends most of her time outside of school hours on weekends and most of the weekends together with her child
B-3	Homeroom teacher	Early 60s	Teaching experience: 34 years, including 2 years as a re-employed teacher after mandatory retirement; currently belongs to the junior high school department.	He has known the student for less than a year, and is deeply involved in their daily class and life activities

B-4	Teacher of self-reliance activities (registered occupational therapist)	Early 40s	Registered occupational therapist for 21 years; teaching experience: 15 years	She uses the iPad voice input together with the student in class about twice a month

Table 3

Perceptions of Factors Influencing ICT Use for Communication and Education of Children with Physical Disabilities

Theme	Subthemes
Supportive environmental factors	• Level of ability to speak indistinctly with effort • Attitudes exhibited by people around the target student that are important for understanding the student's language • Knowledge exhibited by people around the target student that is important for appropriately using ICT in educational settings • Physical environment needed for future ICT promotion • Attitudes exhibited by people around the target student that are needed for effective ICT use
Safety considerations in ICT use	• Environmental adjustments required to achieve quality ICT operations

	• Controls necessary for the safe use of ICT among students • Physical burden of ICT use is intensified by disability characteristics
Purposeful and goal-oriented use	• Promote ICT use when there is a purpose • Communicative independence gained through the introduction of ICT • Connections with society that may expand through future use • Convenience of ICT as a means of communication • Effort to communicate varies depending on the level of interest • Enjoyment found in ICT • Vocabulary comprehension of target students improved by ICT • Meaningful forms of teaching expected from ICT

	• Burden on those around the target student reduced by ICT
Balanced functional demands	• Importance of developmental support for students' future • Amount of expression actually reduced by the use of effortful ICT • Number of students who can use ICT is limited • Practicality of ICT for target students is still low • ICT utilization is limited due to current lack of need • Priority of ICT utilization is low relative to other needs

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