

Educational and Assistive Technologies for Students With Severe Motor Impairments, Multiple Disabilities, and Complex Communication Needs: A Comparative Scoping Review

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This scoping review mapped educational and assistive technology research for students with severe motor impairments, multiple disabilities, and complex communication needs, with attention to comparative trends between South Korean and international studies. Following Arksey and O'Malley's framework, later methodological refinements, and PRISMA-ScR guidance, Korean and international databases were searched for peer-reviewed journal articles published from 2002 to May 2026. Eligibility was defined using the PCC framework: target learners with severe motor, physical/multiple, profound/multiple, or complex communication access needs; educational or assistive technology applications; and school, home, community, or education-linked contexts. Broad database and manual searches yielded 1,310 records; after duplicate removal, title/abstract screening, full-text assessment, and population-fit checking, 29 studies were included. Fourteen were South Korean and 15 were international. Five functional roles were identified: establishing access pathways, expanding communicative expression, increasing activity participation, supporting curriculum access, and promoting self-determination and digital agency. South Korean studies emphasized AAC applications, switch-mediated communication, and VR-based contextual learning, whereas international studies emphasized eye-gaze access, functional independence, interaction, and robotics. The field requires stronger integration of classroom implementation, specialized access assessment, longitudinal evidence, and curriculum participation.

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Introduction

Educational and assistive technologies increasingly mediate access to communication, learning, and participation in special education. For students with severe motor impairments, multiple disabilities, and complex communication needs, technology is not an optional supplement. It often provides the route through which learners make choices, indicate responses, initiate communication, control computers, and participate in curricular or community routines. Switches, AAC systems, eye-tracking interfaces, eye-gaze technologies, VR, mobile applications, and robotics can therefore be understood as educational access systems rather than as devices alone.

The literature is heterogeneous. Studies use overlapping labels such as physical and multiple disabilities, severe and multiple disabilities, profound and multiple disabilities, cerebral palsy, severe physical impairments, complex needs, and complex communication needs. Technology foci also vary, ranging from smart-device AAC applications and switch-based access to gaze-based assistive technology, visual scene displays, virtual simulations, and robots. South Korean studies have often emerged from classroom, home-based, or community-linked instructional contexts and have emphasized AAC applications, switch-mediated communication, and VR-based simulation. International studies have more frequently examined eye-gaze technologies, gaze-based computer access, functional independence, communication-partner interaction, and specialized assistive technology implementation.

A scoping review is appropriate because the field is broad, methodologically diverse, and not yet suited to pooled effect estimation. This review mapped the range and functional roles of the evidence and compared South Korean and international trends. The review asked: (a) what are the general characteristics of the studies; (b)

what functional roles have technologies served; (c) how do South Korean and international trends differ; and (d) what gaps remain for international special education research?

2. Methodology

This study used a scoping review design guided by Arksey and O'Malley (2005), Levac et al. (2010), Peters et al. (2015), Munn et al. (2018), and PRISMA-ScR reporting guidance (Tricco et al., 2018). Because the purpose was to map characteristics, concepts, and gaps rather than synthesize effect sizes, formal quality appraisal and meta-analysis were not conducted.

Eligibility criteria followed the PCC framework. Population referred to children, students, adolescents, or transition-age youth with severe motor impairments, physical and multiple disabilities, severe or profound and multiple disabilities, cerebral palsy with substantial motor limitations, or complex communication needs requiring alternative access. Concept referred to educational or assistive technology applications supporting communication, access, participation, learning, functional engagement, or self-determination. Context included schools, special schools, special classes, home-based educational services, community instruction or simulation, education-related therapy settings, and daily educational participation. Only peer-reviewed journal articles were included. Dissertations, conference papers, product-development reports without student application, perception-only studies, and medical or rehabilitation-only studies without educational relevance were excluded.

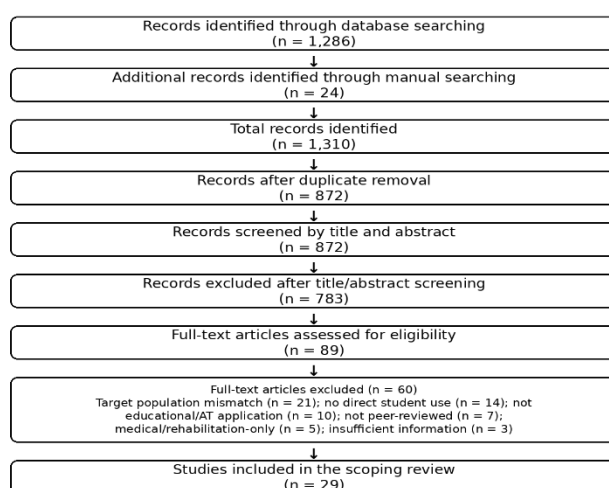
KCI, RISS, Scopus, Web of Science, PubMed, and Google Scholar were searched for studies published from January 2002 through May 2026. Search terms combined disability-related terms with technology-related terms in Korean and English, including severe physical impairments, physical and multiple disabilities, severe and multiple disabilities, cerebral palsy, profound

and multiple disabilities, complex communication needs, AAC, switch, eye-gaze, eye tracking, gaze-based assistive technology, visual scene display, virtual reality, robot, mobile application, educational technology, and assistive technology. Searches were intentionally broad because terminology was inconsistent across countries. Reference lists of included studies were also manually checked.

Database searches yielded 1,286 records and manual searching identified 24 additional records. After duplicate removal, 872 records

were screened by title and abstract. Eighty-nine full-text articles were assessed for eligibility; 60 were excluded, leaving 29 included studies. Fourteen studies were South Korean and 15 were international. A data-charting form extracted author, year, publication context, participants, technology type, educational context, study design, application function, outcome measures, and major findings. Synthesis was descriptive and thematic, with comparative coding across technology orientation, educational context, outcome focus, and implementation emphasis.

Figure 1. PRISMA-ScR flow of study selection



Results

The 29 included studies used varied participant labels and research designs, but all addressed learners whose educational participation was shaped by severe motor limitations, multiple disabilities, or complex communication access needs. Most studies used single-case, multiple-baseline, case-study, multiple-case, small-scale intervention, or qualitative designs, reflecting the low-incidence and heterogeneous nature of the population.

Five functional roles were identified. First, technologies established access pathways. Switches, microswitches, eye tracking, eye-gaze systems, and low-tech gaze boards transformed limited movements or gaze behaviors into intentional selections, responses, or

communicative acts. Second, technologies expanded communicative expression. AAC applications, communication boards, visual scene displays, just-in-time programming, eye-gaze AAC, and low-tech AAC supported requesting, rejecting, turn-taking, symbolic communication, and initiation. Third, technologies increased activity participation. Eye-gaze computers, VR, gaming-based systems, microswitch-supported programs, and robots enabled participation in computer activities, play, simulation, and instructional routines. Fourth, technologies supported curriculum access through early numeracy, emergent literacy, social studies inquiry, community-safety simulation, and AAC-supported classroom participation (Caron et al., 2025; Hudson et al., 2016; Jeong et al., 2021). Fifth, emerging work

addressed self-determination and digital agency through choice-making, mobile application use, and participation in digital environments (Kim et al., 2026; Stasolla et al., 2019).

The comparative pattern was clear. South Korean studies more often focused on technologies embedded in instructional routines across special schools, special classes, home-based education, and community-linked settings (Bae & Chae, 2017; Kim, 2015; Kim & Han, 2019; Seo & Park, 2018). Smart-device-based AAC applications and switch-mediated AAC were prominent and were used to improve requesting, symbol use, communicative functions, class participation, and context-based learning. South Korean VR and 360-degree video studies also framed simulation as a way to address restricted mobility, safety, and limited community access while preserving educational participation.

International studies more often examined specialized access technologies (Borgestig et al., 2016, 2021; Drager et al., 2019; Hsieh et al., 2021, 2024). Eye-gaze and gaze-based assistive technology studies addressed computer access, eye-gaze performance, activity repertoire, communication interaction, functional

independence, and sustained use. International studies also included visual scene displays, just-in-time AAC programming, low-tech eye-gaze boards, eye-gaze gaming, emergent literacy through eye-gaze AAC, and early robotics-related applications (Drager et al., 2019; Hedgecock et al., 2014; Holyfield et al., 2023). Thus, South Korean studies contributed classroom-embedded and community-linked implementation examples, whereas international studies contributed stronger evidence on specialized access assessment, longitudinal use, interaction analysis, and functional independence.

Reported outcomes clustered at three levels: micro-level access outcomes such as activation, accuracy, and device control; interaction and participation outcomes such as requesting, initiation, engagement, and class participation; and curriculum or life-context outcomes such as early numeracy, literacy, social studies learning, community instruction, self-directed behavior, and digital agency. However, long-term maintenance, generalization, teacher training, device abandonment, family-school coordination, AI, robotics, and broad subject-area curriculum outcomes remained underexamined.

Table 1. Eligibility criteria and data charting framework

Review element	Operational definition
Population	Students with severe motor impairments, physical/multiple disabilities, cerebral palsy with substantial motor limitations, profound/multiple disabilities, or complex communication needs requiring alternative access
Concept	Educational or assistive technologies supporting communication, access, participation, learning, functional engagement, or self-determination
Context	Schools, special classes, home-based education, community instruction/simulation, education-related therapy, or daily educational participation contexts
Included sources	Peer-reviewed journal articles applying or analyzing technology use with students
Excluded sources	Studies without clear target population fit, perception-only studies, technology development without student application, medical/rehabilitation-only studies, dissertations, theses, and conference papers

Data charting	Author, year, context, participants, technology type, design, function, outcomes, and findings
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Table 2. Comparative mapping of South Korean and international research trends

Dimension	South Korean studies (n = 14)	International studies (n = 15)
Technology orientation	AAC applications, switch-mediated AAC, smart devices, VR, mobile applications	Eye-gaze technology, gaze-based AT, VSD, JIT programming, low-tech gaze boards, robotics
Main context	Special schools/classes, home-based education, community simulation, curriculum-linked activities	Computer access, daily activities, communication interaction, functional independence, AT implementation
Primary outcomes	Requesting, symbol use, communicative functions, class participation, community/curriculum engagement	Eye-gaze performance, computer activity participation, functional independence, activity repertoire, interaction
Distinctive contribution	Teacher-mediated, context-embedded instructional use and community/curriculum simulation	Specialized access technology, longitudinal use, interaction analysis, functional independence
Remaining gaps	Long-term implementation, access profiling, broader subject-area learning	Classroom feasibility, contextualized curriculum embedding, cross-setting educational use

Discussion

This review shows that educational and assistive technology for students with severe motor impairments, multiple disabilities, and complex communication needs is best understood as an access- and participation-oriented field shaped by educational ecology. The central issue is not technological novelty but whether technology enables meaningful educational action. Access should therefore be treated not merely as a prerequisite to learning but as an educational outcome. Learning to activate a switch, select through eye gaze, communicate through AAC, or navigate a visual scene display can expand a learner's participation in educational life.

Cross-national differences were analytically important. South Korean studies tended to emphasize smart-device AAC, switch-mediated communication, and VR-based community or curriculum simulation. These emphases suggest

a practice-oriented research tradition closely tied to classroom routines, teacher-mediated intervention, and curriculum adaptation. International studies more often centered on eye-gaze access, functional independence, communication-partner interaction, and longer-term assistive technology use. This pattern may be associated with differences in access to specialized assistive technology, technical support, and implementation contexts across published studies. These interpretations remain provisional because a scoping review cannot establish causal explanations for national differences.

The two bodies of literature offer complementary strengths. The international field can learn from South Korean studies that educational technologies should be embedded in routine instructional practice and community-linked learning rather than treated as stand-alone

devices. South Korean VR studies also illustrate how simulation can support students when direct community access is constrained by mobility, safety, or staffing. Conversely, South Korean research can learn from international work on eye-gaze technology, longitudinal assessment, communication-partner interaction, functional independence, visual scene displays, and just-in-time programming.

Future research should move from technology-centered evaluation toward ecology-centered implementation. Studies should report student access profiles, positioning, fatigue, visual demands, calibration, wait time, prompts, partner behaviors, family involvement, maintenance, and environmental barriers. Curriculum-based outcomes should also be expanded beyond communication and access to literacy, numeracy, science, social studies, arts, physical education, and vocational learning. Finally, outcome measures should include participation, autonomy, choice, communication rights, and quality of life, because technology use for this population is directly related to whether students can express preferences, influence environments, and participate in relationships.

Limitations should be noted. Only peer-reviewed journal articles were included, and terminology varied across studies and countries. The comparative analysis reflects patterns in published literature rather than national practice as a whole. As a scoping review, this study did not conduct quality appraisal or meta-analysis.

5. Conclusion

Educational and assistive technologies can support students with severe motor impairments, multiple disabilities, and complex communication needs by creating access pathways, expanding communication, increasing participation, supporting curriculum learning, and promoting digital agency. South Korean and international studies reveal complementary strengths: classroom-embedded AAC, switch, and VR applications on one hand, and specialized eye-gaze access, functional independence, and longer-term assistive technology research on the other. Integrating these strengths may advance a more inclusive and ecologically grounded approach to educational technology in special education.

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Author Declaration

The author declares that this manuscript is original, is not under consideration elsewhere, and has no conflict of interest. As this study is a scoping review of published literature, institutional review board approval was not required. The author used a generative AI tool during drafting and language editing and subsequently reviewed, revised, and takes full responsibility for the accuracy, integrity, and originality of the manuscript.

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