Assistive Technologies for Children with Disabilities in Inclusive and Special Schools in Indonesia

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Acronyms

ADHD	Attention Deficit and Hyperactivity Disorder
AR	Accentuated Reality
ASD	Autism Spectrum Disorder
AT	Assistive Technology
BOP	Education Operational Assistance (*Bantuan Operasional Pendidikan*)
BOS	School Operational Assistance Fund (*Bantuan Operasional Sekolah*)
CBT	Computer-based training
CI	Cochlear implant
DAK	Special Allocation Fund (*Dana Alokasi Khusus*)
Dapodik	Basic Education Data (*Data Pokok Pendidikan*)
DSU	Disability Service Units
FGD	Focus group discussion
GoI	Government of Indonesia
GPK	Teacher trained on inclusive education in regular schools (*Guru Pembimbing Khusus*)
HA	Hearing aid
ICT	Information and Communication Technology
ID	Intellectual Disability
IE	Inclusive Education
IEP	Individual Education Plan
IS	Inclusive School
LD	Learning Disability
LMS	Learning Management System
ML	Machine learning
MoECRT	Ministry of Education, Culture, Research and Technology
MoH	Ministry of Health
NGO	Non-governmental oganization
NLP	Natural language processing
OCR	Optical character recognition
PECS	Picture exchange communication system
PMPK	Directorate for Community and Special Education (*Direktorat Pendidikan Masyarakat dan Pendidikan Khusus*)
RPMT	Responsive Prelinguistic Milieu Teaching
SD	Speech Disorder
SGD	Speech-generating Device
SS	Special School (*Sekolah Luar Biasa - SLB*)
SSET	Directorate of Secondary and Special Education Teachers
STT	Speech-to-text
TTS	Text-to-speech
VE	Virtual Environment
VM	Video Modelling
WM	Working Memory

Executive Summary

Enhancing the quality of education for children with disabilities, including through the use of assistive technology, is a global concern. Assistive Technology (AT), defined as any technologies and items used by teachers, including high-tech and low-tech, to facilitate students with disabilities to participate in learning activities, is crucial to enhance their quality of education.[1] Despite the importance of AT to enhance equality of learning for children with disabilities, there is a lack of research on what types of technology are available and how they can be used for learning for children with disabilities in low and middle-income countries.[2]

Improving the quality of learning for children with disabilities, especially through addressing their equitable access to AT, is an urgent issue to ensure their right to education and to build back better following the COVID-19 pandemic. In Indonesia, the quality of education for children with disabilities has been overlooked and remains a key issue, while their access to education has gradually increased in the past decade.[3] In addition, while the pandemic has led to innovations and investment in education technologies, it also widened existing educational inequalities in Indonesia.[4] Children with disabilities are arguably the worst affected by the pandemic because many of them have been unable to access adequate services for their individualized learning.[5] However, very limited attention has been paid to AT for children with disabilities in education in Indonesia. While existing studies in Indonesia imply AT can help students with disabilities in the learning process,[6] they are often limited to limited types of disability focusing on specific schools. Thus, a wider understanding of the structural issues, including children with various disability types and school conditions, and changes required in the education systems in policy and practice is needed. In this context, a more holistic empirical study to examine AT is needed to place children with disabilities in the debate on the quality of education in Indonesia.

This study addresses this knowledge gap, focusing on the Indonesian context. This empirical study of the Indonesian context aims to rigorously examine availability and usage of AT for children with disabilities. It reviews key challenges and support needed in both inclusive and special schools, focusing on teachers in primary and secondary education in Ministry of Education, Culture, Research and Technology (MoECRT). Key questions included:

1) What is the availability and use of AT for students with disabilities in schools in Indonesia?
2) In what ways can teachers, schools, and local and national stakeholders work together to promote equitable and quality learning through AT for children with disabilities?

To answer these questions, this study employed a mixed method to enhance the validity and quality of evidence-based analysis of AT for children with disabilities in Indonesia, including a national level teacher survey with over 2000 teachers who participated voluntarily, focus group discussions with teachers, school principals and policy makers as well as an international review of practices on AT for children with disabilities to address the lack of previous studies in Indonesia. Examination of AT issues necessitates local contexualization because challenges vary widely across locations. In this study, the concept of AT is revised through consultation with teachers, school principals and policy makers to adjust to the Indonesian context. The concept of AT is expanded to include not only high-tech (mainly including electric devices, their supportive equipment, software/application, and are more likely to be purchased and costly) but also low-tech (mainly including non-electric devices and solutions which are less costly) which is currently assumed to be more common in Indonesia especially where resources and connectivity are limited.

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[1] Lynch et al. (2021)
[2] Lynch, Singal, and Francis (2022)
[3] Ministry of Education, Culture, Research and Technology (MoECRT). 2021. Dapodik.
[4] UNICEF (2020)
[5] Ibid.
[6] Andrean et al. (2021)

The study revealed very limited use of AT for children with disabilities, especially in inclusive schools. Analysis of quantitative and qualitative data in Indonesia and a comparative analysis with international practices on AT showed that teachers often struggle due to the paucity of governmental support including the lack of teacher training and provision of AT. Limited governmental support is often caused by lack of regulations, training content and understanding of school-level issues at a national level. There is often an assumption by central government that teachers can and should deal with AT issues on their own, despite limited training and provision of adequate AT especially in inclusive schools. On the other hand, teachers' use of AT was strongly associated with availability of AT in school and teacher training related to AT. Thus, focused teacher training, provision of AT, accessible guidelines and additional technical support are needed for teachers to use AT for children with disabilities. This point was emphasized by the teachers consulted through the study.

This study concludes that a shift in service delivery model is required to address quality issues in policy agenda and implementation. Recommendations focus on how Indonesian schools can adopt high-tech and/or low-tech and how stakeholders at multi-levels (central, local and school levels) can ensure that all necessary resources are available for teachers to use, and how to strengthen supporting mechanisms for teachers. Recommendations propose changes to be made at central, local and school level, including to:

1. **Develop regulations and guidelines on the use of and support for AT;**
2. **Improve the procurement process of AT and expand multi-sectoral collaboration;**
3. **Develop teacher training on AT and strengthen supporting mechanisms.**

The priorities for the shift should be redesigning government regulations, procurement process, teacher training and supporting mechanisms for teachers, with an aim to improve not only access but also educational outcomes that contribute to reducing the inequality experienced by children with disabilities in Indonesia.

Table 1: Summary of Key Findings

Category	Key findings
Availability of AT	• **Availability of AT for children with disabilities is very limited in inclusive schools.** o Almost 70 percent of GPK (teachers trained on inclusive education (IE) in inclusive schools) who participated in the survey reported they have no AT even though they have children with disabilities in their schools. On the other hand, approximately 80 percent of teachers in special school who participated in the survey have AT. • **Supply of AT in inclusive schools tends to rely on schools and teachers rather than governmental support.** o As main suppliers of AT in inclusive school, 25 percent of GPK reported school as a main supplier, followed by others (23 percent) and teacher themselves (22 percent) meaning teachers create AT. Teachers reported lower percentage of supply from governments at all levels including central, provincial and city/district governments. This is partly due to the lack of regulation that mandate the need of AT, especially high-tech, in inclusive schools.
Teacher training	• **Teacher training on AT for children with disabilities is severely lacking both in inclusive and special schools.** o Almost 85 percent of GPK in inclusive schools and 70 percent of teachers in special schools reported to have no training on AT for children with disabilities. This may be because the current teacher training on IE by the Directorate of SSET tends to cover the basics such as the concept of IE, diversity of children and identification of children with disabilities, rather than AT to improve their learning experiences. Thus, when it comes to AT, it may be more common that teachers have to learn by themselves, without support from any training providers. • **In inclusive school, not only government bodies but also schools and school collaboration have important roles in providing training on AT. However, an urban-rural gap exists in inclusive schools, and training is limited in rural areas.**
Catalogue, manual and access to information	• **Most teachers have no access to catalog, manual and information on AT, and teachers in inclusive schools are more likely to be effectively stranded by this lack of support.** o 96 percent of teachers in inclusive schools and 86 percent of teachers in special schools do not have an AT catalog in their schools.

	o 94 percent of teachers in inclusive schools and 78 percent of teachers in special schools do not have manuals for the use of AT in their schools. o 72 percent of teachers from inclusive schools reported difficulty in accessing information regarding AT. In contrast, 48 percent of teachers from special schools had difficulty in accessing information, partly because they tend to share information on AT with peers in school.
Use of AT	• **The use of AT is quite limited in inclusive schools and over 60 percent of teachers trained on IE have not used AT for children with disabilities yet.** • **Teachers' use of AT is strongly associated with availability of AT in school, teacher training and access to information.** o The odds of using AT are more than 500 percent higher for teachers who have AT in their schools than for those who do not. Importantly, teacher training on AT increases the odds of teachers' use of AT by 350 percent. Ease of to access information about the types and uses of AT for children with disabilities also increases a teachers' odds of using AT by 122 percent. Having knowledge on AT to support children with disabilities also enhance the odds of teachers' use by 110 percent. o On the other hand, the odds of AT use are almost 50 percent lower for teachers in inclusive schools than for special education teachers. Similarity the odds are 27 percent lower for teachers in public schools than for teachers in private schools. • **Use of high-tech is still limited compared to low-tech across different types of disabilities including learning disabilities (LD), autism spectrum disorders (ASD), attention deficit and hyperactivity disorders (ADHD), speech disorders (SD), hearing and visual impairments and physical disabilities.** Even if teachers use high-tech and/or low-tech, AT is not always used to meet the specific needs and/or skills of different types of disabilities, due to the lack of training and guidelines on AT in inclusive and special schools. • Experienced teachers tend to utilize multiple types of AT to provide better learning experience according to student characteristics.
Assessment of AT needs	• **In inclusive schools, teachers are more likely to use AT when teachers determine students' AT needs by considering assessment of student achievement with and without AT, assessment by other professionals (e.g., psychologist, doctors), and student preferences** o The odds of teachers using AT are increased by 66 percent if teachers consider students' achievement with and without AT to decide whether the student needs AT. Similarly, collaboration with health professionals in assessing students' needs for AT also increases the odds of actual use of AT by 46 percent. Consideration of students' preferences also increases the odds of teacher AT use by 42 percent. Existence of teacher observation and assessment were also related to the use of AT. • **Collaboration with health professionals matters for teachers in inclusive schools who tend to lack specialized knowledge and support to identify suitable AT according to characteristics of different disability types and learning challenges.**
Challenges	**1. Creating AT** • **Almost 70 percent of teachers in inclusive schools and 50 percent of teachers in special schools have not created AT to support children with disabilities.** o The most prevalent reasons for not creating AT were the lack of information on the current status of AT and lack of technical support o Nearly 50 percent of teachers who have created AT largely get information relying on social media such as YouTube. **2. Lack of teachers' practical skills and supporting mechanisms** • **The biggest challenge for teachers to use AT is the lack of adequate skills and training on AT for children with disabilities, and insufficient knowledge.** Approximately 40 percent of teachers from inclusive and special schools do not have adequate skills, and 39 percent of teachers in inclusive schools expressed they do not know how to use AT for students with disabilities, as a key barrier to use AT. • **Infrastructure issues were also common including limited hardware, lack of internet connectivity and difficulties with maintenance.** 30 and 46 percent of teachers from inclusive and special schools respectively raised infrastructure issues as one of key barriers to use AT. • **High teacher-student ratios also need to be noted especially in inclusive school settings where one trained teacher may take care of multiple students with diverse needs.** Nearly 20 percent of teachers from inclusive and special schools raised an issue of too many teaching resources and high teacher student ratios as barriers to use AT for children with disabilities.

Support needed	• **83 percent of teachers who participated in the survey have needed additional support to use AT for children with disabilities both in inclusive and special schools. However, many teachers cannot gain additional help, and teachers in inclusive schools are less likely to get support compared to special school teachers.** • **Training to understand and use AT is the most needed support for teachers in both inclusive and special schools, followed by adequate AT and sufficient information for teachers.**

Table 2: Summary of Policy Recommendations

Recommendations	Timeline	Estimated impact	Implementation Arrangement
1. Develop Regulations on AT and Guidelines			
Develop a Regulation on AT for children with disabilities in inclusive schools, which allows the governmental support for both high and low tech	Short	High	Central (Directorate for Community and Special Education -PMPK)
Establish a Regulation on AT for all children with disabilities including those with LD, ASD, ADHD or SD, with a list of AT covering inclusive schools	Short	High	Central (PMPK)
Develop guidelines for different types of disabilities, and make guidelines easily accessible for all teachers, school principals, local government education offices, parents and caregivers	Short	High	Central (PMPK, Directorate for Secondary and Special Education Teachers- SSET)
2. Improve Procurement Process of AT and Expand Collaboration			
Modify relevant funding schemes, especially the BOS scheme, to facilitate procurement of AT, and provide training/support for school principals especially for public schools with limited budget	Short	High	Central (PMPK)
Expand collaboration to promote procurement of AT at central and local levels	Short-Mid	High	Central and local government, schools, organizations promoting IE
Ensure that school principals make a school budget activity plan and build partnerships with service providers to provide AT and relevant support to teachers	Mid-long	Medium	
3. Develop Teacher Training on AT and Strengthen Supporting Mechanisms for Teachers			
Develop a teacher training course on IE focused on AT, which is accessible for all teachers who have children with disabilities in their classrooms	Short	High	Central (SSET)
Expand collaboration to promote procurement of AT at central and local levels	Short-Mid	Medium	Central (SSET), universities
Promote multidisciplinary assessment of AT needs especially in inclusive schools in rural areascentral and local levels	Short-Mid	Medium	Central (MoECRT, Ministry of Health -MoH), local government, schools
Establish a regulation with a special scheme to allow teachers from special education background to work in or support inclusive schools	Mid-long	Medium	Central

Teknologi Asistif bagi Peserta Didik Penyandang Disabilitas di Sekolah Inklusi dan Sekolah Luar Biasa di Indonesia

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Ringkasan Eksekutif

Peningkatan kualitas pendidikan bagi peserta didik penyandang disabilitas melalui penggunaan teknologi asistif telah menjadi perhatian dunia. Teknologi Asistif (TA) didefinisikan sebagai segala macam teknologi dan alat bantu yang digunakan oleh guru, baik yang berteknologi tinggi maupun berteknologi rendah, yang digunakan untuk memfasilitasi peserta didik penyandang disabilitas agar mereka bisa berpartisipasi dalam kegiatan pembelajaran. TA memiliki peran penting dalam peningkatkan kualitas pendidikan bagi peserta didik penyandang disabilitas.[1] Terlepas dari pentingnya TA untuk meningkatkan kesetaraan pembelajaran bagi peserta didik disabilitas, penelitian tentang jenis teknologi apa saja yang tersedia dan bagaimana teknologi tersebut dapat digunakan untuk pembelajaran bagi peserta didik disabilitas di negara-negara berpenghasilan rendah dan menengah masih sangat kurang.[2]

Peningkatan kualitas pembelajaran bagi peserta didik penyandang disabilitas, terutama melalui akses yang adil terhadap TA, merupakan isu yang mendesak untuk menjamin hak pendidikan mereka dan membangun kembali kehidupan yang lebih baik paska pandemi COVID-19. Di Indonesia, kualitas pendidikan bagi peserta didik penyandang disabilitas masih belum memadai dan masih menjadi isu utama, meskipun akses mereka terhadap pendidikan telah meningkat secara bertahap dalam satu dekade terakhir.[3] Meskipun pandemi telah mendorong inovasi dan investasi dalam teknologi pendidikan, namun juga berdampak dalam memperlebar kesenjangan pendidikan yang ada di Indonesia.[4] Peserta didik penyandang disabilitas merupakan kelompok yang paling terdampak oleh pandemi karena selama pandemi banyak dari mereka yang tidak dapat mengakses layanan yang memadai untuk pembelajaran individu.[5] Perhatian yang diberikan untuk TA bagi peserta didik penyandang disabilitas dalam pendidikan di Indonesia juga masih sangat terbatas. Meskipun penelitian yang ada di Indonesia menunjukkan bahwa TA dapat membantu peserta didik penyandang disabilitas dalam proses pembelajaran, namun penelitian tersebut seringkali hanya terbatas pada jenis disabilitas dan pada sekolah-sekolah tertentu saja. Oleh karena itu, diperlukan pemahaman yang lebih luas mengenai isu-isu struktural, berbagai jenis disabilitas dan kondisi sekolah, serta perubahan apa saja yang dibutuhkan dalam sistem pendidikan baik dalam skala kebijakan maupun praktiknya. Dalam konteks ini, studi empiris yang lebih holistik untuk mengkaji TA diperlukan untuk menempatkan peserta didik penyandang disabilitas dalam wacana tentang kualitas pendidikan di Indonesia.

Studi ini menjawab kesenjangan pengetahuan tersebut, dengan fokus pada konteks Indonesia. Studi empiris yang mengambil konteks Indonesia ini bertujuan untuk mengkaji secara mendalam ketersediaan dan

[1] Lynch et al. (2021)
[2] Lynch, Singal, and Francis (2022)
[3] MoECRT (2021)
[4] UNICEF (2020)
[5] Ibid.

penggunaan TA bagi peserta didik penyandang disabilitas. Studi ini juga mengulas tantangan utama dan dukungan yang dibutuhkan, baik di sekolah inklusi maupun Sekolah Luar Biasa (SLB), dengan fokus pada guru-guru di pendidikan dasar dan menengah di Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi (Kemendikbudristek). Pertanyaan-pertanyaan kunci yang diajukan meliputi:

(1) Bagaimana ketersediaan dan penggunaan TA bagi peserta didik penyandang disabilitas di sekolah-sekolah di Indonesia?
(2) Dengan cara apa guru, sekolah, dan pemangku kepentingan di tingkat lokal dan nasional dapat bekerja sama untuk mendorong pembelajaran yang lebih adil dan berkualitas melalui ketersediaan TA bagi peserta didik penyandang disabilitas?

Untuk menjawab pertanyaan-pertanyaan tersebut, studi ini menggunakan metode campuran untuk meningkatkan validitas dan kualitas analisis berbasis bukti mengenai TA untuk peserta didik penyandang disabilitas di Indonesia. Metode yang dilakukan meliputi survei guru di tingkat nasional yang melibatkan lebih dari 2.000 guru yang berpartisipasi secara sukarela, diskusi kelompok terfokus dengan guru, kepala sekolah, dan pengambil kebijakan, serta tinjauan internasional mengenai praktik TA untuk peserta didik penyandang disabilitas untuk mengatasi kurangnya studi tentang kasus ini di Indonesia. Kajian terhadap isu TA ini membutuhkan kontekstualisasi lokal karena tantangan yang dihadapi berbeda-beda di setiap lokasi. Dalam studi ini, konsep TA direvisi melalui konsultasi dengan guru, kepala sekolah, dan pembuat kebijakan untuk menyesuaikan dengan konteks Indonesia. Konsep TA juga diperluas, tidak hanya mencakup teknologi tinggi (yaitu perangkat listrik, peralatan pendukung, dan perangkat lunak/aplikasi yang biasa dibeli dan cenderung mahal), tetapi juga teknologi rendah (yaitu perangkat non-listrik dan solusi yang terjangkau) yang saat ini lebih umum digunakan di Indonesia, khususnya di daerah yang memiliki sumber daya dan konektivitas yang terbatas.

Studi ini mengungkapkan bahwa penggunaan TA untuk peserta didik penyandang disabilitas, terutama di sekolah inklusi, masih sangat terbatas. Analisis data kuantitatif dan kualitatif di Indonesia dan analisis komparatif dengan praktik-praktik internasional mengenai TA menunjukkan bahwa guru sering mengalami kesulitan karena kurangnya dukungan dari pemerintah, termasuk kurangnya pelatihan guru dan penyediaan TA. Terbatasnya dukungan pemerintah seringkali disebabkan oleh kurangnya peraturan, konten pelatihan, dan pemahaman tentang permasalahan di tingkat sekolah di tingkat nasional. Sering terdapat asumsi dari pemerintah pusat bahwa meskipun pelatihan dan TA yang tersedia belum memadai, khususnya di sekolah-sekolah inklusi, seharusnya para guru bisa menangani kekurangan tersebut secara mandiri. Di sisi lain, penggunaan TA sangat terkait dengan ketersediaan TA di sekolah dan pelatihan TA bagi guru. Oleh karena itu, pelatihan guru yang terfokus, penyediaan TA, pedoman yang mudah diakses, dan dukungan teknis tambahan diperlukan agar guru dapat menggunakan TA dalam pengajaran untuk peserta didik penyandang disabilitas. Poin inilah yang ditekankan oleh para guru yang dimintai pendapatnya dalam studi ini.

Studi ini menyimpulkan bahwa pergeseran dalam model pemberian layanan diperlukan untuk mengatasi masalah kualitas dalam perumusan dan implementasi kebijakan. Rekomendasi berfokus pada bagaimana sekolah-sekolah di Indonesia dapat mengadopsi teknologi tinggi dan/atau teknologi rendah, serta bagaimana para pemangku kepentingan di berbagai tingkatan (pusat, daerah, dan sekolah) dapat memastikan bahwa semua sumber daya yang dibutuhkan tersedia untuk digunakan oleh guru sekaligus bagaimana memperkuat mekanisme pendukung bagi guru. Rekomendasi yang diusulkan adalah perubahan yang perlu dilakukan di tingkat pusat, daerah, dan sekolah, termasuk untuk:

1. **Mengembangkan peraturan, pedoman penggunaan, dan dukungan untuk TA;**
2. **Memperbaiki proses pengadaan TA dan memperluas kolaborasi multisektor;**
3. **Mengembangkan pelatihan guru tentang TA dan memperkuat mekanisme pendukung.**

Prioritas dari perubahan ini adalah mendesain ulang peraturan pemerintah, proses pengadaan, pelatihan guru, dan mekanisme pendukung bagi guru, dengan tujuan untuk meningkatkan tidak hanya akses tetapi juga hasil pendidikan yang dapat berkontribusi dalam mengurangi ketidaksetaraan yang dialami oleh peserta didik penyandang disabilitas di Indonesia.

Ringkasan temuan-temuan utama

Kategori	Temuan Utama
Ketersediaan TA	• **Ketersediaan TA bagi peserta didik penyandang disabilitas di sekolah inklusi masih sangat terbatas.** o Hampir 70% Guru Pembimbing Khusus/GPK (guru di sekolah inklusi yang telah dilatih mengenai pendidikan inklusif) yang berpartisipasi dalam survei melaporkan bahwa mereka tidak memiliki TA, meskipun di sekolah mereka terdapat peserta didik penyandang disabilitas . Di sisi lain, sekitar 80% guru di SLB yang berpartisipasi dalam survei menjawab memiliki TA. • **Penyediaan TA di sekolah inklusi cenderung bergantung pada sekolah dan guru, bukan pada dukungan pemerintah.** o GPK melaporkan bahwa penyedia utama TA di sekolah inklusi adalah pihak sekolah (25%), diikuti oleh pihak lain (23%), dan guru (22%), yang berarti guru sendirilah yang membuat TA. Para guru juga menyampaikan tentang rendahnya persentase suplai TA dari pemerintah di semua tingkatan, termasuk pemerintah pusat, provinsi, dan kota/kabupaten. Hal ini terjadi karena kurangnya peraturan yang mengamanatkan kebutuhan TA, terutama yang berteknologi tinggi, di sekolah-sekolah inklusi.
Pelatihan guru	• **Pelatihan guru tentang TA bagi peserta didik penyandang disabilitas sangat jarang dilakukan, baik di sekolah inklusi maupun sekolah luar biasa.** o Hampir 85% GPK di sekolah inklusi dan 70% guru di SLB mengaku belum pernah mendapatkan pelatihan tentang AT untuk peserta didik penyandang disabilitas. Hal ini disebabkan karena pelatihan guru tentang Pendidikan Inklusif yang diberikan oleh Direktorat Guru Pendidikan Menengah dan Pendidikan Khusus saat ini cenderung mencakup hal-hal mendasar seperti konsep Pendidikan inklusif, keberagaman peserta didik, identifikasi dan asesmen peserta didik penyandang disabilitas , dan belum mencakup tentang TA untuk meningkatkan pengalaman belajar peserta didik penyandang disabilitas. Dengan demikian, yang sering terjadi di lapangan adalah guru harus belajar TA sendiri, tanpa dukungan dari penyedia pelatihan. • **Di sekolah inklusi, tidak hanya lembaga pemerintah saja, namun sekolah dan kolaborasi antar sekolah memiliki peran penting dalam memberikan pelatihan tentang TA. Namun begitu, masih terdapat kesenjangan antara sekolah inklusi di perkotaan dan pedesaan. Pelatihan TA yang diberikan di pedesaan masih terbatas.**
Katalog, buku panduan, dan akses informasi	• **Sebagian besar guru tidak memiliki akses terhadap katalog, buku panduan, dan informasi mengenai TA, dan guru-guru di sekolah inklusi kemungkinan besar mengalami kesulitan karena kurangnya dukungan ini.** o 96% guru di sekolah inklusi dan 86% guru di SLB tidak memiliki katalog TA di sekolah mereka. o 94% guru di sekolah inklusi dan 78% guru di SLB tidak memiliki buku panduan penggunaan TA di sekolah mereka. o 72% guru dari sekolah inklusi melaporkan kesulitan dalam mengakses informasi mengenai TA. Sebaliknya, 48% guru dari SLB mengalami kesulitan dalam mengakses informasi. Mereka cenderung berbagi informasi mengenai TA dengan rekan-rekannya di sekolah.
Penggunaan TA	• **Penggunaan TA masih sangat terbatas di sekolah-sekolah inklusi, dan lebih dari 60% guru yang dilatih tentang Pendidikan inklusif belum menggunakan TA untuk peserta didik penyandang disabilitas.** • **Penggunaan TA oleh guru sangat terkait dengan ketersediaan TA di sekolah, pelatihan guru, dan akses terhadap informasi.** o Guru yang memiliki TA di sekolahnya memiliki kemungkinan lebih dari 500% lebih besar untuk menggunakannya dibandingkan guru yang tidak memiliki AT. Pelatihan guru tentang TA dapat meningkatkan kemungkinan guru menggunakan TA sebesar 350%. Terbukanya akses terhadap informasi tentang berbagai jenis dan aplikasi TA untuk peserta didik penyandang disabilitas dapat meningkatkan kemungkinan guru untuk menggunakan TA sebesar 122%. Memahami cara menggunakan TA untuk membantu peserta didik penyandang disabilitas dapat meningkatkan kemungkinan guru untuk menggunakan TA sebesar 110%. o Di sisi lain, guru di sekolah inklusi memiliki kemungkinan hampir 50% lebih rendah untuk menggunakan TA dibandingkan guru di SLB. Guru di sekolah negeri memiliki kemungkinan 27% lebih rendah untuk melakukan hal yang sama dibandingkan guru di sekolah swasta. • **Penggunaan teknologi tinggi masih terbatas dibandingkan dengan teknologi rendah pada berbagai jenis disabilitas, termasuk kesulitan belajar (*Learning Disability/LD*), gangguan spektrum autisme (*Autistic Spectrum Disorder/ASD*), Gangguan Pemusatan Perhatian dan Hiperaktif (Attention Deficit Hyperactivity Disorder/ADHD), keterlambatan bicara (*Speech Delay/SD*), gangguan pendengaran dan penglihatan, serta cacat fisik.** Bahkan jika guru menggunakan teknologi tinggi dan/atau teknologi rendah, TA tidak selalu digunakan untuk memenuhi kebutuhan dan/atau keterampilan khusus dari berbagai jenis disabilitas, karena kurangnya pelatihan dan pedoman tentang TA di sekolah inklusi dan SLB.

Kategori	Temuan Utama
	• Guru yang berpengalaman cenderung menggunakan berbagai jenis TA untuk memberikan pengalaman belajar yang lebih baik sesuai dengan karakteristik peserta didik.
Penilaian kebutuhan TA	• **Di sekolah inklusi, guru lebih cenderung menggunakan TA ketika guru menentukan kebutuhan TA bagi peserta didik dengan mempertimbangkan asesmen terhadap prestasi peserta didik dengan dan tanpa TA, dan asesmen dari tenaga profesional lain (misalnya, psikolog, dokter), dan preferensi peserta didik.** o Guru lebih mungkin menggunakan TA jika mereka mempertimbangkan prestasi peserta didik dengan dan tanpa TA ketika memutuskan apakah peserta didik membutuhkan TA. Demikian pula, bekerja sama dengan tenaga profesional kesehatan untuk melakukan asesmen kebutuhan peserta didik akan TA meningkatkan kemungkinan penggunaan TA sebesar 46%. Pertimbangan preferensi peserta didik meningkatkan kemungkinan penggunaan TA oleh guru sebesar 42%. Penggunaan AT juga dikaitkan dengan adanya observasi dan penilaian guru. • **Kolaborasi dengan tenaga profesional kesehatan penting bagi guru di sekolah inklusi yang cenderung tidak memiliki pengetahuan dan dukungan khusus untuk mengidentifikasi TA yang sesuai dengan karakteristik jenis disabilitas dan tantangan belajar yang berbeda.**
Tantangan	**1. Menciptakan TA** **Hampir 70 % guru di sekolah inklusi dan 50% guru di SLB belum menciptakan TA untuk mendukung peserta didik penyandang disabilitas.** o Alasan yang paling banyak dikemukakan untuk tidak membuat TA adalah kurangnya informasi tentang TA dan kurangnya dukungan teknis o Hampir 50% guru yang telah membuat TA sebagian besar mendapatkan informasi dari media sosial seperti *YouTube*. **2. Kurangnya keterampilan praktis guru dan mekanisme pendukung** • **Tantangan terbesar bagi guru untuk menggunakan TA adalah kurangnya keterampilan dan pelatihan yang memadai tentang TA untuk peserta didik penyandang disabilitas, serta pengetahuan yang tidak memadai.** Sekitar 40% guru dari sekolah inklusi dan SLB tidak memiliki keterampilan yang memadai, dan 39% guru di sekolah inklusi menyatakan bahwa mereka tidak tahu bagaimana menggunakan TA untuk peserta didik penyandang disabilitas. Inilah yang menjadi hambatan utama dalam menggunakan TA. • **Masalah infrastruktur juga sering terjadi, termasuk keterbatasan perangkat keras, kurangnya konektivitas internet, dan kesulitan dalam hal pemeliharaan.** Sebanyak 30% dan 46% guru dari sekolah inklusi dan SLB masing-masing menyatakan bahwa masalah infrastruktur merupakan salah satu hambatan utama dalam penggunaan TA. • **Rasio guru-peserta didik yang tinggi juga perlu diperhatikan, terutama di lingkungan sekolah inklusi, di mana satu guru yang terlatih dapat menangani banyak peserta didik penyandang disabilitas dengan kebutuhan yang beragam.** Hampir 20% guru dari sekolah inklusi dan SLB mengangkat isu ini, yaitu terlalu banyaknya bahan pengajaran dan rasio guru-peserta didik yang tinggi sebagai hambatan dalam menggunakan TA untuk peserta didik penyandang disabilitas.
Dukungan yang dibutuhkan	• **Sebanyak 83% guru yang berpartisipasi dalam survei membutuhkan dukungan tambahan untuk menggunakan TA bagi peserta didi penyandang disabilitas, baik di sekolah inklusi maupun SLB. Namun, banyak guru yang tidak mendapatkan bantuan tambahan, dan guru di sekolah inklusi lebih kecil kemungkinannya untuk mendapatkan dukungan dibandingkan dengan guru di SLB.** • **Pelatihan untuk memahami dan menggunakan TA merupakan dukungan yang paling dibutuhkan oleh guru, baik di sekolah inklusi maupun SLB, diikuti oleh ketersediaan TA yang memadai, dan informasi yang cukup.**

1 Introduction

1.1 Rationale

Assistive technology (AT) is essential to ensure quality learning and participation of children with disabilities.[7] Globally, the lack of adequate training, awareness and confidence among teachers of AT is considered one of the key barriers to ensuring quality education for children with disabilities.[8] However, there is a lack of research on what types of AT are available and how they are used to assist learning of children with disabilities in low and middle-income countries.[9]

In Indonesia, a previous study indicates that AT can play an important role in addressing the issue of quality of education for children with disabilities.[10] However, AT is not fully provided for children with disabilities, especially in inclusive schools, despite the increasing number of students with disabilities in schools, and teachers do not always have knowledge and skills to identify what AT is suitable for students with different types of disability.[11] In addition, while the COVID-19 pandemic has led to innovations and investment in education technologies, it also widened existing educational inequalities in Indonesia.[12] Children with disabilities were arguably the worst affected by the pandemic because many of them were unable to access adequate services for individualized learning.[13] Thus, the most vulnerable children, especially children with disabilities, should be prioritized in terms of access to education technologies which can promote quality learning in Indonesia.[14] At a classroom level, teachers need to be able to use AT to better meet the individual needs of children with disabilities and support their learning process and outcomes.[15] However, there has been no detailed investigation of the current situation of AT used for children with disabilities in education in Indonesia, including children with various types of disabilities in both inclusive and special schools across the country. Thus, there is a need for research that contributes to enhancing the understanding of the current situation, challenges, and needs regarding AT used for children with disabilities, with greater involvement of users such as teachers and key stakeholders in research.

1.2 Research Aim and Strategy

This study aims to examine the current status of AT use for children with disabilities in inclusive and special schools, and challenges faced by teachers and key stakeholders. By doing so, this study aims to contribute to the development of future policies to cultivate better effective use of AT to enhance the quality of learning of children with disabilities in Indonesia. This study specifically aims to answer the following research questions:

1. What is the availability and use of AT for students with disabilities in schools in Indonesia?
   - What assistive technologies are available and used?
   - Are inclusive education teachers trained to use AT and do they actually use it?
   - What are the challenges that teachers face in using AT and what support is needed?
2. In what ways can teachers, schools, and local and national stakeholders work together to promote equitable and quality learning through AT for children with disabilities?

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[7] Lynch, Singal, & Francis, (2021)
[8] Lynch, Singal, and Francis (2022)
[9] Ibid.
[10] Andrean, Pradipta, and Purnamawati (2021)
[11] Andrean et al. (2021)
[12] UNICEF (2020)
[13] Ibid.
[14] Ibid.
[15] Andrean et al. (2021)

As a research strategy, this study integrated a rigorous review of empirical research on AT use for children with disabilities at a global level, with an Indonesian case study, to address the paucity of previous research in Indonesia on AT- one of the greatest but as yet unaddressed challenges in IE.

1. **A literature review of international good practices**
   - ➔ Given the paucity of research on AT for children with disabilities in Indonesia, this study conducted a rigorous literature review on the use of technology for children with disabilities in education settings globally, including not only high-income but also low- and middle-income countries. The aim was to examine international practices to inform to what extent various AT is used and/or can be revised for the Indonesian context. The review focuses on LD, ASD, ADHD, given the large number of children with these disabilities in inclusive schools in Indonesia,[16] with a review for SD and hearing impairment.

2. **Case study in Indonesia**
   - ➔ This study adopted a mixed method to examine teachers' understanding and practices related to AT for children with disabilities. Quantitative data were collected through a questionnaire survey for teachers and Indonesia's education dataset, Dapodik, and qualitative data were collected through focus group discussions (FGDs) (*see the Part 2 section for details*).
   - ➔ The case study in Indonesia covers children with different types of disabilities as listed in Dapodik, primarily focusing on those at primary and secondary education levels. This study covers inclusive and special schools, especially aiming to provide insights into the former to meet the lack of knowledge of how to apply technology in inclusive settings at a global level.[17]

1.3 Outline of the Policy Note

This policy note consists of two parts. Part 1 focuses on the status of AT to support learning of children with disabilities drawing on international practices to inform what types of AT can be used for different types of disabilities for what purpose. Part 2 focuses on the Indonesian context, including analysis of policy regulations and teacher training mechanisms. Key findings of the survey are analysed and interpreted through the synthesis with FGDs findings. Based on key findings from the Indonesian context and review of international good practices, conclusions and recommendations are developed and presented by articulating short, medium, and long-term recommendations.

1.4 Defining Assistive Technology

In this study, Assistive Technology (AT) is defined as any technologies and items (including learning media) used by teachers, including high-tech and low-tech, which supports the learning process of students with disabilities.[18] [19] The definition of AT has been contextualized in Indonesia through discussions with key stakeholders including policy makers, teachers, school principals and local universities, by revising the term AT that is often used in high-income countries and associated with high-tech in research and practice, and expanding the term to include various low-tech options that may be more common in low and middle income countries including Indonesia. High-tech includes electronic devices, their supportive equipment, software and applications, and are more likely to be more costly than low-tech but can have multiple functions. Low-tech includes non-electronic devices and are less costly. Some low-tech can be produced by teachers. Teachers can consider low-tech options first before considering more advanced technology since there are often sustainable solutions at this level. Importantly, AT needs to be understood as medium to support the learning and independence of children with different types of disabilities and needs, rather than specific materials. A student-centred approach, namely, taking into account the unique and individual characteristics of children with disabilities is key. This is because AT is part of the solution. The needs of students should be prioritized rather than vice versa.

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[16] Dapodik, 2023
[17] Lynch et al. (2021)
[18] Ibid.
[19] WHO. "Assistive Technology", 2018. https://www.who.int/news-room/fact-sheets/detail/assistive-technology

2

Part 1: International practices

1 Introduction

Learning disability (LD) is an assembly of mental disorders that affects the learning outcomes of students globally across the whole range of education levels (Gillberg and Soderstrom 2003). In recent years, assistive technology (AT) has been increasingly applied to support the learning process and enhance the learning outcomes of children with LDs (Chambers 2019). While many studies have delved into the applications of AT to support various LDs, most of the previous work has focused on high-income, western countries (e.g., Perelmutter, McGregor, and Gordon 2017; Qahmash 2018; Maor, Currie, and Drewry 2011). Moreover, people in low- and middle-income countries also seem to face significant challenges in accessing the technology—only 5-15 percent of children in these countries who require AT have access to it (WHO 2010). As such, there is a significant paucity and need for research on AT applied to a low- and middle-income social context.

Part 1 of this policy note aims to outline the international good practices of the AT use for supporting LDs and discusses applicable low-tech options when high-tech alternatives are difficult to implement. This report opens with a discussion on the definition of different types of LDs, factors contributing to their development, and the symptoms commonly observed. The report then outlines the international good practices for AT applied to supporting the learning in children with different LDs, with a focus on the students in primary and secondary education.

2 Learning disability: definitions, causes and symptoms

LD can be defined in different ways depending on where it is used (McDowell 2018). In the US, European Union and Australasia, this term is defined narrowly and usually refers to a disorder in one or more mental processes that hampers the learning involved in producing or processing speech or language (i.e., listening, speaking, reading, and writing), as well as the ability for fine motor learning (associated with handwriting) or to conduct mathematical calculations (Perelmutter, McGregor, and Gordon 2017; American Psychiatric Association 2013; Lannen 2017). In contrast, the interpretation for this term in the UK stresses compromised intellectual ability and social functions and contains three core criteria: lower intellectual ability (i.e., an IQ of less than 70), impaired social or adaptive functioning, and onset in childhood (National Collaborating Centre for Mental Health (UK) 2015; McDowell 2018).

The current report uses the term LD in a narrow sense, focusing on the disorders (i.e., dyslexia, dyscalculia, and dysgraphia) in three core domains (i.e., literacy, mathematics, and handwriting) identified by American Psychiatric Association (2013). The report also discusses several disorders that are commonly known to affect learning and are often viewed under the umbrella of LD—autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and hearing and language impairments (Lannen 2017). In other words, the sources of difficulty acquiring learning considered in this report will not include factors such as learners' intellectual capacity, medical conditions (e.g., visual impairment or illness), and the lack of opportunities to receive education. Here we define the LDs covered by this report and outline the main findings for their causes and symptoms.

2.1 Dyslexia, dysgraphia, and dyscalculia

2.1.1 Dyslexia

Dyslexia is a cross-linguistic neurodevelopmental disorder featured by difficulties in word recognition (Peterson and Pennington 2012). Individuals with dyslexia usually show inaccurate and slow spelling and word recognition despite adequate tuition, normal intelligence, and absence of identifiable sensory and/or neural deficits (Reid Lyon et al. 2003; Goswami 2015). For example, children with developmental dyslexia often make replacement and/or reversal errors in their writing—*bend* read or written as *bind*, *dug* read or written as *gud* (Orton 1925). Importantly, these errors seem to be constrained to the print of the languages one has knowledge of (Vellutino 1979), implicating the deficit is associated with linguistic rather than visual processing. Indeed, neuroimaging studies identified deficiency of white matter connectivity in the left hemisphere's language network that involves the posterior ventral and dorsal brain regions (Katzir, Misra, and Poldrack 2005), however dyslexic readers can compensate the left hemisphere processing deficits with enhanced contribution from the language regions in their right hemisphere (Ligges et al. 2010). Six genes have been identified for their links with developmental dyslexia (Kere 2011). This genetic contribution seems to be more pronounced in families where parents have a high-level of education, signalling an interaction between gene and environment in the formation of dyslexia (Peterson and Pennington 2012).

2.1.2 Dysgraphia

Dysgraphia is a neurodevelopmental deficit in the acquisition of writing skills (McCloskey and Rapp 2017). Children with dysgraphia typically produce illegible handwriting (e.g., scrambled writing), have trouble in spelling, and struggle with writing tasks (van Hoorn, Maathuis, and Hadders-Algra 2013).

The current state of literature attributes the writing deficits in the individuals with dysgraphia to an impairment in orthographic long-term memory (i.e., the long-term memory storing a word's spelling; Buchwald and Rapp 2009), the conversion from sound to spelling, and the orthographic working memory (WM, i.e., the short-term memory holding a word's spelling; Hepner, McCloskey, and Rapp 2017). Many individuals with dysgraphia are found to have impaired spelling of words (especially irregular words), but not pseudowords, indicating issues of retrieving familiar forms of spelling from the long-term memory (McCloskey and Rapp 2017). Individuals with dysgraphia also tend to make phonologically plausible errors, signalling a defect in transferring sounds to their legal orthographies in the language (McCloskey and Rapp 2017). Nonetheless, some individuals show a reversed pattern behaviorally—spelling performance is better for words than pseudowords, showing a possibility for issues in both the sound-to-form conversion and the orthographic WM (Cholewa et al. 2010).

Further evidence from neuroimaging studies (T. L. Richards et al. 2009) found decreased activations for poor writers in a frontotemporal network that is related to handwriting and spelling when the participants did a sequential hand-movement task compared to a repetitive movement task. However, the activations in the same regions increased between the tasks for good writers. These findings insinuate impaired memory for sequential movements (which is thought essential to handwriting) in children with dysgraphia. Recent works further revealed a genetic underpinning for dysgraphia—genes on chromosome 15 are associated with poor spelling and reading, and genes on chromosome 6 are related to phonemic awareness (Chung, Patel, and Nizami 2020).

2.1.3 Dyscalculia

Dyscalculia is a neurodevelopmental disorder characterizing arithmetic skill markedly below the average age level but otherwise showing adequate intellectual abilities and neurologic development, as well as proper schooling opportunities (WHO 2020). Individuals with dyscalculia are less accurate and slower in counting numbers (Geary, Bow-Thomas, and Yao 1992), calculation (Geary 1993), judging numeric quantities (e.g., compare the duration and number of a dot sequence; de Visscher et al. 2018), mapping Arabic digits to their corresponding quantities (Rousselle and Noël 2007). Without adequate intervention, these deficits can persist across the lifespan (Shalev, Manor, and Gross-Tsur 2007).

In light of the behavioral characteristics of dyscalculia, a predominant theory attributes the origin of the deficit to the cognitive ability for making sense of numbers (Dehaene 1997). However, this view has been challenged by that children with dyscalculia only perform worse when the numeric and non-numeric information of the sets to be compared is incongruent (e.g., when the set of having smaller number of dots are displayed larger in size, and vice versa; Gilmore et al. 2013). These findings suggest that the domain-general processes such as executive functions could be associated with the deficits. Indeed, recent neuroimaging evidence show that children with dyscalculia have stronger activations in the brain networks involved in numeric representations (e.g., intraparietal sulcus (IPS)), visual representations of numbers (e.g., fusiform gyrus (FG)). Elevated activations are also observed in the domain-general attentional and memory systems for directing the attention to numbers, temporarily storing information in the WM (e.g., dorsolateral prefrontal cortex (DLPFC)), and decision making (e.g., anterior insula cortex (AIC) and ventrolateral prefrontal cortex (VLPFC); Iuculano et al. 2015). Recent studies also linked these functional abnormalities to specific gene markers pointing to aberrant protein expressions (T. Iuculano 2016).

2.2 Autism spectrum disorder (ASD)

ASD is a neurodevelopmental disorder that is highly heterogenous and characterized by impaired social communication and interaction skills as well as restricted and repetitive sensory and motor behaviours (Lord et al. 2020). On the social communication aspect, individuals with autism usually lack social-emotional reciprocity (e.g., having trouble maintaining back and forth conversation and showing reduced emotions and interests), have deficits in non-verbal communication (e.g., abnormity in eye contacts, problems in understanding gestures, and failing to integrate verbal and non-verbal communication). On the sensory motor aspect, the autism population show repetitive motor behaviours, insistence on routines and sameness, strong attachment to unusual objects, and hypersensitivity or hyposensitivity to sensory events (American Psychiatric Association 2013).

Neuroimaging studies using functional magnetic resonance imaging (fMRI) revealed increased volumes of white and grey matters in young autistic children (Courchesne et al. 2001), and that high-risk children who were diagnosed with ASD at an age of 24 months showed an increased cortical growth rate as early as the first year of life (6-12 months), which predicted the diagnosis and social impairments in these children at 24 months (Hazlett et al. 2017). Other evidence has demonstrated hyperactivation or hypoactivation in the key regions involved in auditory speech processing (i.e., superior temporal gyrus (STG), inferior frontal gyrus (IFG), and middle temporal gyrus (MTG); Herringshaw et al. 2016; Emerson et al. 2017). Studies have also linked challenges for autistic population to process emotional faces with greater amygdala activation and a stronger connection between amygdala and prefrontal cortex (Monk et al. 2010). In addition, correlations were found between attentional deficits in autism and a lower level of functional connectivity between frontal, parietal, and occipital regions (Solomon et al. 2009). Finally, there is a large genetic contribution to the emergence of autism (with an estimated heritability of 40 to 90 percent), and multiple single-gene mutations were found to collectively impact on the development of autism (Lord et al. 2020).

2.3 Attention deficit hyperactivity disorder (ADHD)

ADHD is a neurodevelopmental disorder featured by inattention, hyperactivity, and/or impulsivity (American Psychiatric Association 2013). Individuals with ADHD usually show deficits in executive functions like WM and inhibition. They also have the tendency of delay aversion (i.e., to choose a smaller and immediate, instead of a larger and delayed reward), especially in children (Sjöwall et al. 2013). In addition, the ADHD population often has a significant variability in the response time (RT) to a task (Castellanos et al. 2005), and illustrates deficiencies in emotion regulation (Walcott and Landau 2004) and recognition (Kats-Gold, Besser, and Priel 2007).

Longitudinal studies have found neuroanatomical abnormities in ADHD children, such as delayed development of prefrontal regions that are important for executive functions and attention, and the rates of cortical thinning in these areas is negatively correlated with the level of ADHD symptoms (Shaw et al. 2012). FMRI studies have also revealed hyperactivity in the right-hemisphere dorsal attention network (Hart et al. 2013), and hypoactivity in the left inferior frontal cortex, left inferior parietal lobe, and right lateral cerebellum that are critical for timing functions during tasks (Wiener, Turkeltaub, and Coslett 2010). Several candidate genes have been linked to the emergence of ADHD (Stergiakouli 2010).

2.4 Hearing and language impairments

Hearing and language impairments are an assembly of neurological deficits that affect the perception and production of speech and language. The deficits can arise as a peripheral deficiency, which is usually caused by sensorineural hearing impairments resulted from the degeneration of the hair cells in the inner ear and the damage to the auditory nerves (R. J. Smith, Bale, and White 2005). Hearing impaired individuals often perceive degraded signals for both sound and speech. However, highly redundant acoustic cues in speech allows listeners to achieve good recognition of speech despite the limited sensory details (Mattys et al. 2012).

The deficit may also emerge as a language production and comprehension disorder in individuals with normal hearing, such as developmental or acquired aphasia. Depending on type of aphasia, individuals may experience deficiency in the fluency of speech production and/or the comprehension of speech. Aphasic individuals may also show difficulty in repeating words or phrases. Lesion and neuroimaging studies have linked the deficits in aphasics to impairments or damage in a frontotemporal network related to speech and language production and processing (Blumstein 2016). Specifically, deficits in production usually involve premotor and motor areas, IFG, basal ganglia and insula (Damasio 1998). Problems in perception is often related to STG, MTG, supramarginal gyrus (SG), and IFG (Blumstein 2016).

Language impairments can also stem from specific language impairment (SLI), which is a neurodevelopmental disorder featured by impaired spoken and written language expression and comprehension, despite normal nonverbal IQ, hearing ability, and speech motor skills or other medical conditions that might compromise language processing (Tager-Flusberg and Cooper 1999). Children with SLI often demonstrate delayed onset of spoken and written language acquisition, as well as non-linguistic deficits in learning and memory (Leonard 2014). Anatomical and functional imaging approaches have identified abnormality in the development of the regions related to language processing. For example, Badcock et al. (2012) observed significantly more grey matter in left IFG, but less grey matter in STG and posterior STS. The aberrant anatomy corroborates with the reduced activity in the left IFG and bilateral STS/STG in SLI children (Hugdahl et al. 2004; Badcock et al. 2012).

3 International good practices for applying AT for Learning Disabilities

In the following sections, we outline the international good practices applied to support individuals having LDs with AT. We will include both hardware (manual or electronic) and software for individuals with LDs that were designed for general purposes (e.g., computers and tablets) or to fulfil the specific needs (e.g., reading pens to transfer text to speech for dyslexics) of the LD users.

3.1 Dyslexia, dysgraphia, and dyscalculia

3.1.1 Dyslexia

3.1.1.1 International practices

Text-to-speech and speech-to-text

One of the most prevalent technologies for dyslexics converts between speech and text as a dominant deficit for dyslexia is in spelling and written word recognition. Text-to-speech (TTS) is a computer-based speech synthesizer that reads the text aloud (Dutoit 1997). The text can be inputted to the computer by the user or scanned and submitted to an optical character recognition (OCR) system. The TTS can be implemented by a general-purpose computer software like Microsoft Word on both Windows and Macintosh machines (Draffan, Evans, and Blenkhorn 2007), or a smart pen that scans and reads out the words that are written down on a special paper (Babafemi Olabisi and Adesoji David 2013). A recent smartphone and tablet app, *Augmentally*, developed by the researchers in the US further provides a customized TTS experience where users are allowed to choose the fonts and colors that are easy to read and input the text by typing or importing from image (Gupta, Aflatoony, and Leonard 2021). The imported image is subsequently converted to text through OCR.

A TTS system is shown to moderately increase reading speed (Elkind, Black, and Murray 1996; Higgins and Zvi 1995) and mildly facilitate the reading comprehension in dyslexics (Wood et al. 2018). For example, Elkind, Black, and Murray (1996) compared the reading ability in TTS-aided and to unaided dyslexic readers in the US. They found a robust improvement in English reading speed via TTS (i.e., 16 percent more words read per minute), but the comprehension score only improved marginally in both a timed and an untimed reading task. Moreover, readers with poorer performance generally showed a larger improvement under TTS, and the performance gain can be predicted from the individual auditory and visual cognitive abilities. TTS can also be used to support the learning of a second language in dyslexics. Chiang and Liu (2011) assessed the benefit of TTS software (Kurzweil 3000) on English word learning in Taiwan high school students. Student self-reports suggests the software alleviated the difficulties in reading, writing, spelling, and pronunciation, and facilitated their comprehension during class.

Speech-to-text (STT) is a technology that synchronously recognizes and transcribes text from speech input (*Shadiev* et al. 2014). STT is a built-in feature of most desktop and mobile operating systems (e.g., Dictation on macOS and iOS) and some general-purpose or learning-enhancing applications (e.g., *IBM ViaVoice* and *Texthelp Read & Write*). Matre (2022) interviewed three secondary school children (in Norway) for the experience on using STT for voice input. The children in general found it easy to get started with but reported that it was challenging to edit the text efficiently. The teacher further noted that the initial draft produced by STT could be improved using additional assistive tools such as a spellchecker.

Another important application for STT in dyslexic learning is audio notetaker software. For example, *Sonocent Audio Notetaker 4* is a computer software designed for dyslexic students that enables users to import speech from file or record it directly on the device. The software then transcribes the speech to written text (through *Dragon NaturallySpeaking*) and allows users to link the audio with text note and other medias like images. McKnight (2013) interviewed primary school teachers in the United Kingdom for the AT used to support dyslexic pupils. Among a range of software packages (e.g., *Inspiration* for mind-mapping or *Read & Write* for TTS), *Sonocent Audio* Notetaker was rated as the most successful. The software has also been used by the teachers to record revision notes for students, or by the students to record speaking responses to homework assignments or a writing task.

Spellcheckers

Another widely adopted technology for dyslexia is spellcheckers. A spellchecker checks the spelling and grammar of the content a user inputs and gives suggestions for correcting misspelled words or words/phrases not used properly (C. Smith and Hattingh 2020). Thanks to the progress in machine learning (ML) and natural language processing (NLP), recent packages such as *Grammarly* can also detect real-word errors (e.g., *form* instead of *from*) and offer writing style and tone rendering (Rello, Ballesteros, and Bigham 2015). Spell checking is usually carried out by a word processor (e.g., *Microsoft Word*) or a dedicated spell-checking software (e.g., *Grammarly*).

A questionnaire among school children with dyslexia in Sweden revealed spellchecker among the most popular and satisfied options for daily supporting dyslexic writing and learning (Björklund 2011). A recent study on the dyslexic students in the UK (Hiscox, Leonavičiute, and Humby 2014) also showed that spell-checking software significantly improved the understanding and recall of text during the transcription of fiction novels presented over audio recordings. These results suggested that autocorrection possibly eased the working memory (WM) load on dyslexics during writing tasks, enabling more effective processing and recall of the text.

Virtual environment

With developments in Information and Communication Technology (ICT), virtual environment starts to gain popularity in assisting learning for people with dyslexia (virtual environment or VE; a computer-simulated environment that projects users into a 3D space that mimics the real world; Kalyvioti and Mikropoulos 2014). VE is often used for assessment and intervention purposes (Kalyvioti and Mikropoulos 2014), therefore complementing other technologies that directly support the learning process (e.g., TTS and STT).

For example, Fokides, Chronopoulou, and Kaimara (2019) found that training with interactive role-play in VE significantly improved the functional skills and behaviors of Greek students with dyslexia in a wide range of school activity (e.g., attending a lecture or a ceremony, playing in the schoolyard) compared to the traditional approach of presenting students with educational videos. The results show the potential for VE to help dyslexic students overcome challenges in a school environment.

3.1.1.2 Low-tech options

A tool that can be potentially used in place of TTS to support dyslexic learning is an audio textbook (i.e., book on tape; Ruffin 2012). Instead of an app that requires computers or mobile devices, an audio textbook can be recorded by teachers and stored on low-cost medias like tapes and CDs. Teachers can also audio record their lectures and disseminate them to students who need them.

3.1.2 Dysgraphia

3.1.2.1 International practices

Various types of AT have been applied to assisting students with dysgraphia. Technologies available to enhance dyslexic learning, such as STT and audio notetaker, are also used by users having dysgraphia as a workaround for problems in handwriting (Rettig 2014). Other technologies that are commonly used for dysgraphia include word prediction software and graphic organizer (Rettig 2014). A word prediction software provides typing suggestions for the words that a user intends to type based on the previously observed sequence of inputs (e.g., *Lightkey* on Windows, the built-in *Accessibility Keyboard* on macOS; Rettig 2014; Lewis 2020). A graphic organizer (software) helps students develop and organize their ideas and projects by presenting them in a graphic structure (Rettig 2014).

Despite the prevalence of dysgraphia and the amount of available AT, no study so far has systematically evaluated the effects and benefits of AT on learning in for people with dysgraphia. Lewis (2020), in her personal blog, reviewed a wide variety of AT that supported her learning as an American college student with dysgraphia. She used AT ranging from those with little to no technology (i.e., pencil grips, wide ruled notebooks) to some high-tech ones (e.g., smart pen, OCR software). Lewis reported that pencil grips made her hold a pen more naturally and wide lines on the notebook helped her write in a straight line. She also uses a smart pen or OCR software (also see section *Dyslexia*) to scan the printed text to other devices such as iPad and further modify the text as needed.

Recently, researchers also consider the use of augmented reality (accentuated reality or AR; an interactive experience that merges reality and computer-generated information such as sound, text, and graphics; Mehler-Bicher and Steiger 2014) in supporting dysgraphic learning. For example, researchers in Pakistan developed an AR model where dysgraphic students receive support on writing from smart glasses (Faizan Khan et al. 2017). When a student has trouble in writing a word, they speak out the word, which is then picked up by the glasses and converted to the corresponding text shown on its display. The proposed model therefore addresses the issues associated with spelling mistakes.

3.1.2.2 Low-tech options

Stationeries

Individuals with dysgraphia might develop problems in gripping a pencil as they usually concentrate too hard on the letter formation (R. Richards 1999). As a result, students' hand-writing performance is affected as children focus on holding the pencil instead of their writing. Pencil grip is a very low-cost utility that can help children with dysgraphia hold pencils or pens in a more natural /correct way.

Dysgraphic children sometimes also experience trouble writing straight lines and writing on narrowly spaced lines. A potential solution can be using wide ruled notebooks where the high contrast lines and additional space between lines can reduce the effort of writing and help children write in a straight line (Lewis 2020).

Whiteboards with a dry erase marker can also be useful for dysgraphic children as it is sometimes easier for them to write on a whiteboard compared to writing on a paper with a pen, as it is easier to correct mistakes (Lewis 2020). A whiteboard can also be useful for hand-draw graphs or for writing mock-ups for the homework.

Hand-writing practice and fine muscle exercise

Dysgraphic children are also shown to benefit from hand-writing practice and fine muscle exercise paradigms in a study by researchers in the United States (Crouch and Jakubecy 2007). During hand-writing practice, a teacher asks students to practice writing certain letters on a formatted letter. The teacher verbally states how to write the letters correctly and correct the students if their writing derails from the standard writing. The teacher also records the progress of the students' writing and reviews their performance before the end of each session. In the fine muscle exercise, students participate in a range of activities including finger painting, cutting with scissors, gluing, sewing and weaving. At the end of each session, students provide a writing piece on which they are given feedback on the

hand-writing practice session. The two training methods can be rolled out in an interleaved fashion each lasting one week. When combined, these methods can aggregate to improve handwriting performance by 50 percent by the end of an eight-week training programme.

3.1.3 Dyscalculia

3.1.3.1 International practices

iPad App

Numerous apps have been developed for iPad (i.e., Apple's tablet device) to assist students with dyscalculia to make sense of numbers, where the majority focuses on helping the users build an intuitive understanding of abstract mathematic concepts (e.g., fraction). For example, Number Line assists mathematic learning by allowing the students to make sense of numbers and practice basic arithmetic operators on a virtual number line. Users can mark and hide numbers from the line and use a floating bar to represent the quantity of the number and visualize numeric operations.

Other apps like *MathTappers*: *Fraction Estimation* helps learners get a grip of fractions by asking them to drag and drop a number (e.g., 1/7) to a number line where the correct position corresponds to the nearest half (e.g., between 0 and 1/2 for 1/7). A relevant app *MathTappers: Equivalents* challenges learners to find the pairs or triples of fraction, decimal, and/or percent that are equivalent (e.g., 70 percent and 7/10), whereby helping the learners establish correlations between one concept and another.

Computer games

Computer games are another tool widely adopted for assisting dyscalculic learners. The story game "Rescue Calcularis" developed by researchers in Switzerland and Germany (Kucian et al. 2011) aims to enhance the association between numbers and space and improve general arithmetic skills by training the learners to "rescue" their "homeland Calcularis". In the game, an Arabic digit, several dots, an addition problem, or a subtraction problem shows on a spaceship. The task is to land the spaceship at the corresponding position on the number line. Learners need to successfully solve certain number of questions to progress to the next level, where the difficulty of the question raises. The training paradigm significantly improved the spatial representation of numbers and the performance in solving arithmetical problems in dyscalculic children, indicating an enhanced processing of numerical tasks.

3.1.3.2 Low-tech options

A low-tech replacement for the high-tech solutions discussed above is a physical analog that functions similarly. For example, in the case of *Number Line* app teachers can use physical gadgets such as a ruler to replace the virtual number line, and coloured paper bars to replace the floating bar in the app. Teachers can then manually train the students on key mathematic concepts such as number and fraction in this setup following the training paradigm implemented in the app. Similar principles can also be applied to the computer game where a teacher can design a gamified scenario and challenge the students with certain mathematic tasks and reinforce the learning with rewards.

3.2 ASD

3.2.1 International good practices

Speech-generating device

Individuals with ASD often illustrate difficulties in spoken language communication, such as a delay in language development, limited speech repertoire, and inefficient communication (Scheuermann and Webber 2002; Howlin 2003). A speech-generating device (SGD) is a portable device or a computer/iPad-based software (e.g., *Proloquo2Go* and *My Choice Board* on iPad) widely used to support speech communication in ASD. An array of symbols or pictures is displayed on the device to serve a variety of communicative functions including greeting, requesting, or commenting (Lang et al. 2014). The device plays a pre-recorded or synthesized audio message (e.g., *may I have my toy please?*) when a user selects the corresponding picture (e.g., the user's favorite toy).

A recent study on New Zealand school children with autism found a positive effect of SGD (i.e., Proloquo2Go) on their requesting skill—children had significantly more responses with their natural speech to request for preferred objects following the intervention (Roche et al. 2014). Another study evaluating the same app further showed that the improvement in the requesting skill was maintained without the app and generalized to other objects and activities (Sigafoos et al. 2013), suggesting the capability of an iPad app for improving the communication skills of children with autism.

Speech-generating device

Another popular technology used to improve autistic communication is picture exchange communication systems (PECS; Bondy and Frost 2002). PECS aims to train autistic individuals on effective expression of communication intent (e.g., request an object) via teaching children with ASD to exchange the picture card they have with the real object they want from their communication partner (e.g., a clinical psychologist). The training also involves guiding individuals to construct simple sentences visually with a series of pictures (i.e., a sentence strip) of the items they request from the partner, where the partner initiates the response with a verbal prompt "I want...". Children are also trained to respond to simple questions such as "What is it?" or "What do you see?" with the cards they have.

A study on spoken communication of American autistic pre-schoolers found (Yoder and Stone 2006) that the PECS significantly increased the frequency of speech utterance and the range and flexibility of word use over the students who received Responsive Prelinguistic Milieu Teaching (RPMT). The researchers hypothesized that PECS facilitated the speech production in autistic children as the linguistic input from the parents or the communication partner (e.g., "I want..." and verbal narration) might elicit speech response in children.

Video modelling

Autistic disorder often affects social skills such as appropriate eye contact, joint attention, and developing and understanding social relationships (American Psychiatric Association 2013). Video modelling (VM) aims to enhance social skills in autistic children through observation. During the intervention, a person with ASD watches a video of the target skill and mimics the model behavior (Bellini and Akullian 2007). The person performing the skill can be a therapist, a peer, or the person with ASD themselves (i.e., self-modelling). Video modelling is also used to train motor, emotional, communication skills (Bellini, Akullian, and Hopf 2007).

A research group in United Arab Emirates investigated the efficacy of VM in promoting the social skills of autistic children (Alzyoudi, Sartawi, and Almuhiri 2015). Children were asked to perform complete a social skill task after viewing the videotaping of correct social behaviors (e.g., making a request such as asking to sit with someone) between the portrayed interaction of a therapist and a child with ASD. All children showed improved social skills during the intervening sessions compared to their baseline performance. The skill was also maintained in a follow-up test one month after the intervention. The results suggest VM is an effective method for improving social skills in ASD.

Script training

A method similar to VM for improving social skills is script training, where a teacher or a therapist writes a script for specific social interactions which is then portrayed by an ASD child and their peer to practice pro-social behaviors. The use of script is usually faded over the training course to eventually lead individuals with ASD to flexibly express ideas that are unscripted (Wichnick et al. 2010).

A study on American school children tested the effect of script training on social skills in ASD (Wichnick et al. 2010). The researchers started the training with a baseline phase where children with ASD were given no script while their peer shared a toy with them. In the second phase, children with ASD were offered scripts that guides their response to a toy handed to them (e.g., "I like the toy animals"). In the last phase, the scripts were simplified gradually (e.g., "I like the toy...", "I like...", "I...") to elicit unscripted responses in the children. The results showed increased novel responses for the scripted phase which was generalized to the fading phase. Therefore, the script training is a useful approach to evoking unscripted social responses in children with ASD.

3.2.2 Low-tech options

Some AT introduced in the current section (3.1.4), such as PECS and script training are already available as a low-tech option. VM can also be considered as a low-tech and low-tech solution as it can be conducted between the autistic children and a therapist or teacher instead of with the children watching the pre-recorded video.

3.3 ADHD

3.3.1 International good practices

Timer and smart watch

Children with ADHD often show hyperactivity and are not able to consistently direct their attention to a certain task (American Psychiatric Association 2013). Both physical timers (e.g., a kitchen timer) and wearable devices such as smart watch (e.g., the *Timers* app or the Pomodoro timer in the *Focus-to-do* app on Apple Watch) can be adopted to help children with ADHD to stay focused. For example, a study of school children in Denmark found that a vibrating notification given by a smart watch every 15 minutes can remind children with ADHD to focus on the task without disturbing other students in the classroom (Sonne, Obel, and Grønbæk 2015). Children can on average focus on a task for 10-12 minutes after receiving the vibration. Children with ADHD in Canada also reported in a questionnaire on ADHD AT that a Pomodoro timer (i.e., a timer broken into a typical interval of 25 minutes that is separated by short breaks) assisted them to better structure the task by keeping the attention focused and offering work and break times (Fichten et al. 2022).

Mobile apps

Apps on mobile devices such as smartphone and tablets can be useful for mitigating ADHD symptoms and helping users manage their time and behaviors (Păsărelu, Andersson, and Dobrean 2020). For example, Routinery is an app (available both on iOS and Android) that manages daily chores and tasks for users with ADHD down to the exact minutes and can add reminders and breaks. Users can also set urgency for a task on which they need to be more focused. *HabitNow* helps form new habits by letting a user input the habits they want to reinforce and remind the user to do them again. The app also reminds the user of the deadlines of the tasks related to their hobbies. *Monday.com* organizes and reminds users of their current deadlines and provides an overview of completed tasks, thereby helping the users navigate through complex workflows. Forest helps users stay focused on certain tasks. The app asks the user to plant a tree before they start a task. The tree grows while the user works on the task, but the tree dies if the user accesses their device and leaves the app halfway.

Computer-based training

Computer-based training (CBT) is a training protocol implemented on a computer. In the context of ADHD, CBT is used to improve deficits in cognitive functions and is often tailored to meet individual needs (Black and Hattingh 2020). Working memory seems to be the domain that can be most effectively modulated by CBT in children with ADHD (Karch et al. 2013). A popular training paradigm for improving WM is *RoboMemo* developed by a group of Swedish researchers (Klingberg et al. 2005). The programme involves training in a visuospatial task (i.e., memorizing object positions in a 4 x 4 grid) and a verbal task (i.e., memorizing phonemes, letters, or digits) targeted at different aspects of WM. The paradigm significantly improved the visuospatial and verbal WM, as well as inhibition and complex reasoning abilities in children with ADHD. However, it is noteworthy that CBT seems to have very little effect on the secondary outcome measures including intelligence and school performance (Karch et al. 2013).

3.3.2 Low-tech options

Timer is a comparatively low-tech and low-cost tool that can be easily accessible for managing time for daily tasks. Solutions such as placing sticky notes in strategic locations (e.g., standing desk) can serve as a visual reminder. Moreover, books recorded on tapes can also be used to assist in learning for ADHD children when they cannot concentrate on reading (Murphy 2005).

3.4 Hearing and language impairments

3.4.1 International practices

Hearing aids and cochlear implant

Individuals with hearing impairments usually struggle in auditory and speech perception, where the intelligibility of speech and performance in basic hearing tests (e.g., audiometric thresholds, tone and frequency perception) are typically lower than those who have normal hearing (NH; Holmes and Griffiths 2019). Two major interventions for hearing loss are hearing aids (HA) and cochlear implant (CI). HA is a small electronic device put in the ear canal that amplifies the sound going into the ear. A CI is a device surgically installed in the inner ear to bypass the damaged hair cells and transfer the sound to electrical signal that stimulates the auditory nerves.

Children with severe hearing loss often show a significant benefit on auditory skills (e.g., changes in vocalization, attending to environmental sounds, or deriving meaning from sounds) for their age at implementation (McConkey Robbins et al. 2004). In other words, the younger one receives the CI implementation, the better their chance to acquire communication skills approximating their peer with NH. In school-age children, it seems that individuals with CI have significantly higher performance in auditory perception than those who wear HA. However, CI does not seem to provide additional benefit over HA in terms of speech intelligibility (Ashori 2020).

Sound transmission system

Sound transmission system such as loudspeakers and microphones are also used for supporting students with hearing impairments at school. Loudspeakers are usually installed in the classroom or directly on student desk to amplify teacher's voice. Microphones are usually used by students and teacher paired with a receiving device such as headphones or a HA or CI device (Rekkedal 2012). A questionnaire on Norwegian school kids' use of hearing supporting techs found generally satisfactory responses from children who found that microphones made it easier for them to hear their classmates and teachers. However, some students also reported feeling embarrassed about their peers using a microphone or about themselves being joked about for using microphones (Rekkedal 2012).

Text-to-speech and Speech-to-text

TTS is a useful technology to support children at school who have difficulty in producing speech (e.g., Broca's aphasia, dysarthria), which converts input text from users to clear speech that can be understood by listeners. *VocalID* is a TTS software producing personalized speech synthesis that mimics the voice profiles of the user (Jreige, Patel, and Bunnell 2009). In a usability test on the school children in US, researchers show that listeners can accurately transcribe speech produced by VocalID (94 percent correct) and match the sample with the original speaker (79.5 percent).

SST can also be used to increase the intelligibility of speech produced by those who have impaired speech production. For example, researchers in Italy recently built a mobile app based on machine learning (i.e., deep convolutional neural network) that can precisely recognize the otherwise morphed speech produced by users with dysarthria (Mulfari et al. 2021). The model uses the users' own speech as a sample to increase the model's accountability of the distorted speech input. In a usability test, the app showed an average accuracy level over 90 percent correct, suggesting the tool is a promising approach to recognizing pathological speech.

3.4.2 Low-tech options

Low-tech approaches to hearing and language impairments aim to bypass constrained communication channels (e.g., impaired audition or speech production). For example, communication between teachers, students with LD, and their peers can be conducted using sign language, facial expressions, gestures. Students can write down the sentences on a paper to communicate. Alternatively, a printed virtual keyboard can allow students to point at the letters and formulate the sentences they intend to "input" and express if they also have LDs in writing such as dysgraphia (Paterson and Carpenter 2015).

4 Summary

This section demonstrated the current state of AT applied to support the learning in children with LDs. We focused on the mental disorders that are treated as LDs in a narrow sense—dyslexia, dysgraphia, and dyscalculia, which mainly affect reading, handwriting, and mathematic skills. We also expand the discussion to three disorders that usually affect learning outcomes—ASD, ADHD, and hearing and language impairments. An overview of the AT applicable to each LD, as well as the level of technology and cost of each AT can be found in Table 3. Most of the AT adopted as a good practice internationally seem to involve somewhat middle to high technologies, such as electronic devices (e.g., computer, hearing aids) and software (e.g., iPad apps, computer games). Though not dominant, low-tech options are available for each LD covered in this report and can be implemented at a very low cost in general. Their high accessibility makes the low-tech options particularly suitable for the implementation in a middle or low-income society.

Table 3: An Overview of AT for LDs

LD	AT	Level of Tech	Level of Cost	Potential Solutions
Dyslexia	Text-to-speech	High	Dependent on the hardware	Microsoft Word, Augmentally
	Speech-to-text			Apple Dictation, IBM ViaVoice and Texthelp Read & Write, Sonocent Audio Notetaker 4
	Spellcheckers			Microsoft Word, Grammarly
	Virtual environment		High	Under active development
	Book on tape	Low	Low	Cassette audiobooks
Dysgraphia	Speech-to-text	See above	See above	See above
	Audio notetaker	High	Dependent on the hardware	Sonocent Audio Notetaker 4
	Word prediction software			Lightkey, Apple accessibility keyboard
	Graphic organizer			Bublup, bubble.us, Popplet
	OCR, smart pen		Medium	Adobe Acrobat, Livescribe smart pen
	Augmented reality		High	Under active development
	Stationaries	Low	Low	Pencil grip, wide-ruled notebook, whiteboard
	Hand-writing practice and fine muscle exercise			Behavioral training
Dyscalculia	iPad App	High	Dependent on the hardware	Number Line, MathTappers: Fraction Estimation
	Computer games			Rescue Calcularis
	Physical analog	Low	Low	Developed by teachers
ASD	Speech-generating device	High	Dependent on the hardware	Proloquo2Go and My Choice Board
	The picture exchange communication system	Low	Low	Behavioral training
	Video modelling	Medium	Medium	Behavioral training
	Script training	Low	Low	Behavioral training
ADHD	Timer			Kitchen timer
	Smart watch	High	High	Timers app, Focus-to-do app
	Mobile apps		Dependent on the hardware	Routinery, HabitNow, Monday.com, Forest
	Computer-based training			RoboMemo
	Book on tape	See above	See above	See above
Hearing and language impairments	Hearing aids and cochlear implant	High	High	Dependent on the hardware manufacturer
	Sound transmission system		Medium	Dependent on the hardware manufacturer
	Text-to-speech	See above	See above	See above
	Speech-to-text			See above

3

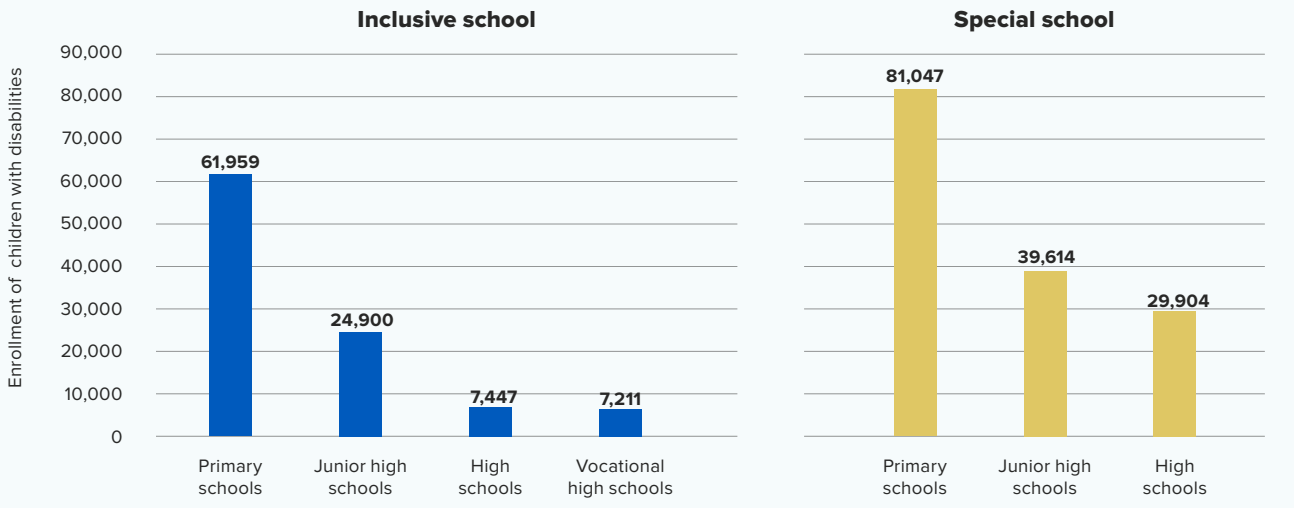
Part 2: Indonesian Case Study

3.1 Indonesian context

3.1.1 Issues with quality education for children with disabilities

In Indonesia, enrolment of children with disabilities decreases with every level of education, and quality issues such as their drop out and repetition has been a hidden key issue. The number of children with disabilities enrolled in inclusive schools is increasing at every level of education from primary to high school since 2015.[20] However, enrolment of children with disabilities decreases with every level of education (see Figure 1). Drop out and repetition of children with disabilities remains a key issue from primary education, partly due to the lack of capacity of teachers and schools to provide adequate learning environment for children with disabilities.[21] Children with disabilities are less likely to continue their education than children without disabilities, and their inequality in education can lead to economic (e.g., poverty), social (e.g., limited access to social services) and political inequalities (e.g., limited political participation). However, children with disabilities are often overlooked in the policy debates on quality education in Indonesia, and IE for children with disabilities tends to focus on issues with access rather than quality. The number of inclusive schools has also increased over time, and there are 17,938 primary schools, 7,397 junior high schools, 2,896 high school and 2,950 vocational high schools which are acknowledged as inclusive schools.[22] As for special schools, there are more children with disabilities than in inclusive schools at every level of education, with 2,298 special schools from primary to high school levels across Indonesia.[23] Enrolment also decreases at every level of education, and issues of quality has received scant attention. In this context, it is critical to examine and address issues with education quality, with AT as part of the solution to address it.

Figure 1: Number of children with disabilities in inclusive and special schools, MoECRT 2022



[20] MoECRT, Dapodik, 2021. Children with disabilities enrolled in inclusive schools include children with learning disabilities (37.9 percent), visual impairment (10.8 percent), attention deficit hyperactivity disorder (ADHD) (7.5 percent), intellectual disabilities (9.9 percent), autism (5.1 percent), speech impairment (4.2 percent), hearing impairment(2.8 percent), physical disabilities (4.2 percent), multiple disabilities (4.3 percent) among others, MoECRT (2022).

[21] Hata, Anna, Joko Yuwono, Ruwiyati Purwana, and Shinsaku Nomura. "Embracing Diversity and Inclusion in Indonesian Schools: Challenges and Policy Options for the Future of Inclusive Education". (Washington, DC: World Bank, 2021), https://documents.worldbank.org/en/publication/documents-reports/documentdetail/535361634052935364/embracing-diversity-and-inclusion-in-indonesian-schools-challenges-and-policyoptions-for-the-future-of-inclusive-education

[22] Dapodik, 2022

[23] In Indonesia, special schools (SLB) usually focus on specific disabilities which are categorized in five groups. SLB-A focuses on blind and low vision, SLB-B focuses on hearing impairment, SLB-C focuses on intellectual disabilities, and SLB-D focuses on physical disabilities including those who are disabled due to polio. The last category is ASD. Children with learning disabilities usually go to inclusive schools.

3.1.2 Regulations related to AT

AT is part of reasonable accommodation, guaranteed by a regulation for all children with disabilities to exercise their rights to have quality education, and it is the government's responsibility to provide AT for children with disabilities. Government Regulation Number 13, 2020 concerning Adequate Accommodations for Students with Disabilities articulates the responsibility of central and local governments to provide reasonable accommodation for children with disabilities in education in Indonesia, and AT is understood as part of reasonable accommodation. Under Article 1, reasonable *accommodation is defined as modification and proper and necessary adjustments to guarantee the enjoyment and exercise of all human rights and fundamental freedoms to persons with disabilities based on equality.* Article 13 elaborates forms of adequate accommodation for children with disabilities in education settings in terms of what can provide flexibility for their learning process, including learning media. AT in this study is defined as any technologies and items (including learning media) used by teachers, including high-tech and low-tech, to facilitate students with disabilities to participate in learning activities. Thus, AT is an important part of reasonable accommodation to enhance the quality of learning process for children with disabilities to exercise their right to education. The responsibility of central and local governments for providing decent and reasonable accommodation to facilitate education for children with disabilities is stipulated in Article 2. Article 9 explains that the beneficiaries of appropriate accommodation are persons with disabilities including those with physical disabilities, intellectual disabilities, mental disabilities, and/or sensory disabilities (visual impairment, and/or hearing impairment and/or speech disabilities) and multiple disabilities.

However, there is a lack of standards related to the use of AT. The policy overlooks standards for different types of disabilities including both high and low tech, children with disabilities in inclusive schools, and the linkage between AT and quality learning. The Regulation of the Minister of National Education of the Republic of Indonesia Number 33 of 2008 (hereafter referred to as Permendiknas 33/2008) is currently the only reference for education facilities including assistive technologies for students with disabilities in the education sector in Indonesia. Permendiknas 33/2008 includes standards for facilities and infrastructure for Special Elementary Schools (SDLB), Special Junior High Schools (SMPLB) and Special High Schools (SMALB). While Permendiknas 33/2008 can be a reference for inclusive schools,[24] there are no clear standards for facilities and infrastructure and the use of AT for students with disabilities in inclusive schools. The types of disability covered in the Permendiknas are mainly limited to visual impairment, hearing impairment, intellectual disabilities and physical disabilities. In addition, the Permendiknas largely focuses on low-tech, and standards of variety of high-tech that can be used for children with disabilities are still limited. Moreover, the description of each tech focuses on form (what the tech is), rather than function (how the tech can be used to enhance quality of learning).

The importance of quality of learning for children with disabilities, especially the benefits of AT may be unrecognized at a policy level. The Permendiknas mainly benefits special schools and children with specific types of disabilities only, and the standards for AT are dominated by low-techs and its basic description. As a result, children with disabilities in inclusive schools and those with other types of disabilities in special schools may not benefit from the current regulation regarding AT. The need of a variety of high-tech for children with different types of disabilities, both in inclusive and special schools, still receives scant attention at a policy level. Moreover, AT described in the current regulation is not clearly linked with quality of learning for children with disabilities.

The lack of regulation regarding AT to promote inclusion of children with disabilities in regular classrooms can lead to segregation of children with disabilities within inclusive schools by limiting their access to AT in a separate resource room only. Learning resource rooms are spaces provided in inclusive schools to support the learning process of students with disabilities, as stipulated in the *Guidelines for Management of Learning Resources Room in Inclusive Education Provider Education Unites, 2022, published by the Directorate of PMPK.* The room has standards and to be equipped with AT for children with disabilities. However, there is no specification regarding the types of AT to be used for different types of disabilities, and how to use AT in the resource room. There are no specific regulations related to AT in inclusive schools. While the Directorate of PMPK has a policy on resource rooms in inclusive schools, there is no technical instruction on

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[24] In Indonesia, the term inclusive school is often used to refer to general schools that accommodate children with disabilities, but this narrow interpretation does not necessarily guarantee that inclusive schools provide properly trained teachers or facilities to meet the different needs of children with disabilities. Further discussion about inclusive schools can be found in the previous study on inclusive education in Indonesia, which can be accessed from here: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/535361634052935364/embracing-diversity-and-inclusion-in-indonesian-schools-challenges-and-policy-options-for-the-future-of-inclusive-education

how to use AT for different disabilities in the resource rooms, and lack of attention to the role of AT in regular classrooms where children with and without disabilities learn together. Thus, a current regulation regarding facilities for children with disabilities in inclusive schools is limited to resource rooms, and there is no specific reference to types of AT and how to use them.

There is a need to translate the principal standard into actual standards of education facilities that benefit all children with disabilities in both inclusive and special schools. Regulation Number 4/2022 claims education standard of facilities should include friendliness toward people with disabilities, but there is a lack of regulation that can elaborate the standard of facilities to make meaningful changes in school settings. *The Government Regulation of the Republic of Indonesia Number 4 of 2022 concerning Amendment to Government Regulation number 57 of 2021* concerning National Educational Standards articulate national education standards. The Article 25 about the principals of standard of facilities and infrastructure stipulates that facilities and infrastructures should be friendly to persons with disabilities. Article 26 mentions that further provisions regarding the standard of facilities and infrastructure is to be regulated by Ministerial Regulation. However, given the narrow scope of the existing standard in the Permendiknas 33 in 2008, there is a gap between what the Regulation Number 4 2022 claims as principals of standards of facilities and existing standards.

3.1.3 Procurement

The existing funding scheme for AT by the central government, the Special Allocation Fund Scheme, is insufficient to allow inclusive and special schools to purchase appropriate AT for different types of disabilities. Special Allocation Fund Scheme (DAK) is provided by the central government through MoECRT to enable schools to provide infrastructure and AT for children with disabilities in inclusive and special schools. Through the DAK, schools submit proposals to the District/ City or Provincial Education Office including a list of infrastructure (e.g., construction/renovation of classrooms) and/or AT needed. The central government then reviews and approves with reference to Dapodik (the national education data system).

However, the DAK has limitations for both special and inclusive schools. Regarding the DAK for students with disabilities in special schools, the need for AT refers to the Permendiknas 33 of 2008 so it is limited to certain types of disabilities. Whereas the DAK for students with disabilities in inclusive schools is mainly used to establish a learning resource room and required furniture as one package. However, technical instructions are lacking and as a result, some schools that have received assistance for building resource rooms are confused and it is not uncommon that existing learning resource rooms have changed their function to become the principal's room, or for storage. Moreover, the AT positive list for expenditures does not always meet the needs of schools. In fact, discussion with principals revealed that their needs are not listed. Thus, while the DAK can be used to supply AT for children with disabilities, it may be limited, and the lack of technical instructions for inclusive schools is an additional challenge. This is further compounded by a lack of monitoring to examine use of funds for children with disabilities in recipient schools.

While the BOS schemes can be used by school principals to purchase AT for children with disabilities, they are limited by the positive list and by their own knowledge. There are three BOS schemes that can be used by school principals to purchase AT including Regular BOS, Affirmative BOS (for schools in rural areas), and Performance BOS (for schools that excel). To purchase AT, school principals need to submit AT requests to the Education Office to purchase through the SIPLah Application (School Procurement Information System). The key issue is that on the supply side this system limits principals' choice by requiring them to select AT based on a list determined by the government, rather than allowing principals to request AT based on their students' needs on the demand side. Given the lack of guideline on AT for school principals, it is unlikely that they can identify appropriate AT for children with different types of disabilities.

Both city/district and provincial governments are responsible for establishing Disability Service Units (DSU) and providing support including AT for children with disabilities, however so far this support is very limited. Law Number 8/2016 concerning Persons with Disabilities requires local governments to establish DSUs, to support implementation of inclusive education from early childhood education, primary to secondary education, including the provision of learning media and tools needed by students with disabilities and teacher training and provide AT for children with disabilities, however, in reality, so far a very small number of city/district governments out of 514 districts have DSUs, due to the lack of clear guidelines for establishment and financing schemes. Additionally, local governments may not have capacity to identify issues and needs for AT for children with disabilities.

3.1.4 Teacher training and supporting mechanisms

Current teacher training programs on IE for teachers in inclusive schools lack references to access and use of AT for children with disabilities. Teacher training program on IE (called Bimtek Guru Pembimbing Khusus/GPK) for teachers in inclusive schools is developed and provided by the Directorate of SSET since 2019 to address the shortage of teachers who can provide IE for children with disabilities in regular schools, especially in public schools that tend to lack qualified teachers. Teachers who complete the IE training receive a training certificate and are referred to as GPK.[25] The Bimtek has two stages including a stage for understanding the concept and a stage for mastering skills. For the first stage in October 2020, 5000 teachers across Indonesia gained basic knowledge on the concept, regulations, implementation of IE and diversity. The materials are provided online through zoom and the Learning Management System (LMS).[26] The second stage focused on technical skills through independent learning activities via LMS assignments, supported by three mentor sessions over approximately 3 weeks, equivalent to 18 learning hours in total, with four days of face-to-face training, equivalent to 30 hours in total. Neither stage incorporated AT, but focused on identification of disability, academic and/or developmental assessment, making individual education plan (IEP) and lesson plans to create inclusive classes, with a minor reference to AT as materials.

On average, only around 20 percent of inclusive schools have at least one teacher trained on IE. Existing regulations tend to focus on minimal allocations of teachers in inclusive schools, but the number is still limited. MoECRT Regulation 70/2009 on *Inclusive Education for Students with Disabilities and with Special Talents* requires one inclusive education teacher (GPK) for each inclusive school between primary and secondary education. However, the number of GPK is still limited to 21 percent of total inclusive schools between preschool, primary, junior high, high school and vocational high school (see Table 4). This means that even if a child with a disability enrols in inclusive school, the child may have no teacher trained in IE to provide adequate support.

In addition to the lack of GPK, existing regulations limit the amount of time each GPK can allocate for children with disabilities in inclusive schools and the support they can obtain from special schools. If a teacher wants to support children with disabilities in inclusive schools, the teacher has to become a GPK, thus leading them to take two roles. Despite the dual roles a GPK has, they must divide the maximum amount of working hours per week allocated for all regular teachers which is 40 hours per week,[27] into hours as a classroom teacher and remaining hours as a GPK. As a result, if one primary school (Grade 1-6, with one classroom in each grade, for example) has one GPK and two children with disabilities per classroom, one GPK needs to take care of 12 children with disabilities in one school, which can make it harder for the GPK to allocate sufficient time for each child especially given the limited amount of inputs they can have. On the other hand, special education teachers in special schools are assigned to inclusive schools in the regulation[28] but they are still regarded as additional and not all inclusive schools have their assistance. The amount of time which teachers from special schools can allocate to provide mentoring support is limited by the Article 5 of MoECRT regulation 15/2018 concerning *Fulfilling the Workload of Teachers, Principals and School Supervisors,* that stipulates that fulfilling the workload of special education teachers with additional assignments as GPK in carrying out learning or mentoring is equivalent to 6 (six) hours of face-to-face meetings per week. Thus, without more flexible regulations, GPK in inclusive schools tend to be constrained in what they can offer to students with disabilities.

While there is a need for more GPK and a more flexible mechanism to support them, it is unknown to what extent these trained teachers are currently providing adequate learning for children with disabilities. AT is key to provide quality individualised learning for them, but AT is only implied in current teacher training by the central government and there is a need for an empirical study to examine teaching practice. Moreover, while local governments should provide teacher training on IE, implementation remains unclear.

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[25] GPK refers to teachers such as classroom teachers or subject teachers who have been trained on inclusive education, and appointed by decree of local authorities (province and district). They receive training on inclusive education from the Directorate of SSET, city district offices, NGOs, universities and or other institutions. To be registered as GPK, a teacher needs to be qualified on IE. However, there is no specific regulation from the national government on main tasks and functions, so the criteria are ambiguous.

[26] LMS is a web-based software program that is used for a GPK (online-based) training medium. Participants can study independently through online media (zoom). Teachers can also read, discuss and answer questions/assignments online.

[27] MoECRT regulation 15/2008 concerning fulfilment of the workload of teachers, school heads and school supervisors

[28] Ibid

Table 4: Number of GPK in Indonesian schools including public and private schools

Level	Number of inclusive schools	Number of GPK	% of inclusive schools with at least one GPK
Early Childhood Education Programs	7.255	768	10.59%
Primary schools	19.249	4.527	23.52%
Junior high schools	7.841	2.084	26.58%
High schools	2.828	636	22.49%
Vocational high schools	2.865	588	20.52%
Total	**40.940**	**8.603**	**21.01%**

Source: Directorate of SSET, 2022, Note: The number of GPK refers to those trained by the Directorate of SSET since 2019.

3.2 Methodology

While AT is key to improve learning process of children with disabilities and enhance inclusive pedagogy of teachers, the availability and use of AT in inclusive and special schools is unknown. The lack of data on teacher practice can mask issues with quality learning for children with disabilities. Thus, this research aims to investigate the availability and use of AT and challenges faced by teachers.

Strategy and Design

This mixed-methods study addresses the lack of research on access and use of AT by teachers for children with disabilities in Indonesian schools. A triangulation mixed methods design is used, in which different but complementary data are collected on the same topic. In this study, an online survey is used to examine the current access and use of AT for students with disabilities. The survey considers intersecting factors such as school types (e.g., inclusive and special schools) and locations (e.g., urban and rural) in relation to access and use of AT, which provides insights on how to design and deliver interventions in the future. Survey results are validated and enriched through a follow-up focus group discussion with teachers to explore challenges and their needs related to for children with disabilities. Concurrent with this data collection, focus group discussions with school principals, local and national governments explore systemic issues related to access and use of AT.

The sequence of mixed methods is as follows:

- Stage 1: An online survey targeting teachers was given relative priority in this study, and the preliminary results of the survey were used to shape subsequent FGDs in the research process.
- Stage 2.1: FGDs with teachers were used to clarify and illustrate results from the survey.
- Stage 2.2: FGDs with school principals and national and local governments were used to explore systemic factors affecting the availability and use of AT.

Survey

The objective of the survey is to understand and map the availability and use of AT and the relevant support experienced by teachers in regular and special schools, focusing on teachers who are trained and registered to provide educational support for children with disabilities and have children with disabilities in their schools. The online survey was chosen to examine the availability and use of AT from a large number in a short period of time. The survey especially aimed to provide insights to meet the lack of knowledge in applying AT in inclusive settings. The survey employed a cross-sectional design which included the examination of the characteristics of two groups: inclusive education teachers and special education teachers. These two groups are compared to identify differences and commonalities, as well as explore how special education teachers, who potentially have more experience in using AT, can collaborate with inclusive education teachers.

Participants and Sampling

This study used an online survey targeting inclusive education teachers (GPK) in inclusive schools and special education teachers (SET) in special schools who are registered in Dapodik, focusing on teachers who have children with disabilities in their school, to examine the current availability and use of AT for children with disabilities. The survey was distributed to all GPKs trained by the SSET (n=8079) and all special education teachers (n=26801), covering teachers from primary to secondary education in all regions in Indonesia, in collaboration with the Directorate of SSET.[29] Since the survey was voluntary the survey could have a sample selection bias.[30] Nonetheless, the survey was the first national level survey targeting all teachers trained on inclusive and special education in Indonesia focusing on AT for children with disabilities. The WB team was able to work closely with the Directorate of SSET who leads teacher training in Indonesia and regards this study important and needed to understand the reality and inform future policies.

Instrument

The questionnaire was developed in cooperation with the SSET. The validity of the definition of AT was examined and improved through a pilot with selected teachers in inclusive and special schools in urban and rural areas in Indonesia in 2022. In the survey, AT was defined as any items used by teachers, in order to facilitate students with disabilities to participate in learning activities including both high-tech and low-tech. Examples were given to support participant understanding such as; high-tech can include computers with screen readers, projectors, tablet computers for communication, audio books; low-tech can include wheelchairs, embossed maps, communication boards, media blocks, picture cards, etc.). The questionnaire covered all types of disabilities registered in Dapodik (National Education Data System) in Indonesia, and the list of AT is disaggregated by disability type in the survey.

Procedures

With support from the Directorate of SSET, this study distributed the questionnaire to GPK and SET through the teacher management system of the MoECRT called INFO GURU, following the steps below:

1 The Directorate of SSET uploaded and distributed the survey informing GPKs and SET of the purpose of the study. The system was used to enable teachers to access and fill in the questionnaire anytime they open the system.
2. The SSET and the WB team followed up with GPKs and SETs to facilitate their participation and ensure that they are aware of the purpose and timeline of the questionnaire. To enhance the response rate, reminders were sent during the survey period.
3. Confidentiality of the participants was ensured as the identities of the respondents were not known by the researchers, and survey participation was voluntary.
4. The survey was conducted from November 8-23, 2022.

Focus Group Discussions

The objective of the FGDs is to deepen the information related to the understanding and use of AT among teachers in inclusive schools and special schools, with a focus on challenges and support needed. Multiple online FGDs were conducted in November 2022, including:

1) GPKs from inclusive schools,
2) Special education teachers from special schools,
3) School principals, and
4) local and national government.

Participants invited for the FGDs included 30 GPKs from primary, junior high school and senior high schools in urban and rural areas, ten special education teachers, eight principals from inclusive schools and ten principals from special schools, and around 20 national, provincial and district education officials.

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[29] Some teachers who responded (4673 samples, response rates were 17.2 percent among GPKs and 12.0 percent among SETs) but were excluded if they did not have students with disability at the time of survey.
[30] As a limitation of the online survey, the main caveat is the voluntary basis, which may have led to self-selection biases (Bethlehem, 2010)

3.3 Key findings

3.3.1 Overview

Summary statistics

In the survey, 2569 participants responded and answered that they have children with disabilities in their school (581 from IS, 1988 from SS). Among them, 2056 data is used for analysis after dropping the cases that have missing values.[31] Summary statistics are shown in the Table 5, and key statistics are summarized in the Figure 2 below.[32]

Table 5: Summary statistics of teacher survey

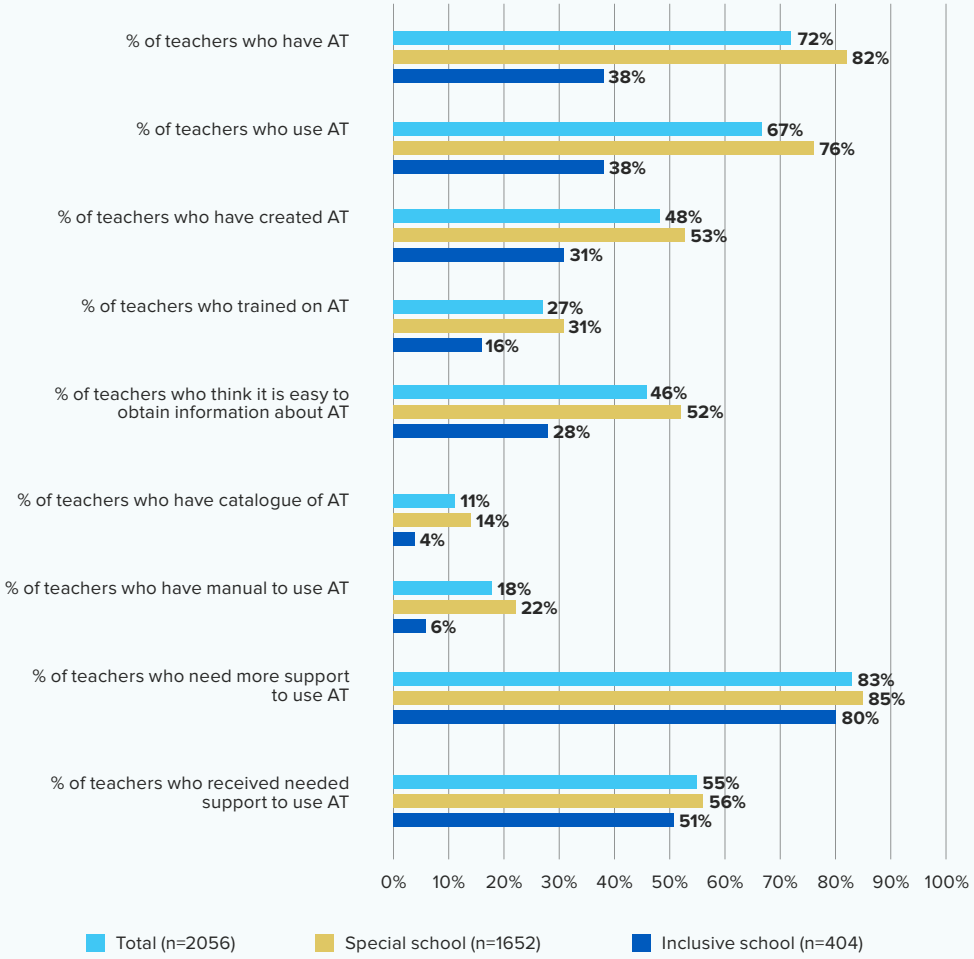
Variables	Special school	Inclusive school	Total number of teachers
School type	**1652**	**404**	**2056**
Gender			
Female	**1245**	**278**	**1523**
Male	**407**	**126**	**533**
School status			
Public	**897**	**293**	**1190**
Private	**755**	**111**	**866**
Urban/rural			
City	**838**	**210**	**1048**
Village	**814**	**194**	**1008**
School level			
Primary	**935**	**213**	**1148**
Junior secondary	**368**	**87**	**455**
High school	**339**	**41**	**380**
Vocational	**-**	**37**	**37**
Have children with disabilities in school	**1652**	**404**	**2056**
Types of disabilities			
Learning disability	**648**	**324**	**972**
Intellectual disability	**1225**	**192**	**1417**
ADHD	**497**	**160**	**657**
ASD	**515**	**100**	**615**
Speech delay	**529**	**107**	**636**
Blind	**342**	**24**	**366**
Deaf	**775**	**63**	**838**
Physical disability	**453**	**91**	**544**
Multiple disabilities	**376**	**27**	**403**

Source: Created by the authors based on the AT survey 2022

[31] Approximately 500 teachers did not respond to information including school type, school status, location, gender of teacher, training status, knowledge about AT, access to information, catalogue, manual, support needs and support received, and they are thus excluded from the analysis.

[32] Proportion of teachers in special schools (80.4 percent) was higher than the actual proportion in the population (76.8 percent). Similarly, responses from teachers in inclusive schools (19.6 percent) was lower than the actual proportion (23.2 percent). In the following section, weight variables were used to construct the analysis.

Figure 2: Percentage of teachers who have access to AT, training, materials, support and use AT, by school type.



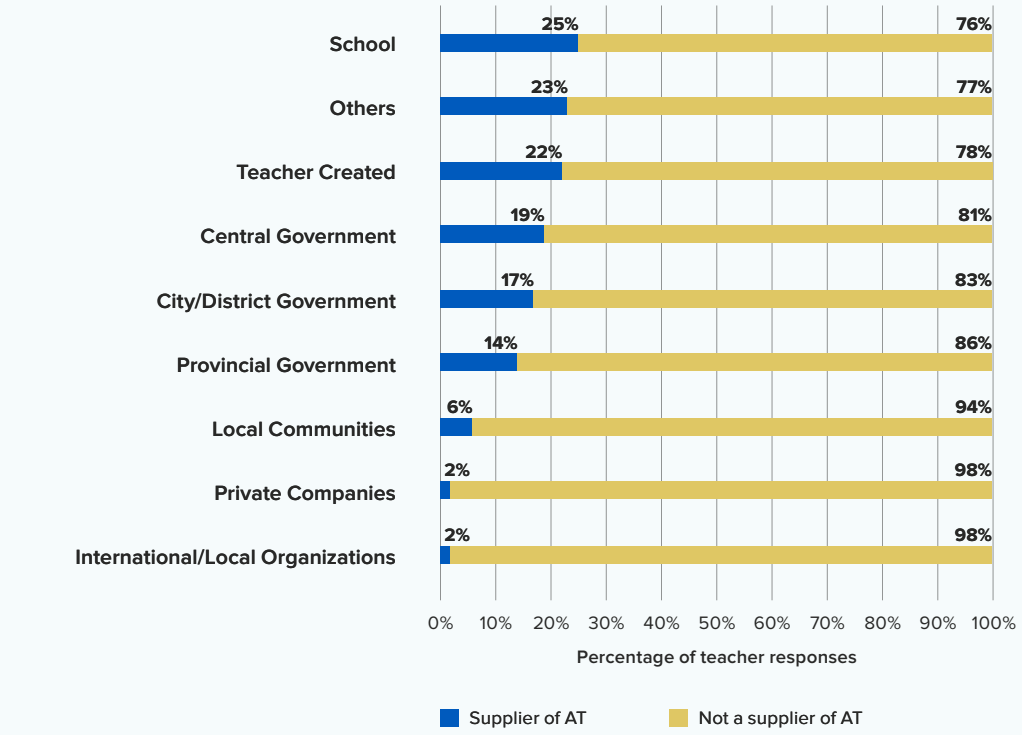
Source: Created by the authors based on the AT survey 2022

1.1 *Availability of AT*

Availability of AT for children with disabilities is very limited in inclusive schools. Almost 70 percent of teachers in inclusive schools reported they have no AT despite having children with disabilities. On the other hand, about 80 percent of teachers in special school have AT. The large gap in access to AT between inclusive schools and special schools indicates that inclusive schools may be left behind despite the rapid increase of the number of inclusive schools in Indonesia in the past decade.

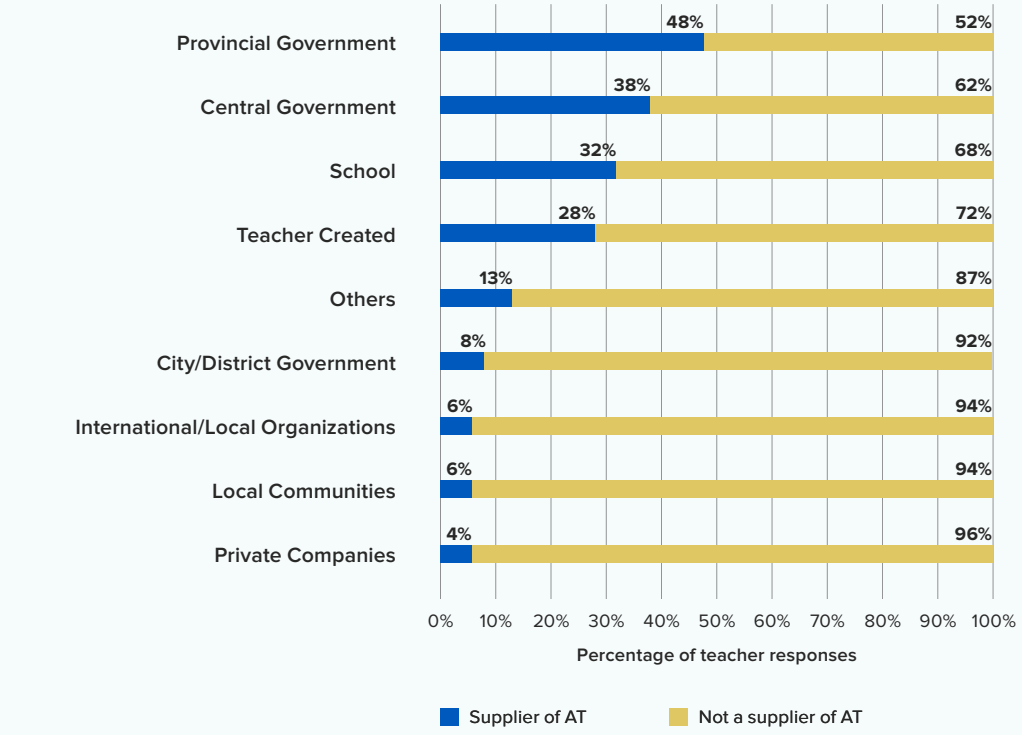
The supply of AT in inclusive schools tends to rely on schools and teachers rather than governmental support. As main suppliers of AT in inclusive school, 25 percent of teachers reported schools, followed by others (23 percent) and teachers themselves (22 percent), meaning teachers create AT. Teachers reported a lower supply from governments at all levels including central, provincial and city/district governments. This is contrary to the Government Regulation Number 13/2020 which mandates the government to provide adequate accommodation, including AT, for children with disabilities at all levels of education. On the other hand, special schools are more likely to gain AT from provincial and central governments. The high percentage of provincial government supplies to special schools would be because special schools are governed by provincial governments in Indonesia's decentralized system. Governance of inclusive schools varies with education level, where inclusive primary and junior high schools are governed by city/district governments and inclusive high schools and vocational schools are governed by provincial governments. However, the result demonstrates governmental responsibilities in supplying AT for children with disabilities is ambiguous especially in the inclusive school system. This is partly due to the lack of regulation mandating the supply of AT, especially high-tech in regular schools.

Figure 3: Main suppliers of AT in inclusive schools, based on responses from teachers (n=404)



Source: AT survey 2022

Figure 4: Main suppliers of AT in special schools, based on responses from teachers (n=1652)



Source: AT survey 2022

1.2 *Training on AT and relevant support*

Teacher training on AT for children with disabilities is severely lacking both in inclusive and special schools. Only 16 percent of teachers from inclusive schools and 31 percent of teachers from special schools reported that they had training related to AT so far. In other words, almost 85 percent of teachers in inclusive schools and 70 percent of teachers in special schools have no training on AT for children with disabilities. This may be because the current teacher training on IE by the Directorate of SSET tends to cover the basics such as the concept of IE, diversity of children and identification of children with disabilities, rather than AT to improve the quality of their learning. Even in special schools, training focused on AT may be limited. Thus, when it comes to AT, it may be more common that teachers have to learn by themselves, without support from any training providers.

In inclusive schools, not only government bodies but also schools and school collaboration have important roles in providing training on AT, with a significant urban-rural gap. Among 16 percent of teachers in inclusive schools who have received training related to AT, many of them received training from either central, provincial or city/district governments. Following governmental bodies, other providers accounted for 15 percent, the second largest percentage. Others included schools, psychologists, lecturers, universities and other organizations providing IE support. Most rely on the efforts of schools to expand collaboration. Universities that have special education study programs also provide teacher training related to AT, but this is still limited and often restricted to children with visual and hearing impairments. Importantly, urban/rural gaps exist in teacher training on AT in inclusive schools and the difference between urban and rural areas was statistically significant. Teachers in urban areas are more likely to gain training from the government and others. In inclusive schools, large regional gaps were observed in training by the central government, city/district government, others such as schools and local communities (see Figure 5). The large regional gap in training by city/district governments is partly because local governments often lack regulations, guidelines and training related to AT for children with disabilities in inclusive schools, especially in rural areas. Given the fact that city/district governments govern inclusive schools at primary and junior high school levels, inclusive primary and junior high schools in rural areas may specifically lack teacher training on AT. Training on AT by local non-governmental organizations (NGOs), international/bilateral organizations or private companies was only found in urban areas. As for special schools, the urban-rural gap in teacher training was not observed at a statistically significant level. The large percentage of provincial governments was because special schools are under provincial government authority. Thus, teachers in inclusive schools in rural areas may be most at risk of receiving no training on AT, particularly at primary and junior high school levels, partly due to the lack of capacity and initiatives to implement IE among local governments and schools in rural areas.

Figure 5: Percentage of training providers, by school type (n=558, including n IS=65 and n SS=493)

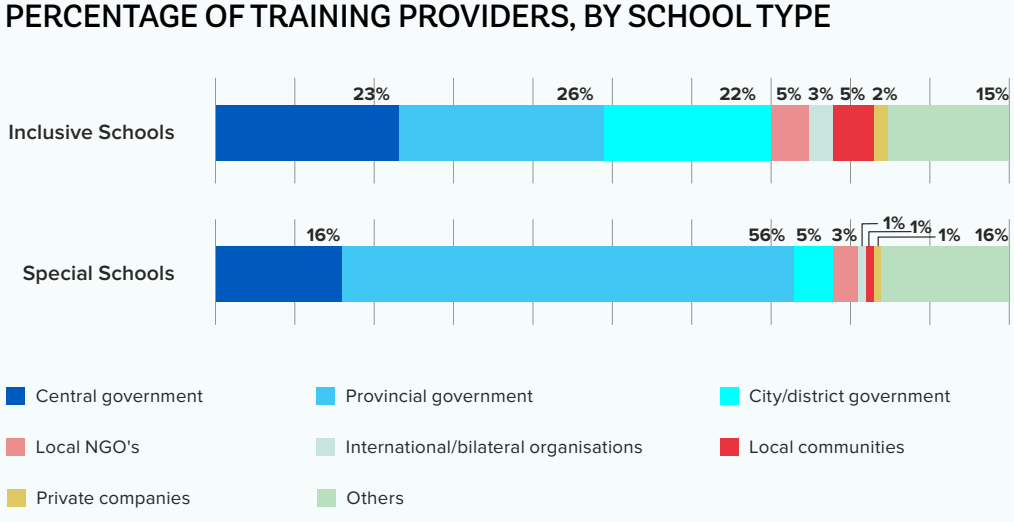
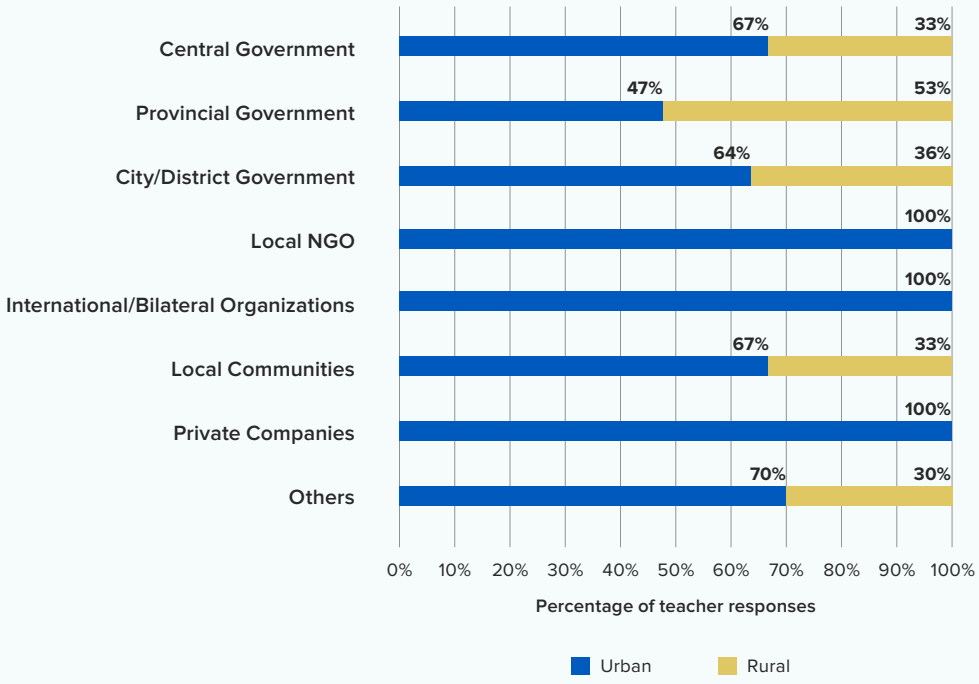


Figure 6: Percentage of training provider for inclusive schools, by region (n=65)



Catalogs, manual and access to information on AT is very limited in both inclusive and special schools. 96 percent of teachers trained on IE in inclusive schools and 86 percent of teachers in special schools do not have an AT catalog in their schools. Manuals for AT are also quite scarce in both types of school. 94 percent of GPK in inclusive schools and 78 percent of special education teachers do not have manuals to use AT in their schools. As for access to information on AT, 72 percent of teachers from inclusive schools reported difficulty in accessing information regarding AT. On the other hand, 48 percent of teachers from special schools had difficulty in accessing information. The differences between inclusive and special schools were statistically significant, and the gap may be caused by the fact that teachers in special schools tend to share information on AT among peers in the same school, as this study found in the follow-up FGD with teachers. Overall, most of teachers have no access to practical tools and information on AT, and teachers in inclusive schools are more likely to due to lack support.

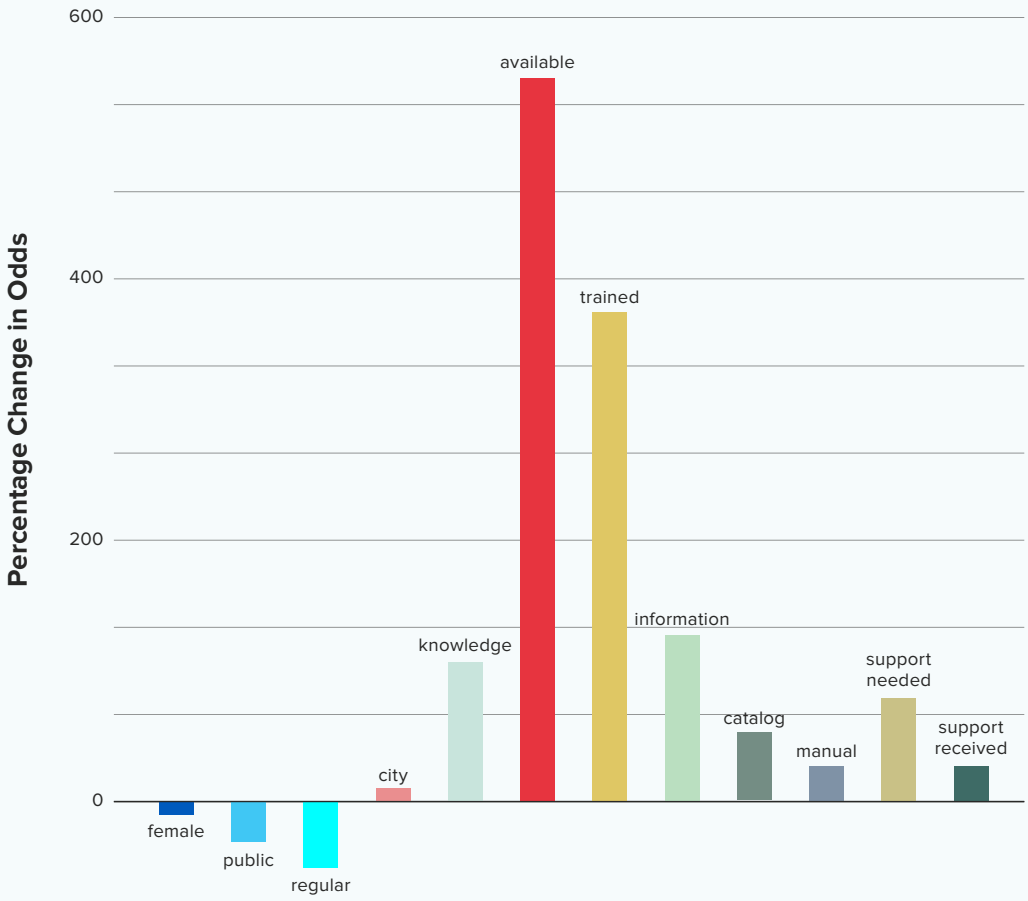
1.3 *Use of AT*

The use of AT is quite limited in inclusive schools, with over 60 percent of teachers trained on IE not yet using AT for children with disabilities. Only 38 percent (n = 155) of teachers in inclusive schools have used AT, while 76 percent (n = 1250) teachers in special schools have. The rate of use of AT was largely similar across education levels for both school types. While teachers in inclusive schools were slightly more likely to use AT at a primary school level, vocational high schools were least likely (42 percent of teachers using AT in primary, 36 percent in junior high, 41 percent in high school, 22 percent in vocational high school), Meanwhile special schools had almost the same rate of use regardless of level (75 percent of teachers using AT in special primary, 76 percent in special junior high, and 76 percent in special high school). There was no statistically significant association between education level and use of AT in inclusive nor special schools.

Teacher use of AT is strongly associated with availability of AT in school, teacher training and access to information. Since teacher use of AT is key to creating a meaningful change in learning quality and outcomes of children with disabilities, it is important to examine the key

factors predicting their behavior. Logistic regression was performed to establish the factors that can predict teacher use of AT for children with disabilities (see Table 12 in annex). The result shows that availability of AT in school and teacher training on AT has a strong association with actual use. The odds of using AT is more than 500 percent higher for teachers who have AT in their schools than for those who do not. Importantly, the odds of using AT are more than 350 percent higher for teachers who received training on AT than for teachers without training on AT. It indicates how important and crucial it is for teachers to have specific AT training. Ease of to access information about the types and uses of AT for children with disabilities also increases a teacher's odds of using AT by 122 percent. Having knowledge of AT to support children with disabilities also enhances the odds of teacher use by 110 percent. This suggests the importance of keeping teachers informed and updated of the current status of high-tech and alternative uses of low-tech. This result also relates to the finding in the previous section that the lack of updates on high-tech was the primary inhibitor of teacher creativity to make AT. All of these influences are statistically significant. On the other hand, the odds of AT use are almost 50 percent lower for teachers in inclusive schools than for special education teachers. Similarly the odds are 27 percent lower for teachers in public schools than for teachers in private schools. Both of these effects are statistically significant, indicating that focused support for public inclusive schools is a key policy strategy to increase teachers' use of AT in an equitable manner.

Figure 7: Factors associated with teachers' use of AT for children with disabilities (n=2056)



Assessment and Use of AT

In inclusive schools, how teachers assess whether a student needs AT can affect their use of AT. In addition to teacher observation and assessment, the odds of teachers using AT are increased by almost 66 percent if teachers consider student achievement with and without AT to decide whether the student needs AT. Similarly, teacher collaboration with health professionals in assessing the student needs for AT also increases the odds of actual use of AT by 46 percent. The odds of teacher use of AT increases by 42 percent if teachers consider students' preferences. The relationships between each of these assessment methods and teacher use of AT are statistically significant. The importance of collaboration with health professionals and assessment of student achievement with and without AT were distinctive methods to encourage teacher use of AT in inclusive schools, while other methods such as teacher assessment and students' preference also associated with use of AT in special schools.

Teachers in inclusive schools tend to lack specialized knowledge and support to identify suitable AT for children with disabilities. FGDs revealed that no teacher participants from inclusive schools have received special training on the use of AT, nor were they aware of any kind of official AT guides for teachers. In this context, collaboration with psychologists and doctors who can explain the special needs of each student can help with selecting appropriate AT and with such professional support, teachers in inclusive schools can then select AT to match each student's disability type, severity, individual learning challenges and education level. According to study findings, teachers in inclusive schools are more likely to rely on collaboration with health professionals in assessing AT needs than teachers in special schools, especially in urban areas, and the differences between school types and regions were statistically significant. Thus, ensuring support from the health sector is important in inclusive schools and focused measures may be needed in rural areas to ensure equity. In addition, guidelines on how to select and examine the effectiveness of AT on student achievement, considering students' preference, is necessary to enhance the use of AT for children with disabilities in inclusive schools.[33]

[33] Further discussions on issues with assessment of children with disabilities in inclusive schools in Indonesia can be found in "Embracing Diversity and Inclusion in Indonesian Schools: Challenges and Policy Options for the Future of Inclusive Education". 2021, https://documents.worldbank.org/en/publication/documents-reports/documentdetail/535361634052935364/embracing-diversity-and-inclusion-in-indonesianschools-challenges-and-policy-options-for-the-future-of-inclusive-education

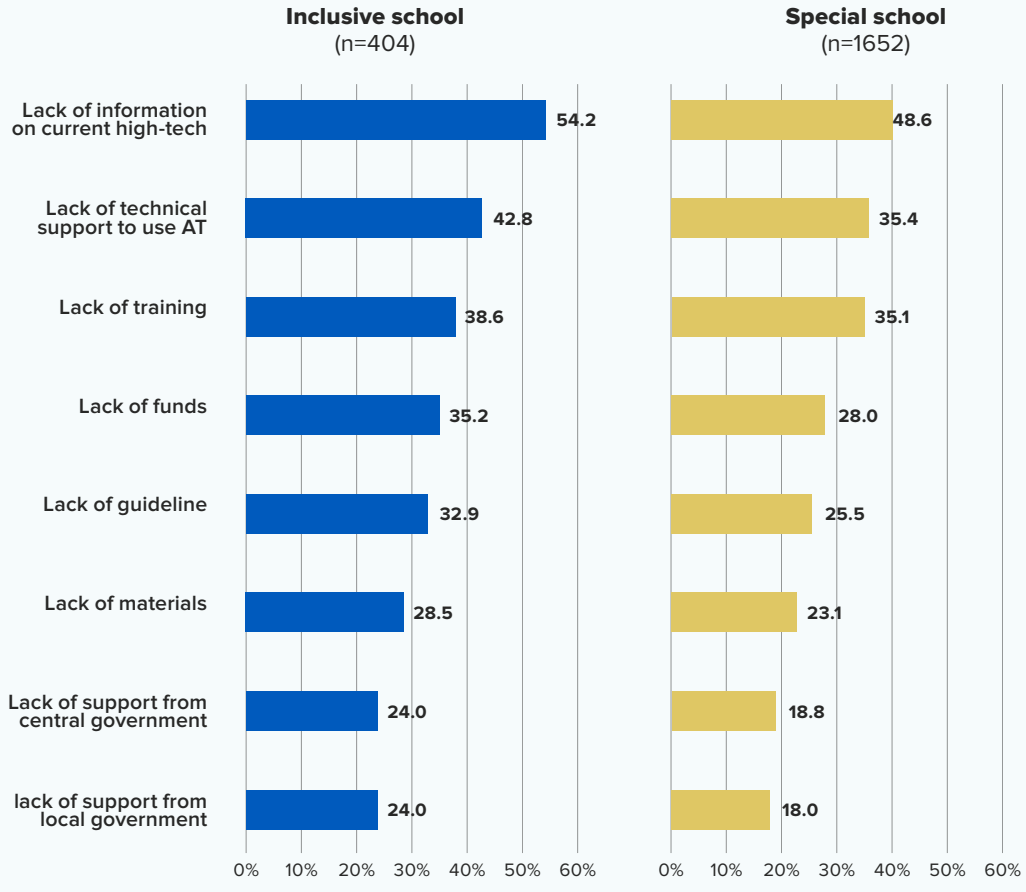
1.4 *Challenges*

1. Creating AT

Almost 70 percent of teachers in inclusive schools and 50 percent of teachers in special schools have not created AT to support children with disabilities. In Indonesia, where the use of high-tech AT for children with disabilities are still limited especially in inclusive schools, low-tech options such as picture cards can be more feasible and be produced by teachers using local materials. FGDs with policy makers in MoECRT found that they expected teachers to create low-tech AT for children with disabilities. However, the survey result shows majority of teachers have never created AT, reaching almost 70 percent of teachers in inclusive schools and 50 percent in special schools. The gap between inclusive and special schools is due to multiple barriers; very limited access to information, guideline and manual, all of which are common in both types of school but more severe in inclusive schools, making it difficult to create AT. The results indicate a mismatch between the central government's expectation of teacher capacity and limited number of teachers who can actually create AT due to the scarcity of adequate support. Given the fact that even in special schools one in two teachers have not created AT, there is a need for a basic guideline on creating AT for teachers in both inclusive and special schools.

The most prevalent reason for not creating AT is the lack of information on high-tech AT and lack of technical support to use it. Creating AT can become easier if teachers know about the key functions of it and which high-tech is suitable for each student depending on type and severity of disability, and how it helps to enhance students' specific skills (e.g., reading, calculating, communicating) to bring better learning outcomes. While all high-tech may not be replaced by low-tech, low-tech can provide great support for inclusive approaches to meet individual needs of children with disabilities. Low-tech is a more realistic and practical solution for many teachers in Indonesian schools where resources are limited. This result confirms the need for teacher guidelines, including up-to-date information on AT, disaggregated by types of disabilities along with follow up technical support for practical use.

Figure 8: Reasons for not creating AT, by school type



Nearly 50 percent of teachers who have created AT largely rely on social media such as YouTube, but for those who are trained on AT, government information is their primary resource. 46 percent of teachers relied on YouTube and other social media, followed by other training by government, others, peer teachers, training by international/bilateral organisations, and local NGOs. This distribution of information source was largely the same regardless of school type (inclusive or special) or city/village. However, differences were found depending on teacher experience of training related to AT. Teachers trained on AT primarily used knowledge gained from official sources, while teachers with no training on AT rely on social media (50 percent) more than total average. This is because teachers without enough training on AT tend to use YouTube as the only source, rather than additional, because they often struggle to find reliable official resources related to inclusive pedagogy for children with disabilities (World Bank, forthcoming). However, school actors often doubt the reliability of information from social media and need official guidelines as their main reference (ibid). The FGDs confirmed that teachers face the same issue with AT. Thus, providing training is key, and the training content can be revisited to include how to create AT.

Figure 9: Source of information to create AT

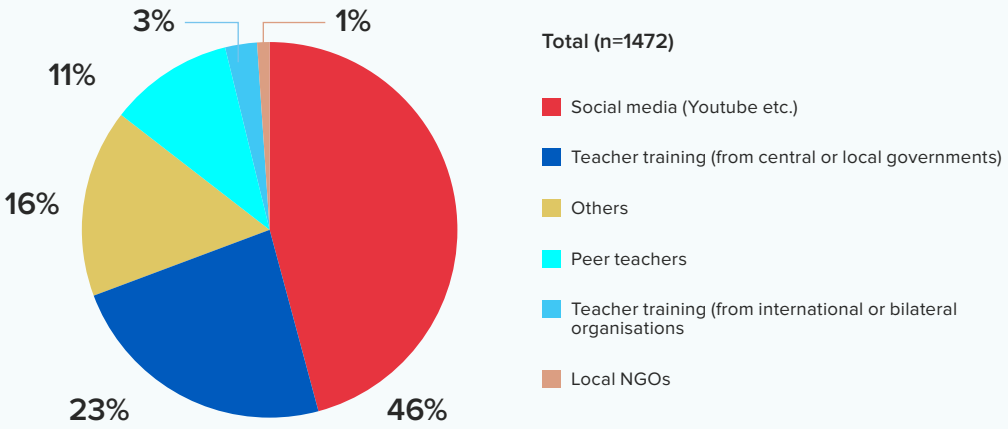
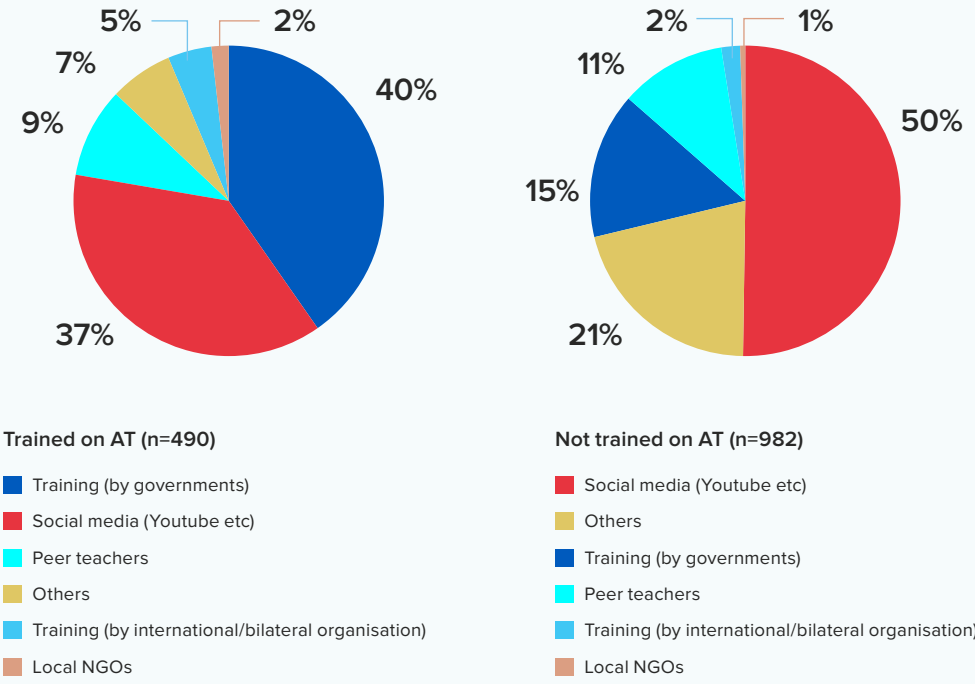


Figure 10: Source of information to create AT, by teacher training status



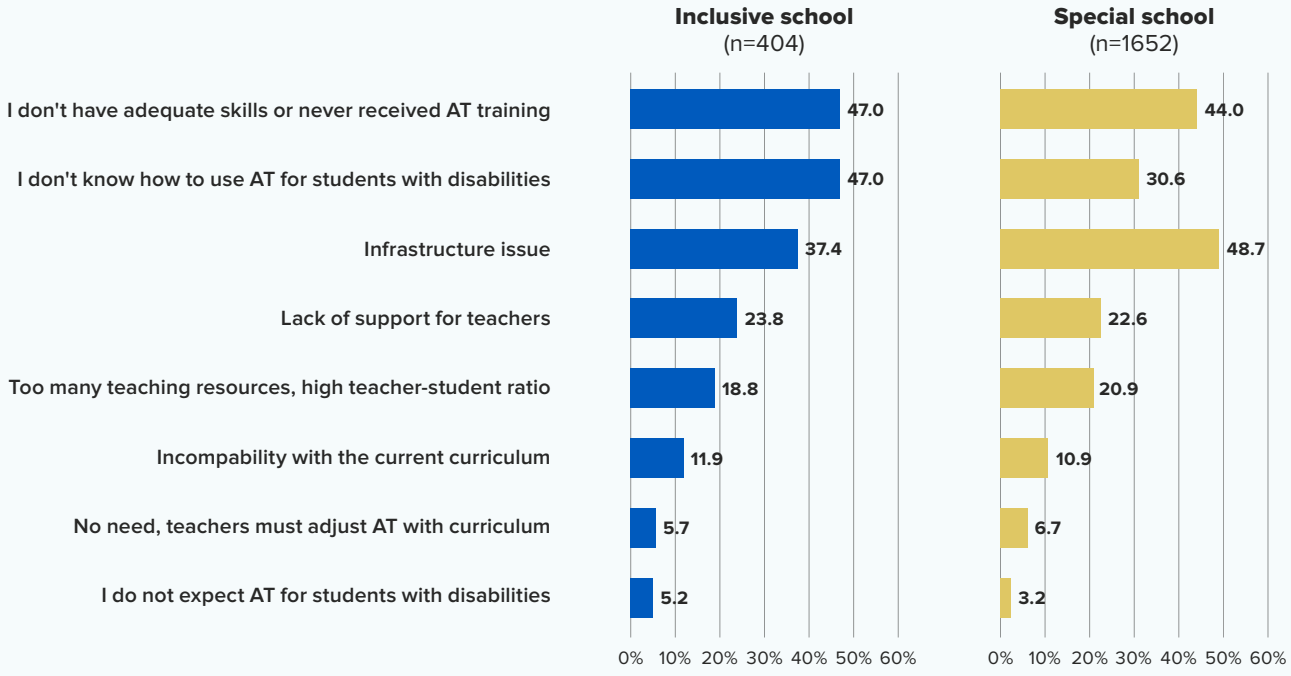
2. Lack of teacher skills and supporting mechanisms

The biggest challenges for teachers to use AT relate to skills, training on AT for children with disabilities, and knowledge. Approximately 40 percent of teachers from inclusive and special schools expressed that they do not have adequate skills or never received AT training. 39 percent of teachers in inclusive schools expressed they do not know how to use AT for students with disabilities. The result shows many teachers do not feel competent in using AT for students with disabilities unless they are trained. The FGDs found that some central government officers tend to put the responsibility on teachers to solve AT related issues on their own, and only send encouragement to teachers without providing adequate training first, further making teachers feel helpless. Thus, training should be provided first, and training should be practical enough to give teachers confidence.

Infrastructure issues were also common including limited hardware, indicating the need to clarify responsibilities in supplying and ensuring the quality of high-tech AT. 30 and 46 percent of teachers from inclusive and special schools respectively raised infrastructure issues as one of key barriers to use AT. Based on FGDs with teachers, maintenance of high-tech can become an issue in some special schools where high-tech such as braille machines and computers with software are needed for students with visual and hearing impairments. Moreover, some special schoolteachers expressed frustration at the lack of supply of new AT, with some schools waiting for years. These issues indicate a need for regular monitoring by the government to examine to what extent high-tech is used or not and why, to improve the effectiveness and efficiency of use of limited resources. It is also key to clarify who is responsible to supply AT for children with disabilities in schools.

Nearly 20 percent of teachers from inclusive and special schools raised an issue of many teaching resources and high teacher student ratios as barriers to use AT for children with disabilities. High teacher-student ratios especially in inclusive school settings, where one trained teacher may take care of multiple students with diverse needs, so it is necessary to strengthen supporting mechanisms for teachers at a school level. This may be related to the scarcity of GPKs which means that an inclusive school may only have one GPK who has to take care of multiple students with diverse learning needs in limited amount of time. Thus, it is required to strengthen supporting mechanisms for teachers at a school level.

Figure 11: Percentage of key challenges for teachers to use AT by school type

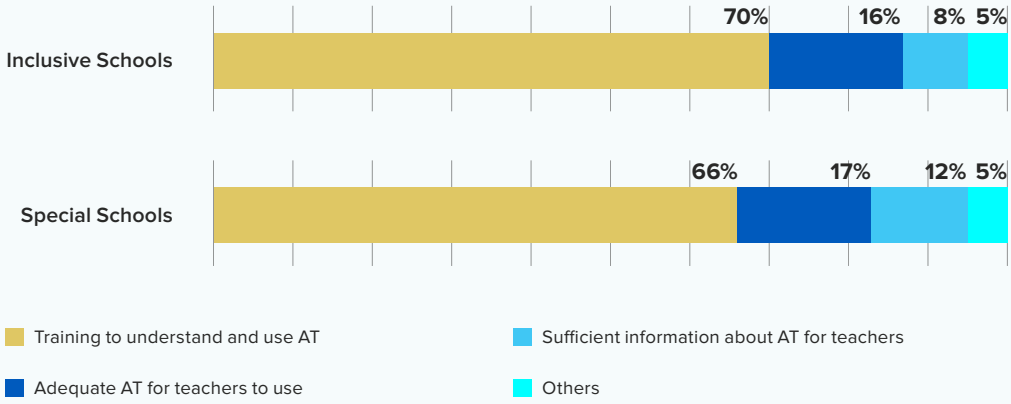


1.5
Support needed

The majority of teachers, including 80 percent of teachers in inclusive schools and 85 percent of teachers in special schools reported that they need additional support to use AT for children with disabilities. 84 percent of teachers (n= 1718) have needed additional support to use AT for children with disabilities both in inclusive and special schools. However, many teachers cannot gain additional help, and teachers in inclusive schools are less likely to get support compared to special school teachers. However, their needs are often unmet. Among teachers who need additional support, 40 percent of teachers in inclusive schools expressed they have not received the support they need. Similarly, 35 percent of teachers in special schools cannot get additional help. While teachers from both schools seem to face similar issue, teachers in inclusive schools are less likely to gain additional help to use AT compared to special school teachers, and the difference is statistically significant.

Training to understand and use AT is the most needed support for teachers in both inclusive and special schools, followed by adequate AT and sufficient information for teachers. Nearly 70 percent of teachers in inclusive and special school prioritized teacher training on AT as key support they need to be able to utilize AT for children with disabilities in their schools. Almost 20 percent of teachers requested provision of adequate AT, and accessible information about AT was also needed.

Figure 12: Types of support needed for teachers to use AT for children with disabilities (n IS=348, n SS=1580)



3.3.2 Analysis of data disaggregated by types of disability and AT

This section analyzes the teachers' use of AT disaggregated by types of disabilities and AT, covering LD, ASD, ADHD, ID, SD, hearing impairment, visual impairment, and physical disabilities, followed by a summary of this section.

1. Learning disabilities

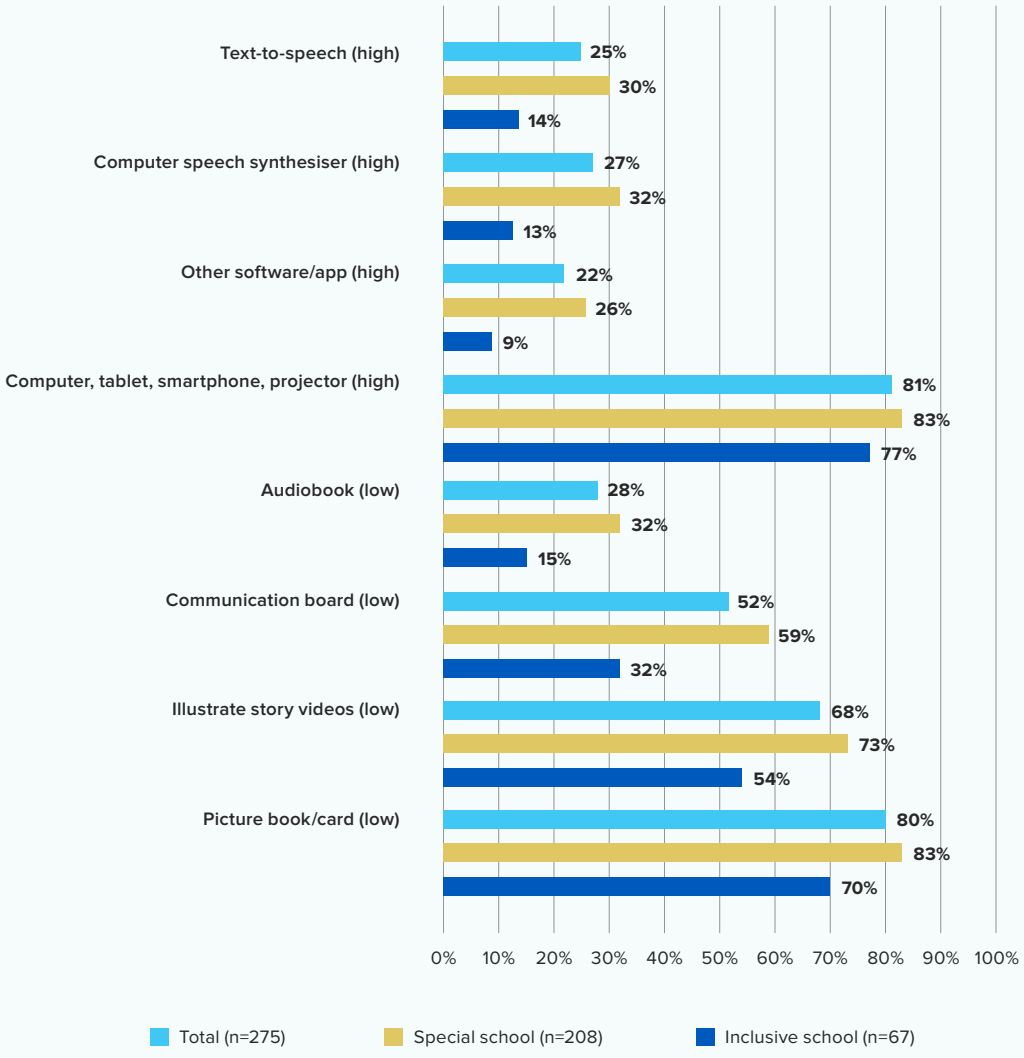
High-tech

The use of high-tech, especially text-to-speech and other software/applications is limited in both inclusive and special schools. As for high-tech, 25 percent of teachers use text-to-speech for children with learning disabilities, including 14 percent in inclusive school and 30 percent in special school. Other software/apps are almost unused in inclusive schools accounting for merely nine percent of teachers having children with LD, while the percentage goes up to 26 percent in special school. Thus, globally common AT for children with LD, such as text-to-speech, is used only by one-in-four teachers supporting children with LD in Indonesia, and the usage decreases to approximately one in ten teachers in inclusive schools.

Low-tech

Even with low-tech AT, teachers lack knowledge of appropriate use. While the use of low-tech is more common than high-tech for LD students, picture card tends to dominate in inclusive schools. Diverse use of low-tech to enhance the effectiveness of low-tech for different disability types within LD may be lacking due to teachers' limited knowledge caused by lack of focused official training. As for low-tech, audiobooks are used by nearly 30 percent of teachers, and the percentage drops to 15 percent in inclusive schools. Other low-tech AT is more popular both in inclusive and special schools, including communication boards (52 percent), illustrated story videos (68 percent) and picture book/cards (80 percent). While low-tech is more commonly used than high-tech for LD students, the effect may be limited unless teachers to know how to adapt and use it for different disabilities such as dyslexia, dyscalculia and dysgraphia. FGDs found that teachers in inclusive schools tend to use picture cards, such as letter cards for dyslexic children to learn how to distinguish the letter d and b at primary school level. However, FGDs found that there was a perception among teachers in inclusive schools that their knowledge about children with disabilities is very minimal, partly due to the lack of specific training on AT. Teachers reported that even if one inclusive school has four GPKs (teachers trained in IE), their knowledge tends to be equally limited. It indicates merely increasing the number of GPK per inclusive school does not necessarily help to improve the use and effectiveness of AT for different disability types within LD, based on the current teacher training system for IE that cannot provide highly skilled teachers in inclusive schools.

Figure 13: Percentage of High and Low Tech used for children with learning disabilities including Dyslexia, Dysgraphia, Dyscalculia



Source: AT survey 2022

2. ASD

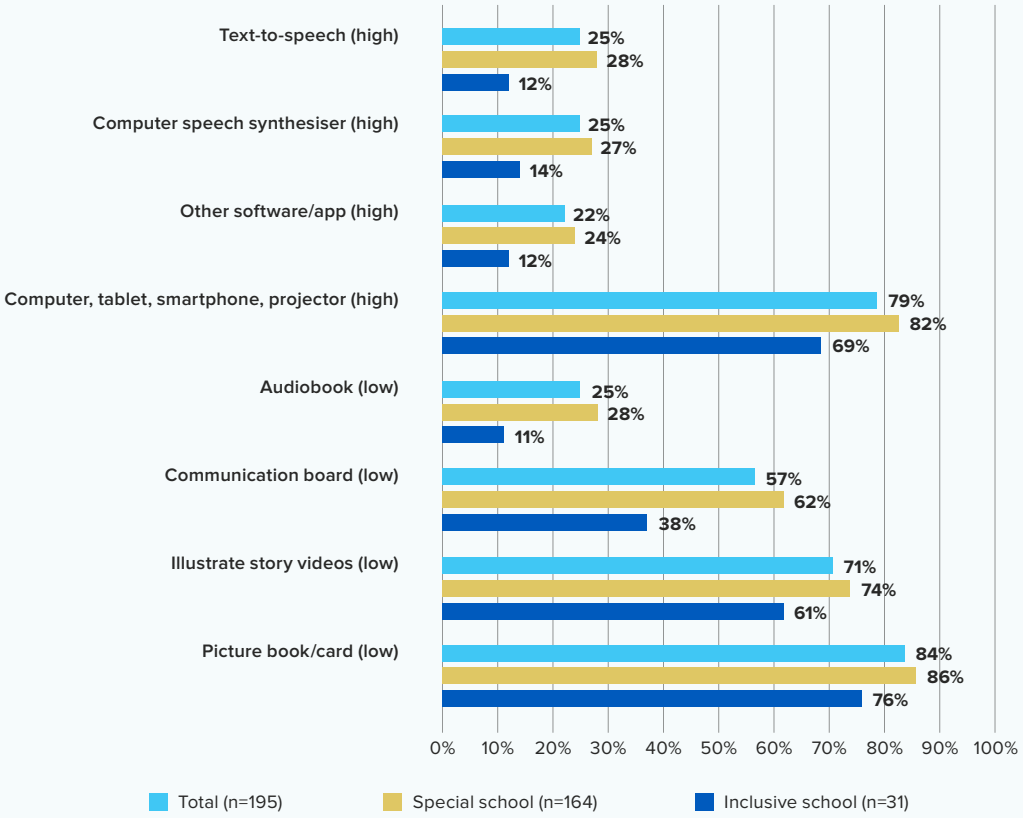
High-tech

The combination of tablet and applications is commonly used for students with ASD by teachers, with variations in type of school and location. The use of high-tech is often limited to special schools, and inclusive schools in urban areas, and the use of high-tech to support communication of students with ASD is unknown. FGDs with teachers revealed that in special schools, teachers use tablets with applications such as ibisPaint to teach how to draw, and Canva to teach vocabulary and stories for children with ASD. In inclusive schools, teachers in urban areas such as Padang city, West Sumatra and Yogyakarta use online learning applications including quizzes and wordwalls. However, gaps between school types (special school versus inclusive school) and region (urban versus rural) exist. Teachers in special schools are more likely to use high-tech for students with ASD than teachers in inclusive schools, and the difference was statistically significant. Among inclusive schools, teachers in urban areas are likely to use high-tech, but this may not be the case in rural areas. The regional gaps in high-tech used for students with ASD were statistically significant for inclusive schools, but not for special schools. Moreover, use of high-tech to support communication of students with ASD is unknown. Teachers in special schools emphasized that tablets and applications help students with ASD to focus and learn better through playing games.However, the use of high-tech to support communication of students with ASD was not articulated during FGDs by teachers from either special or inclusive schools. As for training, some teachers from special schools learned how to make learning videos from a training offered by the Directorate of PMPK, but others learned from YouTube because they had no access to training. As for procurement, in special schools, some school principals use BOS funds to purchase tablets. For example, a teacher in special school in West Papua reported that tablets are purchased to support learning for all children with a variety of disabilities by the school through the performance BOS funds, at the discretion of the school principal. On the other hand, school principals from inclusive schools emphasized that the BOS funds are insufficient, and schools need additional funds to provide AT for children with disabilities. Thus, high-tech especially tablet and allocations for students with ASD is used by some teachers specifically in special schools and inclusive schools in urban areas, but how to use high-tech to support communication skills may not be well recognized. The limited use and purpose of high-tech partly results from the lack of training and school fund for AT in inclusive schools, especially those in rural areas.

Low-tech

While low-tech is more commonly used for children with ASD than high-tech, teachers especially in inclusive schools may not have adopted low-tech to meet and address specific needs and skills of these children. The survey revealed that low-tech was often more commonly used for children with ASD than high-tech by teachers in inclusive and special schools. FGDs with teachers in inclusive school found that teachers in inclusive primary schools in urban areas create and use word cards and picture cards. For example, one teacher from Padang city, West Sumatra gained knowledge and skills to make low-tech from a local university. However, how teachers in inclusive schools use low-tech to meet specific needs of children with ASD was not clearly articulated during the FGDs. Thus, low tech for improving social skills such as video modelling or script training, as learned from international practices, may be limited among teachers who teach children with ASD in inclusive schools. This may be partly due to the lack of training on AT to meet specific needs of children with different types of disabilities. As a challenge faced in special school, while some teachers use audiobooks for children with ASD to learn how to read short stories, teachers need to find materials on their own via google, for example, which often contains advertisements which are sometimes disturbing to children. Thus, while low-tech is used for children with ASD, the linkage between the use of low-tech and specific skills of children with ASD is unclear, and teachers often prepare low-tech by themselves, but some downloadable audiobooks often have irrelevant advertisements that disrupt the learning of children with ASD.

Figure 14: Percentage of High and Low Tech used for children with ASD



Source: AT survey 2022

3. ADHD

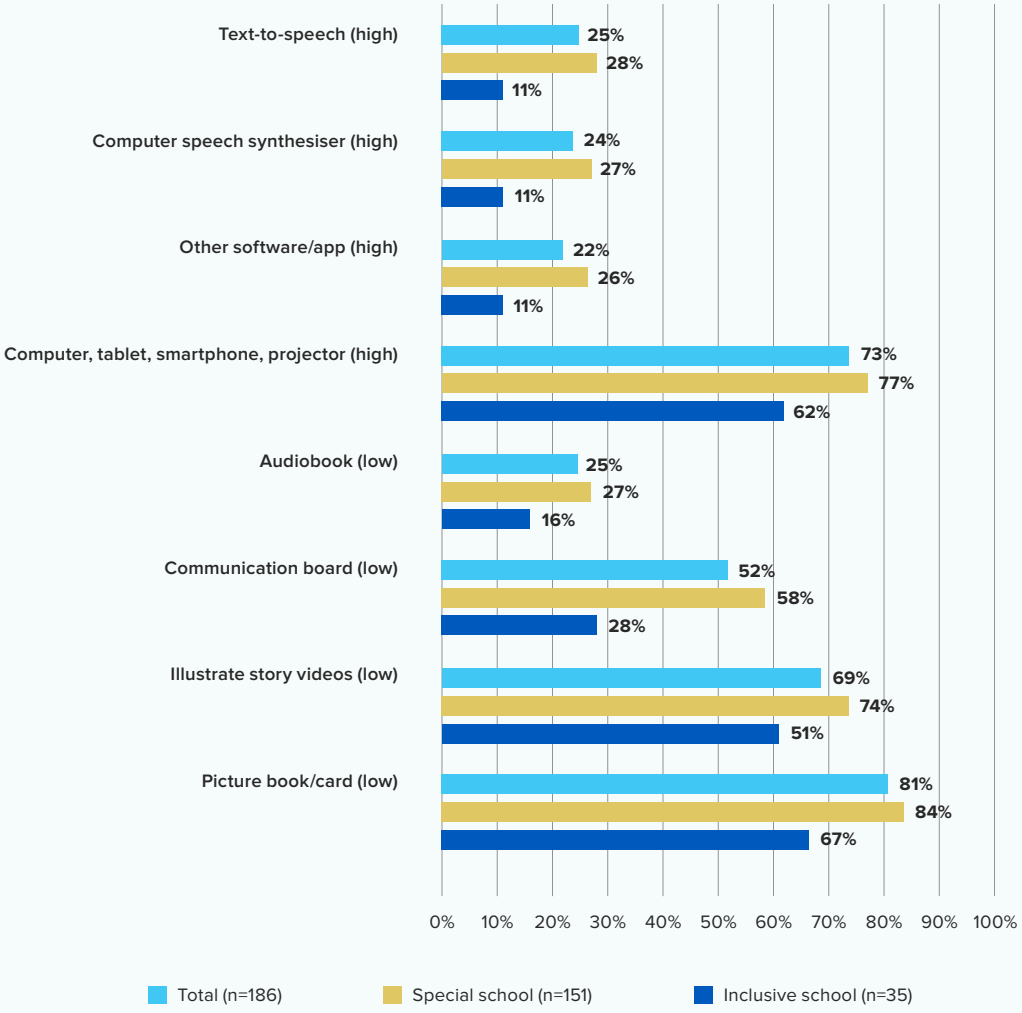
High-tech

It is common that inclusive and special schools have no specific AT for children with ADHD, and even if they have, their teachers may not know how to use them to support learning. For children with ADHD, high-tech can include applications and electronic devices such as timers to support their concentration to complete certain tasks. However, use of high-tech was limited in both regular and special schools. One special school had a tablet which was gained through central government assistance, but how they use it with children with ADHD is unknown.

Low-tech

Low-tech may not be adjusted to needs of children with ADHD, and special rooms are often used for them. FGD with teachers revealed teachers sometimes difficult to help children with ADHD to learn, and sometime these children are sent to a special room which has badminton rackets, gymnastic balls and others to 'improve' behavior of children with ADHD in inclusive schools because teachers think these children have problems with behavior. While one teacher from inclusive primary school reported making a schedule for children with ADHD, it was to give periodic 'interventions' in a special room, rather than to help children to learn how to concentrate on learning and/or specific tasks. Similarly, in special schools, a special room was often used to hold activities for children with ADHD who have difficulty in concentrating. For other teachers from inclusive or special schools, they reported no specific AT for children with ADHD. One private special school provided audiobooks with support from parents, however, teachers in special schools expressed that they observe behavioral problems, and even if they have audiobooks the number was limited and thus used for only a certain number of children. Moreover, while some schools have picture cards or puzzles, they did not seem to know how to use them to meet specific needs of children with ADHD. Thus, the current use of AT may not always be adjusted to the characteristics of children with ADHD, and special rooms are often used for them to calm down.

Figure 15: Percentage of High and Low Tech used for children with ADHD.



Source: Created by the authors based on the AT survey 2022 conducted through this study

4. Intellectual disabilities

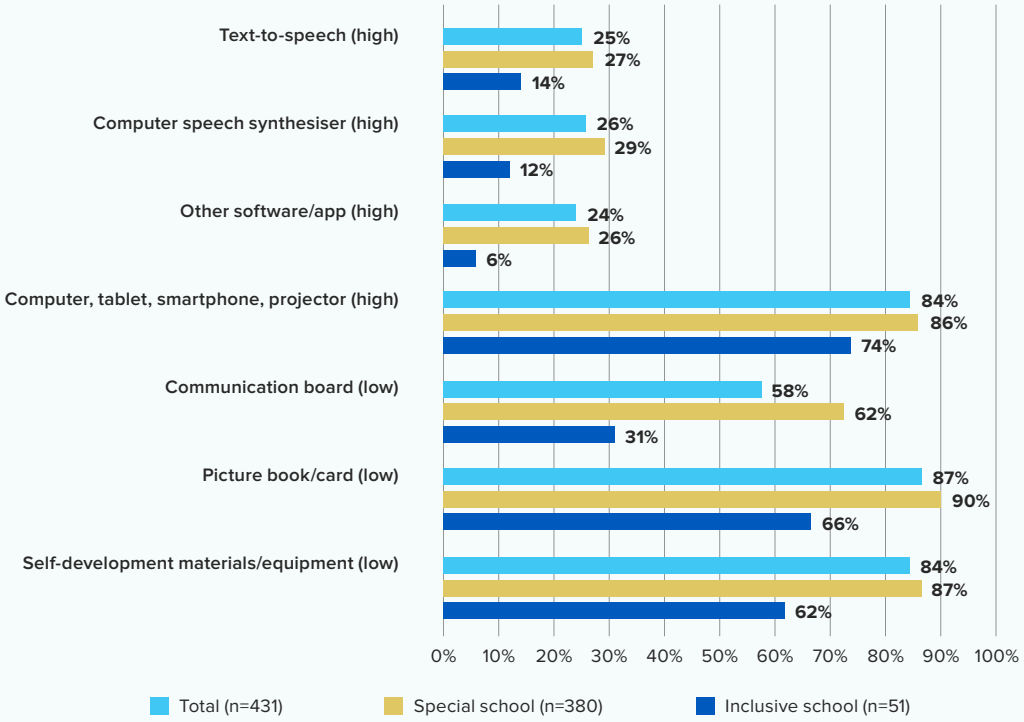
High-tech

The combination of high and low-tech can bring better learning experiences for children with ID. These can include illustrated stories with laptops to teach self-development contents including how to take care of themselves. Some teachers in special schools use pictures and illustrated stories with their laptop to teach how to take care of themselves, finding that children with intellectual disabilities understand and enjoy the contents more easily, with laptop rather than using picture books/cards only. Teachers often use pictures, materials and textbooks provided by the Directorate of PMPK. However, teachers in Papua expressed that they have a challenge to find learning tools for children with ID. Another teacher from a special school uses a laptop for children with IE, but due to the limited number of laptops, teachers only use them occasionally. Some teachers use applications for exams, but it is very limited due to the lack of AT and teacher ability.

Low-tech

Collaboration between inclusive and special schools can enhance the quality and effectiveness of AT for children with ID. FGDs with teachers found that a teacher from inclusive high school uses low tech to teach specific subjects and uses learning videos borrowed from special schools in the vicinity. As a good practice, this school collaborates with special schools to provide AT, and teachers in inclusive schools study together with the special school to better understand the children and determine the type of AT that is suitable for them. Thus, collaboration with special schools can help to make low-tech that is adjusted to specific needs of children with ID.

Figure 16: Percentage of High and Low Tech used for children with intellectual disabilities.



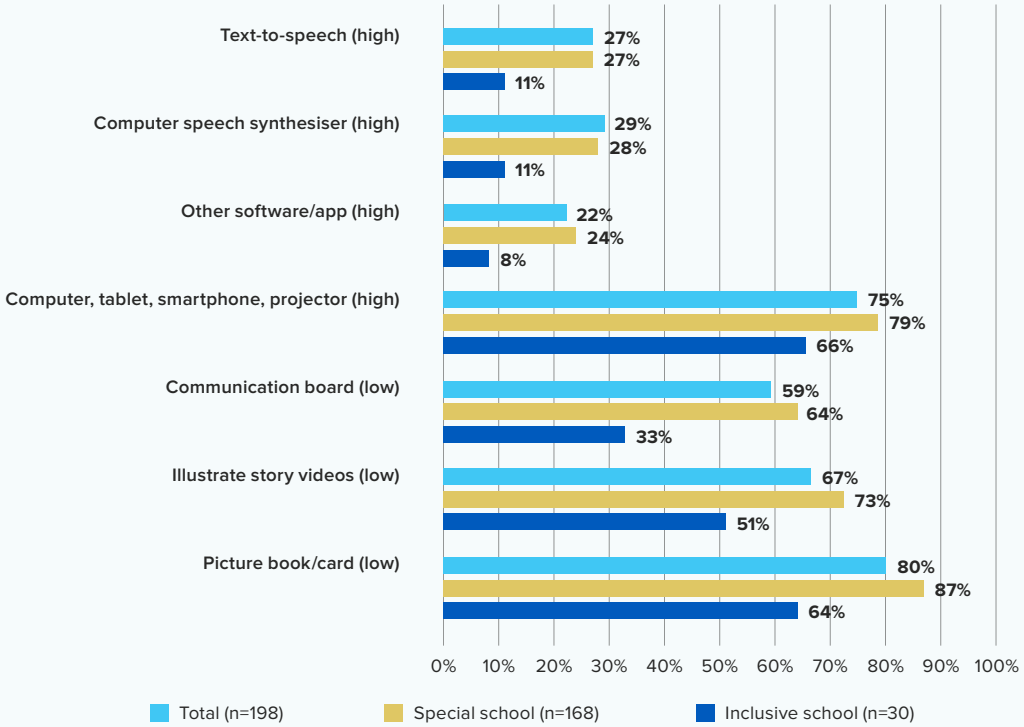
Source: Created by the authors based on the AT survey 2022 conducted through this study

5. Speech disorder

High and Low Tech

The use of high-tech for children with speech disorder is very limited in inclusive schools, and most high-tech is used by only around 10 percent of teachers, except for hardware. Low-tech, especially picture book/cards is widely used by around 60 percent of teachers in inclusive schools, and almost 90 percent of teachers in special schools.

Figure 17: Percentage of High and Low Tech used for children with speech impairment.



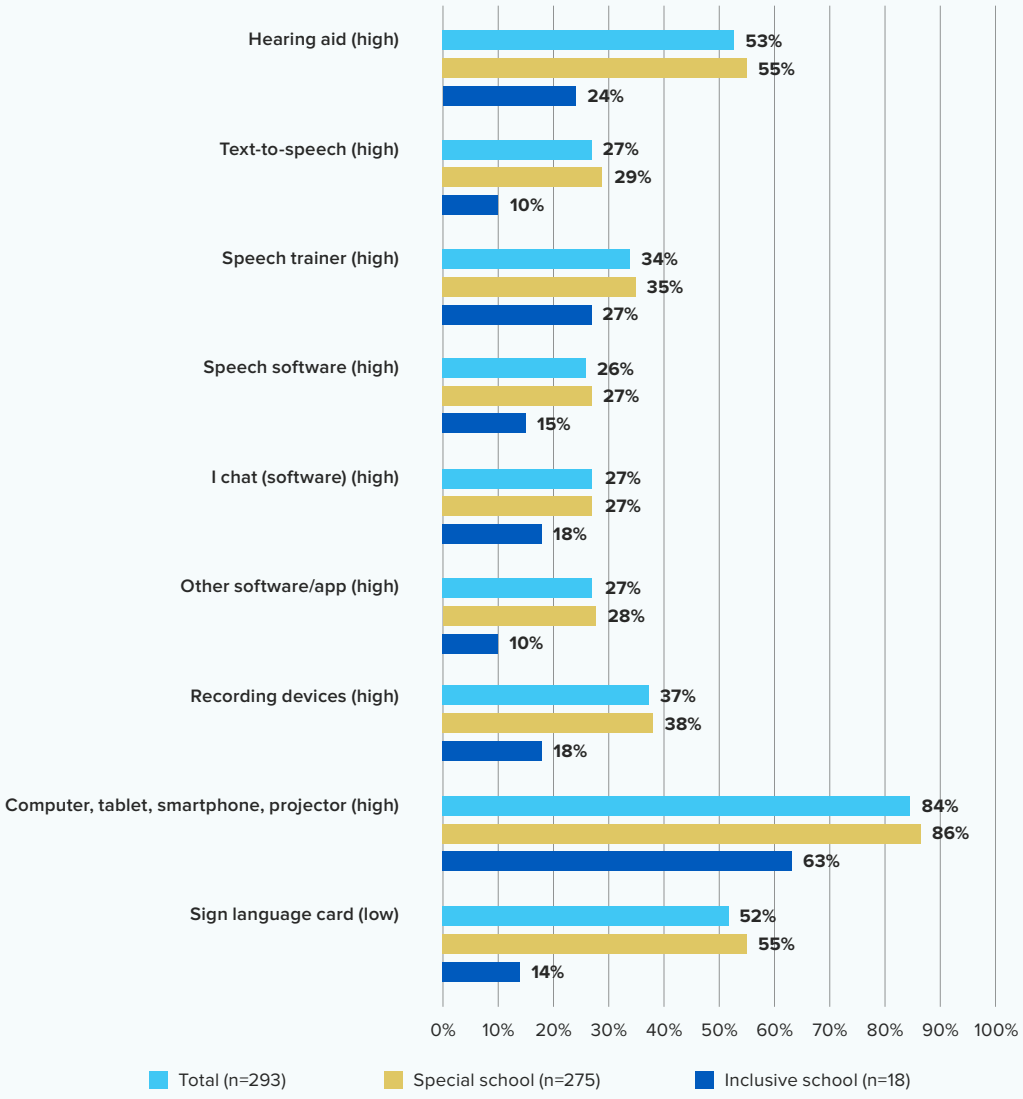
Source: Created by the authors based on the AT survey 2022 conducted through this study

6. Hearing impairment

High and Low Tech

While hearing aids and high-tech is used in some special and inclusive schools, usage is still limited, and maintenance and teacher training is lacking. Hearing aids for students are used by 55 percent of teachers in special schools, and 24 percent of teachers in inclusive schools. Text-to-speech is used by approximately 30 percent of teachers in special schools and 10 percent of teachers in inclusive schools. Speech trainers are used for students with hearing impairment, accounting for 35 percent of teachers in special schools and 27 percent of teachers in inclusive schools. FGDs with teachers, however, identified that high-tech is still limited even in special schools and some of them are broken and cannot be used. Teachers also reported they have limited training on the use of tools for children with hearing impairments. As for low-tech, sign language cards are used by 55 percent of teachers in special schools but only 14 percent of teachers in inclusive schools. Thus, a clear guide on the list and how to use AT for children with hearing impairment is needed for both special and inclusive schools and the maintenance issue should be addressed especially for high-tech.

Figure 18: Percentage of High and Low Tech used for children with hearing impairment.



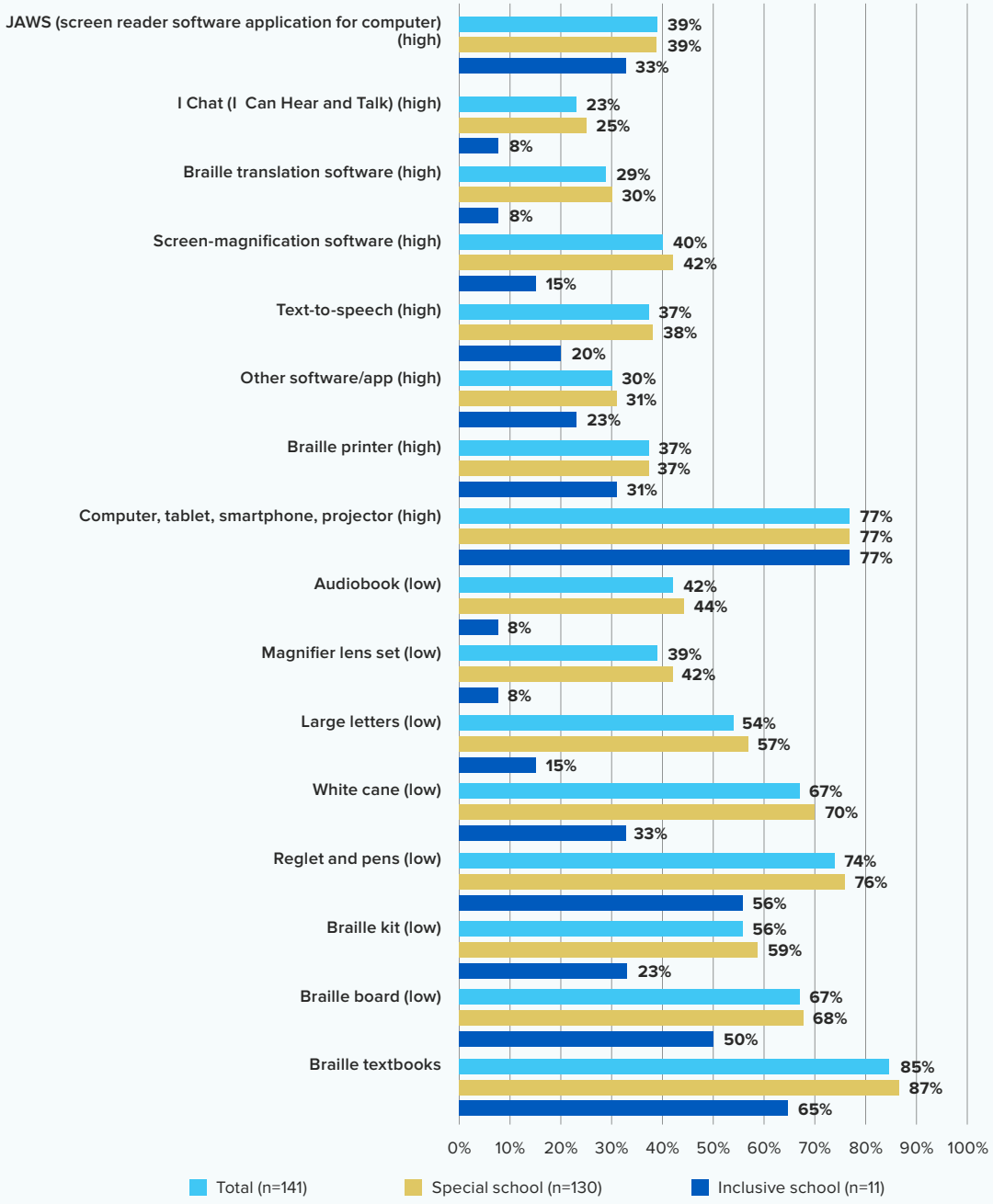
Source: Created by the authors based on the AT survey 2022 conducted through this study

7. Visual impairment

High and Low Tech

Schools may have screen readers and braille printers, but teachers do not always know how to use them. A combination of the JAWS application (screen reader app) with hardware such as computers or mobile phones is used for students with visual impairments in special schools. However, teachers are not always trained to use JAWS program. In a special school in Bali, teachers received no training on JAWS from the provincial government, so teachers train students and students teach each other. Braille printers are used by approximately 40 percent of teachers in special schools and are often purchased with BOS funds through the local government. It is also common, however, that teachers have received no official training or information on AT. Among low-tech, traditional tools such as Reglet, Braille textbooks and Braille boards are used for children with visual impairment by over 50 percent of teachers in both inclusive and special schools. On the other hand, audiobooks are less common in inclusive schools, used by only eight percent of teachers, while 44 percent of teachers in special schools have used them.

Figure 19: Percentage of High and Low Tech used for children with visual impairment.



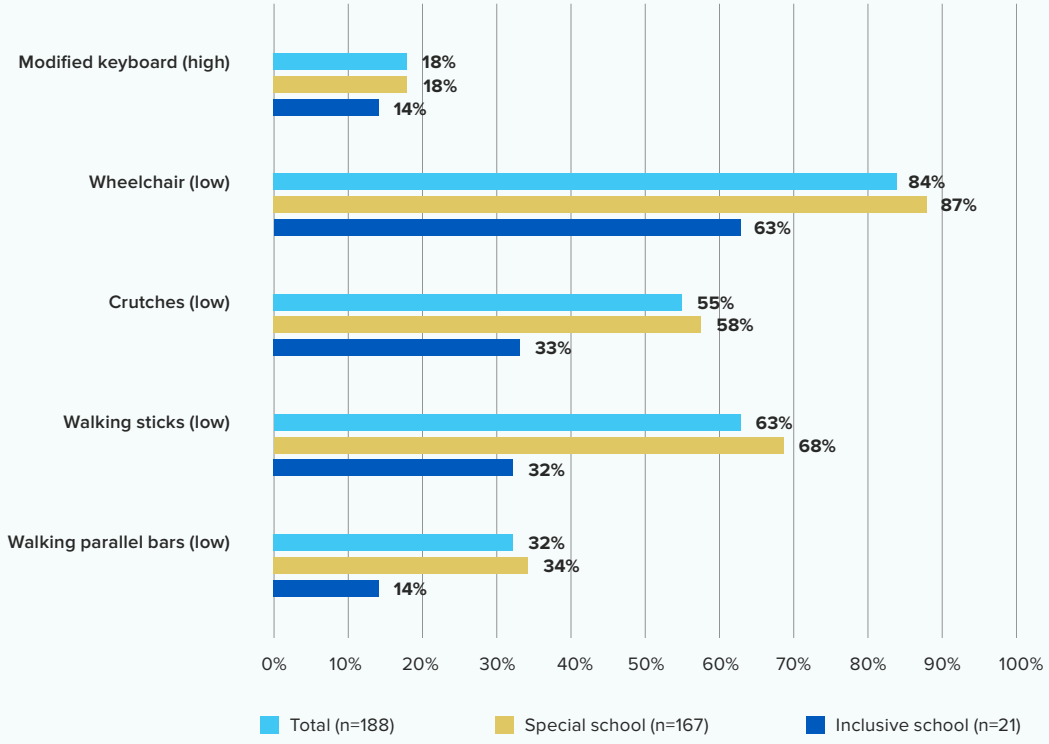
Source: Created by the authors based on the AT survey 2022 conducted through this study

8. Physical disabilities

High and Low Tech

While the use of AT for children with physical disabilities largely depends on their condition, modified keyboards can be used to facilitate the use of computer for some students. The usage of modified keyboards is limited to below 20 percent in both special and inclusive schools. On the other hand, more than half of teachers who have taught children with physical disabilities have assisted them with wheelchairs, reaching 63 percent in inclusive school and 90 percent of teachers in special school.

Figure 20: Percentage of High and Low Tech used for children with physical impairment.



Source: Created by the authors based on the AT survey 2022 conducted through this study

9. Summary of the section

In summary, the analysis of disaggregated data identified that the use of high- and low-tech varies by disability type. However, as a cross cutting issue, use of high-tech is still limited in all the types of disabilities focused on in this study. Even if teachers use high-tech and/or low-tech, AT may not always be used to meet the specific needs and/or skills for different types of disabilities, due to the lack of training and guidelines on AT in both inclusive and special schools.

4 Conclusion and Recommendations

4.1 Conclusion

This study has holistically analyzed AT used for children with disabilities in Indonesia in both inclusive and special schools, from primary to secondary education, in relation to current availability and usage, challenges and support needed. This study also set out to examine the relationship between teacher use of AT for children with various types of disabilities and school conditions, teacher training and provision of materials and support.

This study highlights the limited availability and use of AT by teachers for children with disabilities especially in inclusive schools, due to wider structural issues rather than merely the capacity of teachers and schools. One of the main obstacles for the limited use of AT is the lack of regulations and guidelines on the comprehensive list of AT including high-tech and low-tech, for different types of disabilities, for teachers and principals in both inclusive and special schools as well as local governments. Current regulations related to AT for children with disabilities often omits children with disabilities in inclusive schools especially those with LD, ASD, ADHD and SD. In addition, AT is often narrowly understood in regulations as mere materials rather than as an important medium to support the learning and independence of children with disabilities who have different needs and to enhance inclusion in regular classrooms. The lack of clear guidelines from the central government often prevents schools and local governments from understanding what kind of AT they can use and purchase to support their students, by keeping certain children with disabilities and AT off existing financial schemes. Existing financial schemes for schools, that can be used for procurement of AT, are restricted by the central governments' regulations and tend to predetermine AT options, thus preventing an open process of decision making by school principals, teachers and other key stakeholders who better understand the needs. Further, current teacher training on IE does not clearly cover AT used for children with disabilities. Analysis of survey data reveals not only the lack of access to AT and teacher training but also the lack of accessible information, manual and additional support for teachers, which often prevents them from creating low-tech using local materials or using diverse AT, combining low and high-tech to meet the unique needs of individual children.

There is an urgent need for a shift in IE policy and the service delivery model, to place children with disabilities in the frame of debate on quality of education in Indonesia. Despite the structural issues, FGDs with multiple stakeholders identified how issues faced by teachers are hardly recognized by policy makers at the national level. Instead, the lack of attention to AT in regulation and training was sometimes justified because of the assumption among some policy makers that IE practice in Indonesia is still at the level of disseminating the idea of IE and increasing access. Similarly, local governments often do not have mechanisms to support procurement and training on AT used for children with disabilities. However, quality of teaching is as important as increasing access because children with disabilities can drop out if they merely access schools where there are no qualified teachers to provide adequate support (World Bank, forthcoming). Moreover, even if the school has one GPK, their knowledge and skills may not be enough to support learning of children with disabilities. In fact, this study revealed that the majority of GPK need additional training regarding AT, which is necessary for inclusive pedagogy. Hence, a shift in the service delivery model is required. The priorities should be revamping regulations, teacher training and supporting mechanisms for teachers, with an aim to improve not only access but also educational outcomes that contribute to reducing the existing forms of inequalities experienced by children with disabilities.

4.2 Recommendations

Recommendations propose changes to be made at a central, local and school levels, including 1) developing regulations and guidelines on AT, 2) improving procurement process of AT and expanding collaboration, and 3) developing teacher training on AT and supporting mechanisms. The key recommendations for the central government are to develop and revise regulations, guidelines, funding schemes and teacher training on AT to make them truly 'inclusive' by including all children with different types of disabilities in both inclusive and special schools. A main recommendation for local governments is for them to fulfil their responsibilities to allocate funds for procurement of AT, offering training on AT, and promoting collaboration with multiple stakeholders. Recommendations for schools focus on strengthening supportive mechanisms for teachers by developing school plans and budgets regarding provision of AT, teacher training, and multi-disciplinary assessment of AT. The summary of recommendations is shown below, followed by each recommendation in detail.[34]

Summary of Policy Recommendations

Recommendations	Timeline	Estimated impact	Implementation Arrangement
a. Develop Regulations on AT and Guidelines			
Develop a Regulation on AT for children with disabilities in inclusive schools, which allows governmental support for both high and low tech	Short	High	Central (PMPK)
Establish a Regulation on AT for all children with disabilities including those with LD, ASD, ADHD or SD, with a list of AT covering inclusive schools	Short	High	Central (PMPK)
Develop guidelines for different types of disabilities, and make guidelines easily accessible for all teachers, school principals, local government education offices, parents and caregivers	Short	High	Central (PMPK, SSET)
b. Improve Procurement Process of AT and Expand Collaboration			
Modify relevant funding schemes, especially the BOS schemes, to facilitate procurement of AT, and provide training/support for school principals, especially for public schools with limited budgets	Short	High	Central (PMPK)
Expand collaboration to promote procurement of AT at central and local levels	Short-Mid	High	Central and local government, schools, organizations promoting IE
Ensure that school principals incorporate AT in the school plan and budget and build partnerships with service providers to provide AT and relevant support to teachers	Mid-long	Medium	
c. Develop Teacher Training on AT and Strengthen Supporting Mechanisms for Teachers			
Develop a teacher training course on IE focused on AT, which is accessible for all teachers who have children with disabilities in their classrooms	Short	High	Central (SSET)
Expand in-service teacher training on general knowledge about IE for all teachers, and strengthen a monitoring system for teacher training universities to ensure IE is included in pre-service training	Short-Mid	Medium	Central (SSET), universities
Promote multidisciplinary assessment of AT needs especially in inclusive schools in rural areas	Short-Mid	Medium	Central (MoECRT, MoH), local government, schools
Establish a regulation with a special scheme to allow teachers from special education backgrounds to work in or support inclusive schools	Mid-long	Medium	Central

[34] The recommendations in this report are relevant to the five principles of education technology, presented by Hawkins,Robert J.; Trucano,Michael; Cobo Romani,Juan Cristobal; Twinomugisha,Alex; Sanchez Ciarrusta,Inaki Alejandro. *Reimagining Human Connections : Technology and Innovation in Education at the World Bank (English).* Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/829491606860379513/Reimagining-Human-Connections-Technology-and-Innovation-in-Education-at-the-World-Bank. It is also considered that the recommendations are relevant to the 6 P's education systems framework that consists of people, products, pedagogy, policy, place and provision included in the "A Landscape Review of ICT for Disability-inclusive Education" https://openknowledge.worldbank.org/handle/10986/37080

1 Develop Regulations and Guidelines for AT

Recommendation 1:

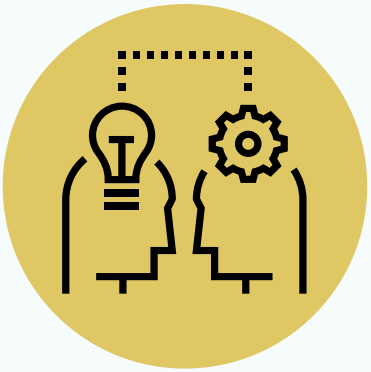
Develop a Regulation on AT for children with disabilities in inclusive schools, which allows governmental support to facilitate access and use of both high and low tech. Currently, the Permendiknas 33/2008 is the only reference for the needs of AT for students with disabilities but is dedicated to special schools only. MoECRT does not yet have a specific regulation on AT for children with disabilities in inclusive schools. Discussion with the Directorate of PMPK identified that due to the narrow scope of the Permendiknas, promoting AT for children with disabilities in inclusive schools, especially high-tech, may violate the current regulation and this concern prevents the central government from providing AT and guidelines to inclusive schools. This is because while the Permendiknas mentions some high-tech for special schools, it does not mention high-tech for inclusive schools. Thus, the lack of regulation on AT for inclusive schools is one of the core causes of limited provision of AT, especially high-tech, in inclusive schools, from the central government. In this context, there is an urgent need for MoECRT to establish a new regulation on AT for inclusive schools, to allow provision and use of both high-and low-tech AT for children with disabilities.

Recommendation 2:

Establish a Regulation on AT for all children with disabilities including those with LD, ASD, ADHD or SD, with a list of AT needed for different disability types, covering inclusive schools. Permendiknas 33/2008 mainly covers children with visual impairment, hearing impairment, intellectual disabilities and physical disabilities only. It means there is no clear list of AT from MoECRT for other types of disabilities including LD, ASD, ADHD and SD. A regulation is needed to cover children with different types of disabilities especially in inclusive schools, as a first step to allow procurement of high and low tech AT for children with different types of disability, as well as the development of guidelines and teacher training.

Recommendation 3:

Develop guidelines for different types of disabilities, and make guidelines easily accessible for all teachers, schools, local government education offices, parents and caregivers who engage with children with disabilities. Guidelines for teachers, schools, local government education offices, parents and caregivers are needed to serve as a manual of high-tech and low-tech for different types of disabilities. The guideline should attend to different AT by severity of disability and how AT help to enhance what kind of skills, such as reading, calculating, writing or communication. The high-tech part is recommended to include up-to-date information on AT and how to use it. Some high-tech can be replaced by low-tech, which would be more practical for many teachers where resources are limited. The low-tech part of the guideline would need to cover how to create low-tech, using local materials. It is recommended to include videos or visual images to help users easily understand what low-tech AT looks like and how to create and use it. In addition, it is key to make information and resources easily accessible for users to ensure their use of guideline and AT in the classroom and at home. This study identified a demand for website as one example of an easily accessible guideline among school principals and teachers. In some high-income countries, a comprehensive website on AT for children with disabilities exist for teachers and anyone who aims to support children with disabilities. These websites include important information for users. An example procedure to develop an accessible and practical AT guide is developed as a recommendation, by adapting a guideline into the Indonesian context, as shown in Box 1 in the annex.



2

Improve Procurement Process of AT and Expand Collaboration

Recommendation 4:

Modify relevant funding schemes, especially the BOS schemes, to improve procurement of various types of AT for children with disabilities in inclusive schools and provide training and support for school principals. Instead of limiting school principals' options of AT within the existing narrow list imposed by the central government, the BOS schemes could include an updated catalog and manual of AT, allowing school principals to choose suitable AT to meet their students' needs. Training on AT for school principals is needed to clarify the procurement process and how to use AT. Monitoring of the use of BOS fund for AT should be conducted by the central and/or local governments to address misuse of funds, identify infrastructure issues, and improve the maintenance of high-tech AT.

Recommendation 5:

Expand collaboration to promote procurement of AT at central and local levels. Development and procurement of AT, especially high-tech, requires collaboration with multiple stakeholders. Local governments should allocate funds for procurement of AT and establish cooperation with NGOs, universities and other organizations that develop and/or provide AT for children with disabilities. As a good example, with support from the Jakarta government, a special school in Jakarta collaborates with multiple partners to provide and promote AT for children with visual impairment, including cooperation with 1) the National Library regarding the availability of digital books, 2) the British Council regarding literacy for children, and 3) an organization from South Korea regarding the provision of digital images supported by sound for children with visual impairment.

Recommendation 6:

Ensure that school principals make a school activity plan and budget (Rencana Kegiatan dan Anggaran Sekolah/ RKAS) and build partnerships with service providers to provide AT and relevant support to teachers. For high-tech AT, schools need to cooperate with service providers to procure equipment, and the partnership between schools and service providers should be supported especially for public schools that have limited budgets for AT. On the other hand, for low-tech, it is possible for schools to support teachers to develop AT. Teachers can develop low tech AT for children with disabilities as long as they receive adequate training and support. Given the need for technical support and hands-on training at a school level, schools are encouraged to provide continued teacher training on AT. School principals must make school activity plans and budgets for AT and teacher training. Networking between schools and actors promoting IE should be strengthened. As a good example, a private primary inclusive school in Yogyakarta city has a school policy to purchase and use of AT for children with disabilities, including low tech such as flash cards and also high-tech such as tablet for learning, especially for children with ASD. The school has a budget every year to buy educational tools (APE).[35]

A proposed roles of the central, local governments and schools for the procurement of AT is summarised in the Table 6 in the annex.

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[35] APE is facilities or tools used for children's play/learning activities in education to enhance development using both modern technology and simple/ traditional technology.

3 Develop Teacher Training on AT and Strengthen Supporting Mechanisms for Teachers

Recommendation 7:

Develop a teacher training course on IE focusing on AT, which is accessible for all teachers of children with disabilities. It is important to fill in the large gap between the lack of teacher training focusing on AT by central and local governments and the strong demand for advanced training on AT among teachers who teach children with disabilities in both inclusive and special schools. To address the gap, teacher training on AT should be developed. Training should include understanding and practicing the use of various types of AT for different disability types, and how to make AT especially low-tech. To make the training practical, teacher training should include how to identify AT needs and how to make the AT align with individual education plans, lesson plans, instructional design and academic and development assessments. The focus should not be limited to how to use AT in resources rooms, but instead address how to use AT to enhance inclusion in the classroom where children with and without disabilities learn together. Targeted training on AT is recommended focusing on teachers who have children with disabilities in their schools and make the training accessible for all. A program of training assessments is recommended to ensure that teachers are competent to provide appropriate teaching adjustments for children based on type of disability, their learning and AT needs in their school context. A proposed training model of AT to fill in the knowledge gap is shown in the Table 7 in the annex, including the roles of key stakeholders such as central and local governments. Proposed teacher training AT content is developed and shown in the Table 8 in the annex, which includes examples of AT by different types of disabilities, also including related low and high-tech.

Recommendation 8:

Expand teacher training to include general knowledge about disabilities for all teachers, and strengthen a monitoring system for teacher training universities, to ensure all teacher training universities follow the regulation to implement pre-service teacher training on IE. It is critical to increase the number of GPK, and to make sure that all teachers in all schools have basic knowledge on how to support children with disabilities. One way is to strengthen in-service training through the existing scheme by the Directorate of SSET. At a pre-service level, it is important to strengthen the monitoring system for teacher training universities, to ensure all teacher training universities follow the regulation to implement pre-service teacher training on IE, covering practical knowledge and positive attitudes for inclusion. According to the *Law Number 8/2006 Article 44*, higher education institutions that organize teacher education are required to include courses on IE in the curriculum. To address the lack of enforcement of the law, it is recommended that the central and local governments strengthen monitoring system with teacher training universities to ensure that all teachers complete and build minimum knowledge and attitudes to support children with disabilities in regular schools.[36]

Recommendation 9:

Promote multidisciplinary assessment of AT needs especially for inclusive schools in rural areas. It is important to introduce appropriate AT for students that help to meet their needs, rather than introducing any types of AT. Thus,

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[36] Further discussion on inclusive curriculum can be found in Kim, K., Noah,Y., (2022) “Options to Improve Indonesia’s Inclusive Education Curriculum” https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099518410122279091/idu0dad87aa7026c704be90be150661a8086fac5

a guideline should include how to select appropriate AT. A multi-disciplinary assessment is key, including teachers, students, specialists if needed in the decision-making process, which is included in the sample AT guide in Box 1. To address the lack of collaboration between inclusive schools and health professionals in rural areas, partnerships between education and health sectors at a governmental level would be required. At minimum, district governments should establish DSUs that serve as a main local-level cross sectoral coordinating body including education and health sectors in local government, to support children with disabilities. Since the establishment of DSU is still limited due to unclear procedures, a clear guideline on funding mechanisms from the central government is needed. The World Bank Inclusive Education Initiative (IEI) Indonesia pilot project 2021-2022 developed a mechanism to connect teachers in rural areas and health professionals in urban areas online to enhance the quality of disability identification in inclusive schools in rural areas, and this approach can be expanded to include AT needs assessment.[37]

Recommendation 10:

Establish a regulation with a special scheme to allow teachers from special education background to work in inclusive schools to provide dedicated support for children with disabilities with flexible working hours. There is a need of regulation that will give teachers in inclusive schools more flexibly to spend sufficient time to provide individualised learning including AT. One way is to allow teachers from special education background to work in regular schools under a special scheme to enable more time and dedicated support for children with disabilities and other teachers who need additional support to teach children with disabilities.

[37] The importance of multidisciplinary assessment is further discussed in "Pilot Program Evaluation of Online Disability Identification and Continuous Learning Support Program for Children with Disabilities in Rural Indonesia." (World Bank, 2022) and "Embracing Diversity and Inclusion in Indonesian Schools: Challenges and Policy Options for the Future of Inclusive Education." (Hata et al., 2021), https://documents.worldbank.org/en/publication/documents-reports/documentdetail/535361634052935364/embracing-diversity-and-inclusion-in-indonesian-schools-challenges-and-policyoptions-for-the-future-of-inclusive-education

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Annexes

Annex I: Technical work related to recommendations

Box 1: Sample procedure to develop an accessible and practical AT Guideline for users.

1. Create categories by disability type
2. Create sub-categories by skills related to each disability
3. Define the disability
4. Define the skills
5. Provide a clear flow of decision-making by giving a range of options to help improve the skills at schools (and home)
   - Start with some basic advice to help with the specific difficulties
   - Then, explore a range of assistive technologies (and give a list of examples)
6. Identify problems
   - Identify possible factors affecting the skill
   - Give a brief low-tech advice
   - Give a brief high-tech advice
7. Emphasize a Student-centered approach and Collaborate process
   - AT is just part of the solution. The needs of students should be prioritized rather than vice versa.
   - Ideally, the decision-making process of suitable AT includes the teacher, specialists if needed, parent and student.
8. Show examples of low tech
   - Define what AT is and what AT can do
   - Show how to adapt the AT for the disability type
   - Explain where/how people can get the AT
   - Include relevant tools and information with website links for each AT
   - Potential disadvantages of AT or conditions can be included
9. Show examples of high tech
   - Define what AT is and what AT can do
   - Show how to adapt the AT for the disability type
   - Explain where/how people can get the AT
   - Include relevant tools and information with website links
   - Potential disadvantages of AT or conditions can be included
10. Insert short videos that include the following information (each video can highlight a specific disability)
    - Types of Disability (and sub-categories of disability)
    - Student skills
      - Skills (strengths of the student), and challenges the student faces
    - Environment
      - School types (inclusive, special, region), and curriculum used
    - Tasks (What the student needs to do)
    - Technology (How does technology compensate for the challenges to complete the task?)
    - Show an example of AT
    - Show how/steps to create the AT
    - Show other relevant AT if any
    - Show how the AT is used by students and teachers in the classroom/school settings
    - Explain the strengths of the AT
    - Explain who else could benefit
      - Other types of disability that can benefit from the AT
    - Suggestions (e.g., what is needed for the best use of the AT, roles of different stakeholders)

Source: Created by the authors based on https://www.callscotland.org.uk/

Table 6: Proposed roles of central and local governments and schools for the procurement of AT

Governance	Roles
Central government	• Improve school access to fund to purchase AT, by modifying the BOS scheme • Provide training and support to access AT for school principals, especially for public schools with limited funds
Provincial, city/district governments	• Establish collaboration with NGOs and key stakeholders to provide AT [*Good practice- Jakarta*: With a support from the Jakarta government, a special school collaborates with multiple partners to procure AT]
Schools	• Make a school budget activity plan regarding the provision of AT [*Good practice-Yogyakarta*: A private inclusive primary school has a school policy and annual budget to purchase and use AT for children with disabilities]

Table 7: A Proposed Training Model- AT as a bridge to fill in the gap.

	IE	AT	SE
Focus	• Basic concept of IE, characteristics of children with different types of disabilities, how to identify children with disabilities, how to create an IEP, lesson plan, assessment	• Practical knowledge/skills of various types of AT for different disability types • How to develop/modify AT, especially low-tech • How to select and use AT, and adjust pedagogy • Follow up technical support to allow teachers keep building up skills	• Practical knowledge/skills of various types of AT for different disability types • How to develop/modify AT, especially low-tech • How to select and use AT, and adjust pedagogy • Follow up technical support to allow teachers keep building up skills
Main target	• All teachers in regular schools	• Teachers of children with disabilities, especially in inclusive schools	• All teachers in special schools
Lead implementers	• Directorate of SSET • Universities (pre-service teacher training)	• Directorate of SSET: provide main training and resources to ensure equity across regions	• Directorate of PMPK, SSET • Universities (pre-service teacher training)
Other key implementers	• Local governments, schools	• Local governments, schools and collaborative actors: provide follow-up training and technical support	• Local governments, schools

Source: Created by the authors

Table 8: Proposed teacher training contents on AT

Objectives

By completing the training, teachers will be able to:

- Understand what types of AT can support children with disabilities and their functions (how each tech can support specific needs of different disability types).
- Understand how to create/modify AT, based on students' characteristics, needs and interests.
- Understand how to use AT, not only in resource rooms but also in classrooms where children with and without disabilities learn together. Understand how the same material can be used differently according to the type of disability and needs.
- Understand how to assess the need of AT for children with different disabilities, how to select suitable AT, and how to adapt IEP, lesson plans, pedagogy and assessment using AT, using a multi-disciplinary approach.
- Have access to learning resources to practice in their schools.
- Have access to technical support including peer-learning.

Examples of AT by types of disability

Disability types	Low tech	High tech
Various disability	**Picture cards, Learning videos, Communication boards**	**Software, applications** **Tablet, mobile phones, and computer**
LD	How to design a gamified scenario for students to work on certain mathematic tasks in a playful manner (Dyscalculia)	How to use **text-to-speech** to support reading comprehension of children with reading difficulties (Dyslexia)
ASD	How to make and use **picture card/ communication board** to support communication and social skills of children with ASD	How to use **tablet and applications** to develop communication skills and/or learn through creative activities (e.g., game, drawing) for children with ASD
ADHD	How to use sticky notes as a visual reminder for managing time for daily tasks/ how to **record textbooks** to assist in learning when they cannot concentrate on reading	How to use **applications/mobile devices** as timer/ smart watch to support concentration and having break times for children with ADHD
ID	How to use **self-development materials** to support children with intellectual disabilities to perform daily activities	How to use **android-based image recognition** to facilitate learning for children with ID, including cerebral palsy
SD	How to use **picture card/ communication board** to allow students to point at the letters and formulate the sentences	How to use **speech-to-text** to support communication of children with SD
Hearing	How to use **sign language cards**, facial expressions/gestures to support communication between teachers and students	How to use **speech-to-text** and **hearing aid** to support learning, communication, participation of children with hearing impairment
Visual	How to use **large letters** to facilitate learning of children with mild visual impairment	How to use **screen readers** to support learning of children with visual impairment
Physical	How to facilitate participation of children with **wheelchairs**	How to use a **modified keyboard** to support learning

Annex II: Additional Tables and Figures

Table 9: Mean and t-score between special and inclusive schools.

	Special (1)	Inclusive (2)	Difference (1)-(2)	t score
Teacher characteristics				
Female	0.754	0.688	0.066	2.697***
Trained on AT	0.306	0.163	0.143	5.791***
Urban	0.507	0.520	-0.013	-0.452
Teachers' access to AT and materials				
Availability of AT	0.823	0.381	0.441	19.656***
Information	0.516	0.285	0.231	8.482***
Catalogue	0.136	0.042	0.094	5.295***
Manual	0.220	0.064	0.155	7.234***
Teachers' use of AT and access to support				
Use AT	0.767	0.384	0.373	15.234***
Support need	0.845	0.797	0.048	2.336**
Support received	0.557	0.510	0.047	1.702*
Teachers' methods of assessment to decide whether a student needs AT or not				
Observation by teachers	0.889	0.861	0.027	1.528
Assessment by teachers	0.703	0.584	0.119	4.627***
Assessment by other professionals	0.551	0.658	-0.108	-3.930***
Student's achievement	0.325	0.324	0.001	0.031
Student's preference	0.541	0.567	-0.026	-0.951
Family preference	0.219	0.292	-0.074	-3.141***
N	1652	404		

Note: * p < 0.1, ** p < 0.05, *** p < 0.01 *Source:* Calculated using AT survey data collected in November 2022

Table 10: Mean and t-score between rural and urban areas, Inclusive school.

	Rural (1)	Urban (2)	Difference (1)-(2)	t score
Teacher characteristics				
Female	0.603	0.767	-0.164	-3.593***
Trained on AT	0.124	0.200	0.075	-2.078**
Teachers' access to AT and materials				
Availability of AT	0.299	0.457	-0.158	-3.306***
Information	0.227	0.338	-0.111	-2.490**
Catalogue	0.036	0.048	-0.012	-0.576
Manual	0.057	0.071	-0.015	-0.602
Teachers' use of AT and access to support				
Use AT	0.284	0.476	-0.193	-4.050***
Support need	0.753	0.838	-0.856	-2.142**
Support received	0.474	0.543	-0.690	-1.379
Teachers' methods of assessment to decide whether a student needs AT or not				
Observation by teachers	0.845	0.876	0.027	-0.895
Assessment by teachers	0.588	0.581	0.119	0.136
Assessment by other professionals	0.603	0.710	-0.108	-2.262**
Student's achievement	0.325	0.324	0.001	0.020
Student's preference	0.588	0.548	-0.026	0.810
Family preference	0.330	0.257	-0.074	1.608
N	194	210		

Note: * p < 0.1, ** p < 0.05, *** p < 0.01 *Source:* Calculated using AT survey data collected in November 2022

Table 11: Mean and t-score between rural and urban areas, Special school.

	Rural (1)	Urban (2)	Difference (1)-(2)	t score
Teacher characteristics				
Female	0.732	0.774	-0.043	-1.995**
Trained on AT	0.299	0.314	-0.153	-0.675
Teachers' access to AT and materials				
Availability of AT	0.812	0.833	-0.021	-1.111
Information	0.496	0.535	-0.038	-1.557
Catalogue	0.138	0.135	0.003	0.163
Manual	0.219	0.221	-0.002	-0.103
Teachers' use of AT and access to support				
Use AT	0.749	0.764	-0.014	-0.679
Support need	0.827	0.863	-0.036	-2.022**
Support received	0.549	0.564	-0.015	-0.626
Teachers' methods of assessment to decide whether a student needs AT or not				
Observation by teachers	0.899	0.878	0.021	1.355
Assessment by teachers	0.688	0.718	-0.030	-1.353
Assessment by other professionals	0.534	0.567	-0.032	-1.325
Student's achievement	0.322	0.328	-0.006	-0.273
Student's preference	0.555	0.526	0.029	1.184
Family preference	0.210	0.227	-0.017	-0.819
N	814	838		

Note: * p < 0.1, ** p < 0.05, *** p < 0.01 *Source:* Calculated using AT survey data collected in November 2022

Table 12: Multiple logistic regression results for teachers' use of AT for children with disabilities

logit (N=2056): Percentage Change in Odds
Odds of: 1 vs 0

Used	b	z	P>z	%	%StdX	SDofX
female	-0.09002	-0.637	0.524	-8.6	-3.9	0.4396
public	-0.31972	-2.498	0.012	-27.4	-14.6	0.4928
regular	-0.65362	-4.251	0	-48	-24.1	0.422
city	0.1319	1.068	0.285	14.1	6.8	0.5
knowledge	0.74565	3.965	0	110.8	31.4	0.366
available	1.86572	12.184	0	546.1	131.1	0.4489
trained	1.52427	7.942	0	359.2	97.3	0.4457
information	0.79772	5.98	0	122	48.9	0.4987
catalog	0.43035	1.251	0.211	53.8	14.7	0.3184
manual	0.27583	1.115	0.265	31.8	11.3	0.3874
support	0.60149	3.471	0.001	82.5	25.1	0.3722
supportgot	0.25598	1.867	0.062	29.2	13.6	0.498

Source: Calculated using AT survey data collected in November 2022

b = raw coefficient
z = z-score for test of b=0
P>z = p-value for z-test
% = percent change in odds for unit increase in X
%StdX = percent change in odds for SD increase in X
SDofX = standard deviation of X

Table 13: Logistic regression results for teachers' use of AT for children with disabilities in inclusive schools

logit (N=404): Percentage Change in Odds
Odds of: Yes vs No

Used	b	z	P>z	%	%StdX	SDofX
Student achievement	0.50647	2.336	0.02	65.9	26.8	0.4687
Teacher assessment	0.50177	2.367	0.018	65.2	28.1	0.4935
Health professionals	0.37656	1.708	0.088	45.7	19.6	0.4748
Student preference	0.35005	1.676	0.094	41.9	19	0.4961
Teacher observation	0.60963	1.897	0.058	84	23.5	0.346
Family preference	0.13726	0.613	0.54	14.7	6.4	0.4553

Source: Calculated using AT survey data collected in November 2022

b = raw coefficient
z = z-score for test of b=0
P>z = p-value for z-test
% = percent change in odds for unit increase in X
%StdX = percent change in odds for SD increase in X
SDofX = standard deviation of X

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