

Diffusion of Assistive Technology Innovations to Support Inclusive Academic Communication in Higher Education: A Case Study at Universitas PGRI Argopuro Jember

Asrorul Mais ¹, Lailil Aflahkul Yaum ²

¹ Universitas PGRI Argopuro, Jember; Indonesia; asrorulmais.plb@gmail.com

² Universitas PGRI Argopuro, Jember; Indonesia; alil.ndyaum@gmail.com

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Abstract

This study explores the diffusion of Assistive Technology (AT) innovations in fostering inclusive academic communication for students with disabilities at Universitas PGRI Argopuro Jember. Employing a qualitative case study design, data were collected through in-depth interviews, participatory observations, and document analysis. The findings demonstrate that AT, such as screen readers (JAWS, NVDA, TalkBack) and locally developed applications (SPETRI-DOC MY EARS, PIVE-MY EYES, CEMA, and SPETRIC-Forum *Sahabat Tuli*), significantly enhance accessibility, independence, and participation among students with visual, hearing, and physical impairments. Guided by Rogers' Diffusion of Innovations theory, the adoption process was found to follow the stages of innovators, early adopters, early majority, late majority, and laggards. Critical success factors include institutional policy support, educator competencies, student volunteers as mediators, and the contextual relevance of locally tailored applications. Nevertheless, challenges remain, particularly limited funding, insufficient training, and technical accuracy issues in speech-to-text applications. Overall, the study highlights that successful AT diffusion is determined not solely by technological availability but also by the readiness of institutional ecosystems, inclusive campus culture, and sustainable adaptive policies that collectively promote equity in higher education.

Keywords

Academic Communication; Assistive Technology; Higher Education; Inclusive Education; Innovation Diffusion

Corresponding Author

Asrorul Mais

Universitas PGRI Argopuro, Jember; Indonesia; asrorulmais.plb@gmail.com

1. INTRODUCTION

In the early development of special education, a segregated model was widely implemented, whereby children with special needs (*Anak Berkebutuhan Khusus*, ABK) were excluded from mainstream schools and placed in specialized institutions known as *Sekolah Luar Biasa* (SLB, Special Schools). These institutions provided individualized learning adapted to students' specific needs and operated across multiple educational levels, including *TKLB* (Special Kindergarten), *SDLB* (Special Primary School), *SMPLB* (Special Junior High School), and *SMALB* (Special Senior High School). SLB schools were further categorized according to the type of disability served, such as visual impairment (*Tunanetra*), hearing impairment (*Tunarungu*), intellectual disability (*Tunagrahita*), physical disability (*Tunadaksa*), and



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emotional or behavioral disorders (*Tunalaras*) (Lubna et al., 2021).

One of the fundamental principles of inclusive education is the belief that every learner can learn and that diversity is an asset in nurturing individual potential. Equally important is the inclusion of students with special needs in mainstream classrooms, which promotes active participation and social acceptance within the school community. In practice, inclusive education is implemented through a flexible curriculum that adapts to the unique situations, characteristics, and needs of each learner (Arriani et al., 2022). Persons with disabilities are an integral part of society whose rights must be guaranteed, respected, and fulfilled, including the right to access education. Higher education institutions that embrace the principle of inclusivity play a vital role in ensuring equitable access to higher education for individuals with disabilities. This study aims to describe the current conditions faced by persons with disabilities within the context of higher education in Indonesia (Puspitosari et al., 2022). Students at the higher education level exhibit diversity across various dimensions, including academic ability, social background, value systems, interests, and motivation levels. Moreover, differences can also be observed within an individual (intra-individual differences). For instance, a student who ranks in the top 10% in reading proficiency may not necessarily possess equivalent mathematical skills and could, in fact, perform at an average or even below-average level in that area (Phytanza et al., 2023).

Assistive Technology (AT) refers to devices or systems designed to enhance the functional abilities of individuals with disabilities. It has been shown to play a critical role in supporting inclusive education. According to a systematic review by Fernández-Batanero et al., (2022) AT tools such as screen readers, mobile applications, and Web 2.0 technologies can significantly enhance accessibility, independence, and academic participation for students with disabilities, particularly those who are visually impaired, hearing impaired, or physically disabled. However, the success of their implementation still faces challenges, including limited training opportunities for educators and restricted access to such technologies. This study emphasizes that the effectiveness of AT in higher education depends not only on the technology itself but also on the institution's readiness to support its adoption and use systematically.

The discourse on inclusive higher education emphasizes addressing visible and invisible disabilities through systemic and institutional support (Moriña, 2024). Highlights that students with invisible disabilities often face significant challenges in disclosure, which in turn limits their access to necessary accommodations and hinders their academic progression. Similarly, Fernández-Batanero, Montenegro-Rueda, & Fernández-Cerero (2022) point out that the overall accessibility and participation of students with disabilities in higher education remain constrained by structural and pedagogical barriers, calling for comprehensive strategies that ensure equal opportunities. In addition, inclusion in specific academic settings, such as physical education, has been shown to depend largely on teachers' attitudes and preparedness, with factors such as professional experience and collaborative support shaping the success of inclusive practices (Tarantino et al., 2022). These findings underscore the importance of designing assistive technology innovations as tools for academic communication and as catalysts for broader cultural and pedagogical transformation within universities.

In addition to the structural and pedagogical barriers identified in prior research, recent studies shed light on the complex intersections of access, stigma, and technological innovation in supporting students with disabilities in higher education (Shpigelman et al., 2022). Emphasize that disability should be seen as an individual condition and a social identity shaped by access, stigma, and power relations, with Disability Support Centers (DSCs) playing a pivotal role in promoting student development. Technological innovations further enrich inclusive practices: for instance, the use of educational chatbots such as *CapacitaBOT* demonstrates how digital tools can foster the social and communicative skills of students with intellectual disabilities, particularly in contexts of isolation such as the COVID-19 pandemic (Mateos-Sanchez et al., 2022). On a broader scale, Lien (2025) Advocates for a decolonial approach to Special Educational Needs and Disabilities (SEND), arguing that current Eurocentric

frameworks neglect the epistemologies and needs of the Global South, and calling for systemic transformation informed by interdependencies between education, politics, technology, and indigenous perspectives. More recently, Zhao et al. (2025) Highlight the potential and challenges of generative AI for students with disabilities, showing that while tools like ChatGPT support academic writing for those with ADHD, dyslexia, or autism, concerns remain regarding accuracy, costs, and academic integrity. Collectively, these insights illustrate the evolving landscape of assistive and inclusive practices in higher education, where identity politics, digital innovations, and global perspectives converge to redefine what inclusivity means in academic communication.

Assistive Technology (AT) is crucial in supporting inclusive education for students with disabilities. Recent studies highlight the significant benefits of AT, including enhanced accessibility, greater independence, increased social participation, and improved academic achievement. According to Vincent et al., (2024) Although AT has been made available in vocational education institutions, its utilization remains low due to limited funding, insufficient educator training, and the lack of institutional policies that support comprehensive adoption. A collaborative approach involving educators, AT specialists, and students is recommended to tailor technological solutions to users' specific needs while fostering a sense of ownership. (Vincent et al., 2024). Meanwhile, UNICEF, (2022) Emphasize the importance of developing teachers' competencies, including awareness, selecting and using AT skills, and the ability to design inclusive learning based on Universal Design for Learning (UDL) principles. Teachers are encouraged to integrate AT as assistive tools and an integral part of responsive and collaborative instructional strategies.

On the other hand, Viner et al. (2022) describe the evolution of AT from simple devices to advanced technologies such as virtual reality (VR) and artificial intelligence (AI), which create opportunities for more immersive and personalized learning experiences for students with disabilities. However, the study also highlights the urgent need for ongoing professional training for educators to leverage these technologies fully. Collectively, these three sources consistently emphasize that the success of AT implementation depends not only on the availability of technology but also on the preparedness of social systems, supportive policies, and educators' competencies in designing inclusive and adaptive learning environments. Furthermore, according to Rogers et al. (2019), the innovation adoption process is divided into five categories: innovators, early adopters, early majority, late majority, and laggards. Each category has distinct characteristics and requires different communication strategies. In higher education, the presence of innovators and early adopters serves as the initial catalyst for implementing Assistive Technology, which must then be supported by evidence of tangible benefits to encourage adoption by the majority groups. Beyond understanding adopter category characteristics, it is also important to examine how the internal dynamics of higher education institutions influence the diffusion process of Assistive Technology innovations.

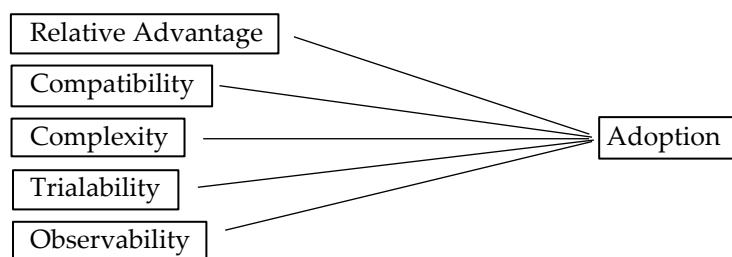


Diagram 1. Diffusion of Innovation Theory

(Rogers, 1983 in Turan et al., 2015)

Rogers's Diffusion of Innovations (DOI) theory explains how innovations are adopted within a social system through communication channels over time (Rogers et al., 2019). Adoption is influenced by five attributes: relative advantage, compatibility, complexity, trialability, and observability (Sahin, 2006). In education, this theory is relevant for integrating technologies such as Open Educational

Resources (OER), which address issues of access and cost but face challenges like technical barriers and limited training (Menzli et al., 2022). Furthermore, adoption depends not only on the innovation itself but also on communication channels, time, and social systems, with mass media being more influential in the knowledge stage and interpersonal communication more dominant in later stages (Rogers et al., 2019; Sahin, 2006).

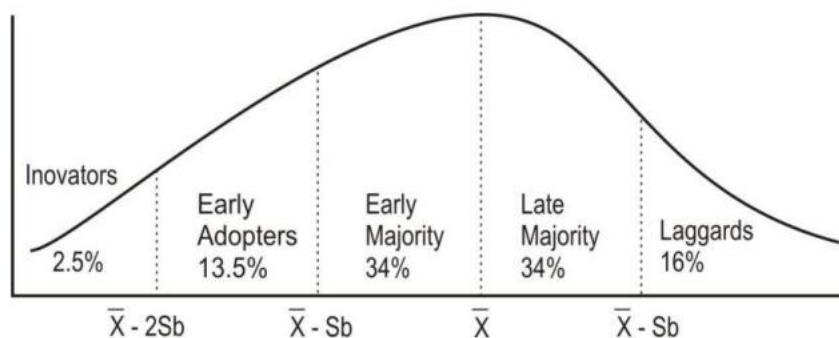


Diagram 2. Innovative Categories according to Everett Rogers (Rogers, 2002)

According to Rogers et al. (2019), the innovation adoption process is divided into five main groups, each requiring a different communication approach. Innovators are pioneers who first experiment with new ideas and help address potential risks. Early Adopters are open to change, viewing innovation as an opportunity for advantage and needing little persuasion. Early Majority adopt once clear evidence of benefits is available, seeking assurance before deciding. The Late Majority are more skeptical, waiting until most peers have adopted before following due to social pressure. Finally, Laggards are the most resistant, strongly adhering to traditional practices and reluctant to accept change.

At Universitas PGRI Argopuro Jember, various assistive technologies have been implemented to support students with disabilities. For visually impaired students, screen readers such as JAWS, NVDA, and TalkBack facilitate activities including reading, browsing, completing assignments, and participating in online lectures. The university has also developed specialized applications such as SPETRI-DOC MY EARS and PIVE-MY EYES for visually impaired students, alongside CEMA and SPETRIC-Forum *Sahabat Tuli* for students with hearing impairments. Accessibility is further enhanced through subtitles, sign language interpreter services, and text-to-speech integration in the Academic Information System (SIA) and Learning Management System (LMS). To support students with physical disabilities, the institution provides modified vehicles and hand control driving systems, ensuring inclusive mobility and equal access to education.

Therefore, this study is expected to significantly enrich theoretical and practical discussions on implementing Assistive Technology to support inclusive academic communication in higher education. Through a qualitative case study approach conducted at Universitas PGRI Argopuro Jember, the findings are anticipated to explain the dynamics of the innovation diffusion process, identify the supporting and inhibiting factors in the use of screen readers and locally developed applications, and offer strategic recommendations for formulating policies and developing disability services that are more adaptive, collaborative, and sustainable within Indonesia's higher education context.

2. METHODS

This study employs a qualitative approach with a case study design. As Creswell & Creswell (2018) described, qualitative research focuses on the meanings individuals attribute to social issues through inductive data collection and analysis, accompanied by flexible reporting that emphasizes the situation's complexity. This study aims to understand the diffusion process of Assistive Technology (AT)

innovations, particularly screen readers and locally developed applications, in supporting inclusive academic communication at Universitas PGRI Argopuro Jember. The research subjects include students with disabilities who use AT, lecturers, local application developers, and university representatives responsible for disability service policies. More specifically, the informants consist of seven visually impaired students, three deaf students, four student volunteers supporting students with disabilities, and five lecturers.

Data was collected through in-depth interviews, participatory observations of technology use in classrooms and on campus, and document analysis, including university policies and application usage reports. The primary instrument was the researcher, supported by interview and observation guidelines developed based on the Diffusion of Innovations theory (Rogers et al., 2019). Data analysis followed the technique proposed by Miles & Huberman (2014), involving data condensation, data display, and conclusion drawing.

To ensure the validity of the findings, this study applied data triangulation, including source triangulation (students with disabilities, lecturers, application developers, volunteers, and university representatives), technique triangulation (interviews, observations, and document analysis), and time triangulation (data collection conducted from the initial to the mid-research period, followed by confirmation at the end). The study was conducted over two months, from February 1 to March 31, 2025. The period from February 1 to March 5, 2025, focused on data collection, while March 6–31, 2025, was dedicated to data analysis and writing the scientific article. Through this approach, the study aims to comprehensively illustrate the innovation diffusion process of Assistive Technology and its impact on inclusive academic communication on campus.

3. FINDINGS AND DISCUSSIONS

Implementation of Assistive Technology at Universitas PGRI Argopuro Jember

Assistive Technology (AT) enhances the functional abilities of persons with disabilities. This technology encompasses a range of products, from low-tech and widely used items such as reading glasses, crutches, and hearing aids to more advanced devices utilizing cutting-edge science and technology. The primary goal of AT is to maintain or improve an individual's functional capacity and independence, thereby facilitating participation and improving overall well-being (Boucher, 2018; WIPO, 2021).

Implementing assistive technology (AT) within inclusive higher education requires effective coordination among educators, support staff, and technology service providers. Evmenova, (2020) Emphasized that AT integration should be carried out with fidelity, data-driven approaches, and structured training to address the needs of students with disabilities effectively. In line with this, (Karki et al., 2023) Demonstrated that accessibility, affordability, and community awareness are key factors influencing the success of AT services, particularly in developing countries. Within the academic setting, (Svensson et al., 2021) Using AT, such as text-to-speech and speech-to-text tools, not only enhances literacy skills among students with reading and writing difficulties but also contributes positively to their overall learning motivation.

Furthermore, (Smith et al., 2024) asserted that the implementation of AT represents an integral component in fulfilling the rights of persons with disabilities, as stipulated by the United Nations Convention on the Rights of Persons with Disabilities (CRPD). Consequently, higher education institutions must develop evidence-based programs to ensure equitable access. From an innovation perspective, Iannone & Giansanti (2023) highlighted the potential integration of artificial intelligence (AI) with AT, for example, through wearable devices that can support students' social communication on the autism spectrum. Such findings are particularly relevant to the increasingly digitalized landscape of higher education. On the other hand, Rasouli et al. (2023) pointed out that the success of AT

implementation is also shaped by the attitudes, experiences, and technical support of academic staff and service providers, who often face limited knowledge and ethical dilemmas.

In the non-academic domain, Pappadà et al., (2021) Provided evidence that technology can assist vulnerable groups, such as individuals with dementia, in maintaining communication and daily functioning, even during the pandemic. This underscores the cross-contextual relevance of AT, demonstrating its adaptability to emergencies and distance learning in higher education. Therefore, the implementation of AT in inclusive higher education extends beyond the provision of technological devices; it also involves the development of a collaborative ecosystem that encompasses training, funding, responsive policies, and sustainable innovation to promote equitable academic communication for all students.

Research shows that assistive technologies are vital in supporting children with special needs education. Qualitative studies have found that teachers perceive AT as motivating students and helping them present information more effectively. Nevertheless, concerns remain regarding the potential for unnecessary dependency on devices, risks of negative emotional impact, and inadequate training for teachers to use AT properly. Therefore, consistent support and professional development in AT usage are essential (Kunka & Wahome, 2021; Wynne et al., 2016).

Generally, AT can be categorized based on its functional type, including mobility, cognition, communication, hearing, built environment, self-care, and vision. Studies often focus on AT for specific disabilities, such as visual impairment and blindness, hearing impairment and deafness, and autism spectrum disorders. The AT industry continues to evolve rapidly, increasingly converging with consumer electronics. Globally, more than one billion people require at least one assistive product, and this number is expected to double over the next decade as the population ages (WIPO, 2021).

Despite growing innovation, access to AT remains a global challenge. Only one in ten people can access the assistive products they need. Barriers to accessibility include limited product availability, especially in countries with narrow AT product lists, and insufficient training for effective device use. Future trends indicate that AT will become smarter and more customizable, emphasizing universal design principles to create products usable by everyone, not only persons with disabilities. This also includes partially or fully integrating devices into the human body, such as neuroprosthetics and artificial eye systems (WIPO, 2021).

Based on observation and internal documentation provided by PNA (Universitas PGRI Argopuro Jember, 2025), several assistive technologies have been developed to support inclusive education.

Table 1. Commercially Available Assistive Technologies for Students with Visual Impairments

No	Technology	Main Functions	Academic Applications
1	JAWS (Job Access With Speech)	Screen reader software for PC; supports text-to-speech, Braille displays, and OCR integration	Reading learning materials (PDF, DOCX, eBooks); browsing academic journals and e-learning platforms; writing assignments and presentations; attending online classes; managing files and references
2	NVDA (Non-visual Desktop Access)	Free and open-source screen reader; supports MathML, LaTeX, and Braille displays	Accessing academic databases; writing theses or essays, online learning participation, spell checking, and file and email management
3	TalkBack (Android built-in)	Mobile screen reader using gestures and voice commands	Reading documents, conducting research via browsers, taking notes through voice typing, attending online classes, managing emails, and files

Table 1 summarizes widely used assistive technologies to support students with visual impairments in higher education settings. These technologies primarily focus on screen-reading functions, text-to-speech conversion, and integration with other accessibility tools to enable academic participation.

- a. AWS (Job Access With Speech): A proprietary screen reader for personal computers featuring advanced text-to-speech, Optical Character Recognition (OCR), and Braille display compatibility. It supports access to various digital formats, navigation of e-learning platforms, academic writing, and reference management.
- b. NVDA (NonVisual Desktop Access): An open-source, cost-free screen reader offering similar functionalities to JAWS, with additional support for mathematical notation (MathML, LaTeX) and Braille integration. It facilitates access to academic databases, essay and thesis writing, and efficient file and email management.
- c. TalkBack: An Android built-in screen reader designed for mobile accessibility, employing gesture-based navigation and voice commands. It enables reading academic documents, exploring online scholarly resources, participating in online learning, and managing digital communication.

Collectively, these assistive technologies play a crucial role in reducing accessibility barriers for students with visual impairments. By enabling independent learning, research, and communication, they support inclusive education and contribute to equal academic opportunities in higher education contexts.

Table 2. Assistive Technologies Developed by Universitas PGRI Argopuro Jember

a. For Students with Visual and Hearing Impairments

No	Technology	Main Functions	Academic Benefits
1	SPETRI-DOC MY EARS	Converts recorded lectures and discussions into editable text	Automatic note-taking; reviewing materials using screen readers; transcribing research interviews
2	PIVE - MY EYES	AI-based object and text recognition; verbal descriptions	Orientation and mobility in new spaces; reading printed materials; identifying lab equipment and surroundings

b. For Students with Hearing Impairments

No	Technology	Main Functions	Academic Benefits
1	CEMA (Center My Ability)	Speech-to-text transcription focused on social media interaction	Drafting essays via dictation, participating in academic groups, and transcribing research data
2	SPETRIC-Forum Sahabat Tuli	Real-time voice-to-text for face-to-face conversations	Directly following lectures and discussions, collaborative group work, and consultations with supervisors
3	Subtitles, Sign Language Interpreter Corner, and Text-to-Speech in Academic Systems (SIA & LMS)	Live captions, interpreter video windows, and audio feedback	Enhancing comprehension of lectures and online seminars; inclusive participation in e-learning and campus activities

c. For Students with Physical Disabilities

No	Technology	Main Functions	Academic Benefits
1	Modified Electric and Fuel Vehicles; Hand-Control Drive Systems	Customized campus transportation	Independent access to classes, libraries, and events; transporting wheelchairs safely; reduced reliance on public transport

Table 2 summarizes a series of innovative assistive technologies designed by Universitas PGRI Argopuro Jember to address the academic needs of students with visual, hearing, and physical disabilities. These technologies integrate advanced features such as Artificial Intelligence (AI), speech-to-text conversion, and customized mobility solutions to enhance accessibility and participation in higher education.

For Students with Visual and Hearing Impairments

The first section highlights two technologies designed to support students who are blind or deaf. SPETRI-DOC MY EARS is an application that records lectures and discussions and automatically converts them into editable text. This function facilitates efficient note-taking without manual typing, enables students to review materials using screen readers, and supports the transcription of research interviews. PIVE-MY EYES leverages AI to detect and verbally describe objects, text, and surrounding environments. This technology assists blind students in navigating new academic spaces such as classrooms and laboratories, reading printed materials unavailable in accessible formats, and identifying laboratory equipment independently.

For Students with Hearing Impairments

The second section presents three technologies specifically developed for deaf and hard-of-hearing students. CEMA (Center My Ability) offers speech-to-text conversion, primarily focusing on facilitating communication through social media platforms. This application allows students to draft essays by dictation, participate actively in academic groups or online discussions, and transcribe research data such as interviews or group discussions.

SPETRIC-Forum *Sahabat Tuli* provides real-time voice-to-text transcription during face-to-face conversations. This function enables students to follow lectures and discussions as they happen, engage effectively in group projects, and consult directly with academic advisors, with all conversations instantly available in text format. In addition, the university has integrated subtitles, a Sign Language Interpreter Corner, and text-to-speech (TTS) features into its Academic Information System (SIA) and Learning Management System (LMS). These innovations include live captioning, interpreter video boxes during live lectures, and audio feedback for digital materials, thus enhancing comprehension and promoting inclusive participation in online and campus-based learning activities.

For Students with Physical Disabilities

The final section focuses on mobility solutions for students with physical disabilities, specifically through modified electric and fuel-powered vehicles and hand-control drive systems. These customized vehicles allow students to independently access classrooms, libraries, and campus events, safely transport wheelchairs, and reduce reliance on public transport. Beyond practical mobility, these innovations also support greater independence and self-confidence in academic and extracurricular engagement.

Overall, the assistive technologies of Universitas PGRI Argopuro Jember exemplify a proactive approach to inclusive education. By addressing multiple types of disabilities (visual, hearing, and physical), these innovations not only remove accessibility barriers but also promote equal opportunities for learning, research, and participation in higher education.

Findings from this study illustrate how the implementation of Assistive Technology (AT) at

Universitas PGRI Argopuro Jember aligns with the theoretical definition of AT as tools to enhance the functional capacity of persons with disabilities (Boucher, 2018; WIPO, 2021). AT here includes not only simple aids but also advanced technologies that facilitate academic participation and student well-being. Among students with visual impairments, using screen readers such as JAWS, NVDA, and TalkBack is a concrete example of AT applied to vision-related functions. Interviews reveal diverse preferences: RDK (10/02/2025), a visually impaired student, reported that JAWS significantly helps him read course materials and complete assignments more efficiently; KA (12/02/2025) prefers NVDA for its lightweight operation on a personal laptop; and IW (14/02/2025) relies on TalkBack while reading references during travel. These findings are consistent with Fernández-Batanero et al., (2022), who emphasize the importance of screen readers and mobile applications in enhancing accessibility and independence among visually impaired students.

Furthermore, local innovations such as SPETRI-DOC MY EARS are utilized by FF (22/02/2025) and R (16/02/2025), visually impaired students, to record lectures and generate automatic transcripts. Meanwhile, according to an interview with A (18/02/2025), another visually impaired student, PIVE-MY EYES helps with navigation in the library by providing descriptions of layouts and bookshelves. This practice aligns with the discussion presented by WIPO, (2021) This practice aligns with the discussion presented by WIPO (2021) regarding the trend of increasingly intelligent AT that converges with consumer technologies, thereby expanding AT functions into areas such as cognition and mobility.

For students with hearing impairments, applications such as CEMA and SPETRIC-Forum *Sahabat Tuli* are crucial communication aids. An interview with BAS (11/02/2025), a deaf student, revealed that the real-time speech-to-text feature greatly helps understand group discussions. In contrast, AA (13/02/2025), another deaf student, reported feeling more confident when consulting with lecturers thanks to the instant readability of conversation transcripts. The implementation of subtitles and a sign language interpreter corner in lecture videos, as described by PNA (26/02/2025), a lecturer, also supports the principles of Universal Design for Learning (UDL) as recommended by UNICEF, (2022), which emphasizes the importance of providing instructional materials that are accessible to all students.

For students with physical disabilities, the university provides specially modified four-wheeled vehicles and hand control drive systems. According to the researcher's observations, these facilities greatly assist students' mobility from dormitories to classrooms without relying on public transportation. This aligns with the mobility category of Assistive Technology WIPO, (2021), which aims to maintain independence and participation. Although implementing AT on campus is relatively innovative, this study also identified challenges: the limited training for lecturers and student volunteers. As noted by PNA (26/02/2025), a lecturer, although subtitles and other tools have been used, there remains a need for more in-depth training to maximize the potential of AT. This finding is consistent with the studies by Kunka & Wahome, (2021); Viner et al., (2022), highlighting the importance of ongoing professional development for educators to ensure that AT is fully integrated into inclusive teaching strategies.

Thus, the implementation of Assistive Technology at Universitas PGRI Argopuro Jember has fulfilled its primary goals of enhancing accessibility, independence, communication, and mobility for students with disabilities. However, as highlighted in the literature, the success of AT implementation depends not only on the availability of technology but also on the readiness of social systems, institutional policies, and the continuous development of educators' competencies to optimize the use of AT across the academic environment fully.

The Diffusion of Innovations Process Based on Rogers' Theory

Rogers' diffusion of innovations theory provides a valuable framework to understand the adoption of emerging technologies in higher education, including assistive technology (AT). Recent studies have expanded its application across diverse technological contexts. Raman et al. (2024) explored university students' adoption of ChatGPT by analyzing five innovation attributes—relative advantage,

compatibility, ease of use, observability, and trialability—combined with sentiment analysis, highlighting that these factors significantly influence behavioral intentions and adoption rates. Importantly, their findings revealed that demographic factors, such as gender, shape the prioritization of innovation attributes, underscoring the necessity of user-centric and inclusive approaches to technology diffusion. Similarly, Patnaik & Bakkar (2024) emphasized the critical role of transformational leadership in adopting artificial intelligence within organizations, showing that vision, intellectual stimulation, and individualized support are key leadership qualities that facilitate adoption across the three stages of Rogers' model: initiation, adoption, and routinization.

Beyond educational and organizational contexts, (Alonso et al., 2024) Examined information communication technology adoption in Vietnam's restaurant industry, identifying both perceived advantages—such as enhanced promotion and sales and disadvantages, including cost and time constraints. Their findings reveal that diffusion is shaped by tangible benefits and users' perceptions, preferences, and generational divides, parallel the barriers often observed in AT adoption within higher education. Complementarily, Kaushalya et al., (2024) Applied Rogers' theory to implementing Building Information Modeling (BIM) in Sri Lanka's construction industry, mapping adoption strategies across the five stages of diffusion and highlighting the necessity of addressing context-specific barriers to achieve successful innovation uptake.

Collectively, these studies illustrate that individual perceptions, leadership practices, organizational readiness, and contextual barriers influence the diffusion of technological innovations. When applied to assistive technology in higher education, Rogers' framework underscores the need for strategies that promote AT's relative advantage and compatibility, provide trial opportunities, reduce perceived complexity, and ensure strong leadership and institutional support.

Findings from the study at Universitas PGRI Argopuro Jember indicate that adopting Assistive Technology (AT) among students with disabilities follows the innovation diffusion pattern described by Everett Rogers. Innovation diffusion is the process by which an innovation is introduced and subsequently accepted through communication channels within a particular social system. At the innovators stage, the research identified students such as IW (14/02/2025), a visually impaired student, and BAS (11/02/2025), a deaf student, who acted as pioneers. According to an interview with IW (14/02/2025), this student actively experimented with campus applications such as TalkBack and SPETRI-DOC MY EARS before their official launch. At the same time, BAS (11/02/2025) tried out SPETRIC-Forum *Sahabat Tuli* to support group discussions. As innovators, both were willing to face technical risks and complexity and were highly motivated to explore new technologies. This aligns with Rogers' theory, which states that innovators seek breakthrough opportunities even without strong evidence or endorsement from their immediate environment.

Next, an early adopters group emerged, such as KA (12/02/2025), a visually impaired student, and PSS (15/02/2025), a deaf student, who followed after observing the direct benefits experienced by their innovator peers. For example, KA (12/02/2025) chose NVDA after recognizing its relative advantage over other screen readers, while PSS (15/02/2025) used AT to support their academic activities. According to Rogers, early adopters play a critical role as role models who help accelerate the innovation adoption among other social system members.

The next stage is the early majority, characterized by broader participation after the innovation has proven beneficial and become more visible (*observability*). According to RNM (27/02/2025), a lecturer, the role of student volunteers such as MIM (17/02/2025) and SNAFI (19/02/2025) was crucial. They acted as agents of interpersonal communication, helping new students understand how to use AT, thereby reducing perceived *complexity* and increasing the *compatibility* of the innovation with users' needs. This finding aligns with Rogers' theory that interpersonal communication plays a more significant role during the persuasion and decision stages than mass media.

The late majority group only adopted Assistive Technology after it was mandated by the

university, for example, during course registration through the Academic Information System (SIA), which is integrated with text-to-speech functionality. An interview with S (04/03/2025), a lecturer, noted a significant increase in AT users on the campus LMS following official socialization efforts through faculty workshops. This illustrates the role of social pressure and institutional policies in encouraging initially hesitant groups to adopt the innovation.

Finally, there is the laggards group, who remain cautious or slow to adopt AT. One example is RF (20/02/2025), a visually impaired student initially facing technical difficulties configuring the screen reader. However, these barriers were gradually overcome with support from volunteers like IP (23/02/2025). According to the theory, laggards are often constrained by long-standing habits, lower digital literacy, and a lack of confidence in new technologies.

When analyzed through Rogers' five innovation attributes:

- a. Relative advantage is evident in the tangible benefits of screen readers, speech-to-text, and text-to-speech tools that enable faster and more independent learning.
- b. Compatibility is reflected in how AT is tailored to the specific needs of students who are visually impaired, hearing impaired, or have physical disabilities.
- c. Complexity remains challenging, especially for laggards like Ridatul Fadilah, who experienced initial technical difficulties.
- d. Trialability emerged through the efforts of innovators and volunteers who tested AT first and demonstrated its use to peers.
- e. Observability strengthened as more students witnessed the benefits experienced by early adopters and the early majority.

Overall, the diffusion process of AT at Universitas PGRI Argopuro Jember reinforces Rogers' theory that successful innovation adoption depends not only on the technology itself but also on the social system, interpersonal communication, and supportive institutional policies. The presence of volunteers like MIM (17/02/2025) and SNAFI (19/02/2025), along with assistance from student volunteers such as IP (23/02/2025), played a significant role in initially bridging hesitant students, enabling them to utilize AT more effectively.

Supporting and Inhibiting Factors in the Utilization of Assistive Technology

In a study by McNicholl et al. (2021), the utilization of assistive technology is influenced by supporting and inhibiting factors. Such technology can substantially improve the quality of life for persons with disabilities by enhancing mobility, communication, and social participation. A key supporting factor is technological advancement, particularly integrating artificial intelligence (AI) into mobility and communication aids, which increases usability and effectiveness. Several studies highlight that adopting assistive technology (AT) in educational settings and daily life is shaped by enabling and constraining environmental factors. Esquivel et al. (2024) found that assistive technology (AT) facilitates the active participation of students with disabilities through user-friendly tools such as robotics and computer devices, supported by parental and teacher involvement. However, challenges include time limitations, software-ability mismatches, insufficient technical expertise, and financial barriers. Thus, effective AT integration requires adequate training, contextual adaptation, and strong environmental support.

Similarly, (Monden et al., 2024) Highlighted the experiences of veterans and civilians with tetraplegia in accessing and utilizing AT. The main supporting factors are access to rehabilitation resources, trial-and-error learning, and knowledge exchange within peer communities. Conversely, the most significant barriers include high costs, lack of awareness of available resources, and administrative requirements that limit access, particularly among veterans. Nevertheless, using AT has enhanced

independence, productivity, participation, safety, and overall quality of life.

However, several barriers hinder the effective use of Assistive Technology. Key challenges include high costs, limited availability of devices that match individual needs, and insufficient user training. Moreover, existing technologies often fail to align with users' specific requirements fully or to integrate seamlessly with other devices, which can reduce their effectiveness (Mahmoudi-Dehaki et al., 2025). Accessibility also remains a significant issue, particularly in underserved regions where the availability of appropriate devices is limited.

It is important to note that adopting Assistive Technology is also influenced by cultural attitudes toward disability, which can affect whether individuals feel comfortable using these devices. In some cultural contexts, there is a stigma associated with the use of Assistive Technology, which can further exacerbate the challenges in adopting it (McNicholl et al., 2021). Therefore, to enhance the utilization of Assistive Technology, it is essential to implement policies that support accessibility and raise awareness, as well as to provide appropriate training for users (Mahmoudi-Dehaki et al., 2025).

In line with this theory, findings from the study at Universitas PGRI Argopuro Jember also identified several supporting factors that strengthen the utilization of AT among students with disabilities. Pro-inclusive campus policies—such as providing screen readers, speech-to-text and text-to-speech applications integrated into the Academic Information System (SIA), and training for lecturers teaching inclusive courses serve as an essential foundation. This aligns with Mahmoudi-Dehaki et al. (2025) that responsive institutional policies are key to successfully adopting Assistive Technology. The direct support provided by RK (02/03/2025), a lecturer, also proved important, as it helped students overcome technical barriers while simultaneously building their confidence. This reinforces the findings of McNicholl et al. (2021). This states that interpersonal communication and direct support can enhance user comfort and minimize the impact of stigma. Additionally, innovations such as developing local applications like SPETRI-DOC MY EARS and PIVE-MY EYES, tailored to the needs of students at UPGrA Jember, represent relevant supporting factors. The theory outlines that these align with global technological advancements, including artificial intelligence.

On the other hand, this study also identified barriers that hinder the optimal utilization of AT. FF (22/02/2025), a visually impaired student, acknowledged the campus's limited budget for premium screen reader licenses such as JAWS, which aligns with the findings of Mahmoudi-Dehaki et al. (2025). The high cost of devices constitutes a significant barrier, especially in institutions with limited resources. IHZ (28/02/2025), a lecturer, also highlighted the lack of advanced training for new students and faculty members, which aligns with the theory that insufficient training hampers the comprehensive utilization of AT. Technical challenges also arise; for example, R (16/02/2025), a visually impaired student, noted that the speech-to-text accuracy in local applications remains imperfect, impacting the effectiveness and user comfort. This is consistent with the explanation by Mahmoudi-Dehaki et al. (2025) Regarding the issue of technical incompatibility between device features and the specific needs of users.

Moreover, the relatively inclusive campus culture and the presence of volunteer assistants help reduce hesitation or discomfort among new students when first using AT, supporting the assertion of McNicholl et al., (2021) Regarding the importance of a social approach to strengthen technology acceptance. Thus, the findings of this study confirm that the successful utilization of Assistive Technology in higher education is influenced not only by technological advancements but also by supportive campus policies, relevant local innovations, the role of assistance, and the institution's ability to overcome financial and technical barriers. These empirical findings reinforce the theory that AT requires a holistic approach to truly enhance the independence and academic participation of students with disabilities.

The Impact of Assistive Technology on Inclusive Academic Communication

Assistive Technology (AT) fosters inclusive academic communication in higher education. Screen

readers, text-to-speech, and speech-to-text reduce communication barriers for visually impaired students, enabling equal access to learning: g materials, active participation in discussions, and greater academic independence. Field findings at Universitas PGRI Argopuro Jember confirm these benefits: applications such as NVDA, SPETRI-DOC MY EARS, TalkBack, PIVE-MY EYES, and SPETRIC-Forum *Sahabat Tuli* have supported students with visual and hearing impairments in accessing lectures, reading references, and engaging in real-time discussions. Moreover, CEMA facilitates cross-disability collaboration, further enriching inclusive learning spaces. Researcher observations highlight a positive shift from passive, one-way communication toward more participatory and collaborative classroom interactions, strengthening students' confidence and dialogue skills. However, successful implementation requires technological availability and collaboration among students, educators, developers, and supportive institutional policies. The study also reveals limitations due to its single-university scope, short duration, and qualitative design, restricting generalizability. Nonetheless, it provides valuable empirical and conceptual insights into the diffusion of AT innovations, offering a foundation for other universities to develop adaptive, technology-based disability services. Future research should involve multi-campus comparative studies, longitudinal sustainability analyses, and exploration of advanced technologies such as artificial intelligence and virtual reality to enhance inclusive education in higher education further.

4. CONCLUSION

This study demonstrates that implementing Assistive Technology (AT) at Universitas PGRI Argopuro Jember through screen readers, locally developed applications, and volunteer support has enhanced accessibility, independence, and participation of students with disabilities in academic communication. Adopting AT followed Rogers' diffusion of innovation pattern, success determined by technological availability and institutional policies, educator competencies, and an inclusive campus culture. Despite persistent challenges such as costs, limited training, and technical accuracy, the findings underscore that AT catalyzes pedagogical.

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