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Advancing Digital Education for Visual Impairment Students (VIS) in Urban and Regional Planning Study Program

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Abstract. Students with visual impairment are one of the vulnerable groups that face these challenges. Digital-based education systems offer technology that ensures equal access if higher education policies and regulations support it and include disability-friendly technological features. The scope of the study includes upgrading myITS Classroom. The simulation involving 12 Visual Impairment Students (VIS) was conducted in the urban and regional planning department of ITS, specifically for the transport system course. The simulation results indicate that there are several things needed to be able to adapt through digital learning systems, namely: assistive technologies such as screen readers; mockup materials for demonstration; provision of all learning materials in digital formats; completion of tables, charts, and figures with descriptive paragraphs containing the information presented in them; provision of maps in embossed materials or tactile formats, and collaborative learning with peers, including discussions, case studies, etc.

Keywords: *visual impairment students, digital learning system, urban and regional planning*

1. Introduction

Institut Teknologi Sepuluh Nopember Surabaya (ITS) is committed to inclusive education, in line with national regulations such as Act No. 8/2016 on People with Disabilities [1] and Government Regulation No. 13/2020 on Decent Accommodation for Students with Disabilities [2]. However, its digital system platforms (portals, e-learning platforms, and internship management systems) are still not fully accessible for blind and low-vision students.

International best practices emphasize the importance of assistive technology in bridging this gap. The access that needs to be provided for blind students not only includes access to physical buildings, but also access to information through Information Technology and communication technologies. This is crucial for students with impairments because it allows them to participate in the learning process independently and successfully. Assistive technology for VIS not only helps them to understand the lecture material delivered in class, but also helps develop their cognitive, social, and communication skills when interacting with the surrounding environment [3]. Assistive technology is needed by VIS to learn Mathematics and Science [4]. Therefore, ITS can enhance inclusivity by formally adopting assistive technology to upgrade ITS digital system.

Currently, several assistive technologies in the digital learning system can be installed, such as screen readers, screen magnifiers, voice recognition, and braille displays. There are several screen readers, including JAWS (Job Access with Speech), NVDA (Non-Visual Desktop Access), VoiceOver (Lee, H. N., & Ashok, V., 2022 in [5]), and UserWay [6]. NVDA is a screen reader application that helps VIS operate the computer. JAWS is created to be easy to use in Microsoft Windows independently. Both of these applications have their own user manuals. Meanwhile, the UserWay accessibility widget is a tool that enhances website accessibility by adding a floating icon that gives options for users to customize their browsing experience for a variety of needs.

This study aims to explore how the elements of digital education can be modified to accommodate VIS by identifying the improvement needs, using a case study of the undergraduate program in Urban and Regional Planning, and involving 12 VIS.

1.1. Objectives of the Study
The objective of this study is to describe the process of improving the myITS platform to make it more visually impaired-friendly.

1.2. Research Methods
This research uses qualitative data that were collected through a literature review, questionnaires, simulations, pre-test, and post-test. The analysis methods used in this research are gap analysis based on triangulation (benchmark studies, simulations, and literature review). These tools provide low-cost, practical, and scalable solutions to ensure inclusivity in digital learning, administration, and internship-related processes. There are three workshops conducted to simulate the use of assistive technology. First, a workshop on IT simulation before the upgrade on 21 April 2025, and the second and third workshops are IT simulations after the upgrade of the system on 17 June 2025 and 5 July 2025. The number of blind participants involved in this research consists of 10 PwDs, comprising 5 male and 5 female; 2 of them were high school teachers from Yayasan Pendidikan Anak Buta (YPAB), the remaining are 3 high school students (all with total blindness) and 5 university students in Surabaya (2 of them were low vision). In the workshop, the participants were directed to try NVDA, JAWS, Web-based assistance, Userway (Free version), and Userway (Paid version) while accessing the ITS website and myITS Classroom. Participants were asked for their feedback on alternative technologies, either positive or negative impressions, as described in Table 1.

2. Theory
The research that explores the application or software that are embedded in a mobile phone or computer is clustered into the effectiveness of screen readers (computer-based) and the usability/impact of dedicated mobile applications (AI-powered, GPS). The academic studies often compare the three major screen reader problems, namely: 1) comparative usability of desktop screen readers to access user experience, 2) plugin dependency, and 3) accessibility gaps.

According to the comparative usability of desktop screen readers to access user experience, a study using the Accessible Usability Scale (AUS) found that, when interacting with desktop products, the overall user experience was rated similarly but with notable differences in specifics.

Based on their study result, JAWS has the highest average AUS score (57/100) [7]. This is concluded to be the most preferred screen reader for blind people working in larger organizations due to its feature set. VoiceOver[1] had the lowest average AUS score (50/100), while users found it familiar [7]. Screen reader technologies play a critical role in enabling digital accessibility for blind and visually impaired users, with NVDA emerging as one of the most widely adopted solutions. Prior studies comparing desktop screen readers such as NVDA, JAWS, and VoiceOver demonstrate that NVDA is often preferred by users, especially in organizational and professional environments, due to its comprehensive feature set, open-source nature, and flexibility [7].

Research about the plugin dependency reveals that screen reader users frequently rely on plugins to improve the usability of both the screen reader itself and the applications they use. Plugins are often necessary to make partially accessible applications fully functional or to provide custom auditory feedback [8] [9]. Advancements in artificial intelligence have further influenced the evolution of screen readers. Studies introducing AI-based conversational accessibility assistants report improvements in task completion time, understanding of page layouts, and user autonomy during web navigation [9].

According to accessibility gaps, several studies have been conducted. The role of web developers, therefore, remains crucial in improving accessibility outcomes. The literature emphasizes that proper web design practices—such as structured headings, descriptive alternative text for images, correctly labeled form elements, and logical navigation—are essential for effective screen reader interaction [9], [10]. Based on the research about Understanding Screen-Reader Users' Experiences with Online Data Visualization [10], significant accessibility challenges remain even with screen readers, particularly with non-text content. A study on online data visualizations found that screen-reader users were 61.48% less accurate and spent 210.96% more time interacting with the content compared to non-screen-reader users. Challenges persist in more complex interaction scenarios, particularly with online data visualizations. Studies examining the experiences of screen reader users reveal that visual content often presents navigation and interpretation difficulties, thereby limiting access to critical information [10]. On the other hand, the utility of mobile apps and exploring specific AI-driven functionalities face challenges of user satisfaction and utility, AI-Powered app performance, and impact on independence. In the mobile accessibility context, the literature identifies a growing ecosystem of applications designed for visually impaired users, commonly categorized into navigation, object recognition, text-to-speech, and social interaction tools [12].

3. Findings and Discussion

Every higher education institution must comply with the mandate for inclusive education and adequate accommodation for students with disabilities, as outlined in [1] and [2], which requires all public and private schools to be inclusive, providing necessary accessible facilities, infrastructure (such as ramps, Braille, screen readers), and support to ensure equal rights and full participation for all students. ITS, as one of the world-class higher education institutions, ranked around 509 globally in QS 2026, also needs to comply with this mandate. However, its digital systems are still not fully accessible for blind and low-vision students. International best

[1] Gesture-based screen reader for macOS, iOS, and iPadOS that provides audible descriptions of on-screen content to navigate devices by hearing text, icons, buttons, and battery levels, and interact with unique gestures.

practices emphasize the importance of assistive technology in bridging this gap. Therefore, ITS can enhance inclusivity by formally adopting free solutions such as NVDA and UserWay.

Six key elements of desktop-based assistance were discussed during the workshop, namely: 1) user-friendly; 2) installations; 3) usages; 4) add-ons support; 5) role of web developer; and 6) use on mobile devices.

According to the user-friendly aspect, most participants reported NVDA as their primary and most familiar screen reader, reinforcing its reputation as a user-friendly and reliable tool. These findings are consistent with studies comparing desktop screen readers such as NVDA, JAWS, and VoiceOver, which demonstrate that NVDA is often preferred by users, especially in organizational and professional environments, due to its comprehensive feature set, open-source nature, and flexibility [7]. Despite NVDA's popularity, the findings also indicate that alternative screen readers offer technical advantages in specific contexts. For instance, JAWS has been reported to provide more accurate detection of web elements such as links and URLs, which can improve navigation efficiency on complex websites [7]. This highlights that while NVDA excels in usability and accessibility, no single screen reader is universally optimal, and users may choose tools based on task requirements and system environments.

According to the installation aspect, NVDA is commonly installed on laptops, though some users also use it on mobile devices (albeit with limitations). Its flexibility could be the reason why NVDA is the primary and most familiar screen reader [7].

According to the usage aspect, NVDA is used to access and transmit text-based information, such as reading documents, emails, and web content. These findings are consistent with the literature showing that the limitations of access to critical information highlight the gap between textual and visual accessibility, underscoring the need for inclusive visualization design methods that accommodate non-visual interaction [10].

According to the add-ons support, NVDA is notable for its extensibility and customization. NVDA's strong add-on support—such as automatic time announcements, PowerPoint content reading, and customizable voices through Vocalizer-based speech—was identified as a major strength. These features allow users to optimize their interaction with digital content, improving efficiency and overall user experience [8], [9],[11]. These developments in add-on support complement NVDA's extensible architecture and suggest that future screen reader enhancements may increasingly depend on intelligent, context-aware assistance. However, successful implementation still depends on how well web content is structured and labeled.

According to the role of a web developer, both the literature and the evaluation emphasize that proper web design practices—such as structured headings, descriptive alternative text for images, correctly labeled form elements, and logical navigation—are essential for effective screen reader interaction [9], [10]. Without adherence to accessibility standards, even advanced screen readers may fail to deliver an optimal user experience.

According to the ease of use on mobile devices, the workshop evaluation findings align with a previous study that reveals a growing ecosystem of applications designed for visually impaired users, commonly categorized into navigation, object recognition, text-to-speech, and social interaction tools [12]. These findings show that NVDA is predominantly desktop-oriented, while mobile accessibility relies more heavily on built-in solutions such as TalkBack on Android[2] and

[2] Android's built-in screen reader for visually impaired users provides spoken feedback and touch-based navigation through gestures to control the device.

VoiceOver on iOS[3]. Some users also adopt alternative mobile screen readers, such as the Jiesuo Screen Reader[4], based on flexibility and feature specificity. These results support earlier systematic reviews emphasizing that usability and platform specificity are central to effective mobile accessibility solutions [12], [13].

Overall, NVDA's widespread adoption is supported by both empirical evaluation and prior research, particularly in terms of usability, extensibility, and community support. However, the findings also suggest that accessibility is a shared responsibility among screen reader developers, web designers, and application developers. Future research and development should focus on improving cross-platform usability, enhancing support for complex content such as data visualizations, and integrating intelligent assistance to further reduce accessibility barriers for visually impaired users [7]–[13].

The workshops were reviewed based on users' experiences with web- and desktop-assistance-based assistive tools, as described in Table 1. There are four different desktop-based assistance tools, focusing on their general type, and summarizing positive and negative user reviews. NVDA is highly regarded as a free, accessible option. It is sufficient for many users with

Table 1. Reviewed based on users' experiences with desktop-based and web-based assistive tools

Desktop Based assistance	Positive review	Negative review
NVDA	The free version is sufficient to meet the needs of users with low vision or total blindness. ITS web applications (Classroom, ITS Website) are generally accessible with assistive tools.	Some content with image elements on ITS web applications still needs descriptive text.
JAWS	A paid application with premium support.	Requires a paid license to access standard features that are already available in NVDA (open source).
UserWay (Free version)	Helpful for users with low vision due to available features.	Lacks features to support users who are totally blind.
UserWay (Paid version)	Offers additional disability profile features.	"Page structure" feature does not function properly. Text-to-speech feature overlaps with NVDA functionality. High cost for websites with heavy traffic.

total blindness or low vision, though it has minor issues with image descriptions on specific applications. JAWS is a paid, premium service. Its main drawback is the cost, as its standard features can be accessed for free through NVDA. UserWay also has a free service option that is limited for total blindness. It is noted as being helpful for low vision, but does not offer features for those who are totally blind. On the other hand, UserWay paid service has functional issues and high cost. Despite offering more features, the "Page structure" feature is noted as not working,

[3] Gesture-based screen reader for Apple devices (iPhone, iPad, and Mac) that provides audible descriptions of on-screen elements, allowing blind or low-vision users to navigate apps, read text, and control their device.
[4] a Chinese-made alternative for Android, due to its flexibility and specific features that meet user's needs.

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and there is a high financial barrier for popular websites. It also has conflicts with other tools (NVDA). The gap analysis in assistive technology utilization among PwDs with visual impairment is as described in Table 1.

NVDA is the most efficient choice in terms of features and cost, as it is free and compatible with many web applications. JAWS excels in premium features but is less efficient due to licensing requirements. Userway is suitable for web integration, but the paid version is relatively expensive and has overlapping functions with screen readers like NVDA. A combination of NVDA for desktop use and Userway Free for web can be a cost-effective solution with sufficient functionality, while continuing to improve the compatibility of ITS web content with these tools.

Table 2. Gap of Assistive Technology

Num	Type of Installation	Assistive Technology	Gap
1	Mobile Accessibility	On Android, students use TalkBack; on Apple devices, VoiceOver is used.	Some also rely on Jieshuo Screen Reader for Android due to its flexible features.
2	Web Accessibility	Most visually impaired students use NVDA as their primary screen reader on laptops, with limited use on mobile devices. • NVDA Features: Add-ons enhance NVDA's functionality, enabling tasks such as reading PowerPoint presentations, automatic time reading, and voice customization. • UserWay (Free Version)	Some also use JAWS for more accurate web element detection. Specialized Braille devices are used by some participants for tactile access. Developers must ensure that ITS web pages and digital platforms are structured for screen reader compatibility, including clear headings, alt text for images, labeled forms, and logical navigation.

The use of assistive technology was also reviewed during student-industry linkage session workshops, and findings showed that students with visual impairments report difficulties accessing job vacancy information, internship guidelines, and academic portals due to non-inclusive website design. Many course materials and digital forms are image-based or poorly labeled, making them inaccessible without a screen reader.

Overall, powerful assistive technologies like TalkBack, VoiceOver, and NVDA are widely adopted. There are still two main areas for improvement. First, there are feature gaps in standard tools. Users sometimes need to supplement standard tools with others (like Jieshuo or JAWS) to access more flexible or accurate features. Second, there are structural gaps in web content. The most significant challenge is ensuring that digital content itself is designed correctly (using proper headings, alt text, etc.) to allow the existing assistive technologies to function effectively. The gaps in assistive technology based on the type of installation are described in Table 2.

The recommended assistive technology alternatives mentioned above are more affordable compared to the assistive technology used at UWE Bristol as a best practice, which already has disability service provision facilities and assistive technology for people with disabilities on campus. UWE uses Blackboard to upload materials. Based on the UWE website [14], the term 'assistive technology' covers many things, such as text-to-speech and voice recognition software, video magnifiers, keyboards, computer mice, wrist rests and grips for pens. Some materials are provided in audio-only formats. UWE policy requires audio recording for learning materials. Figure 1 illustrates the UWE Blackboard platform.

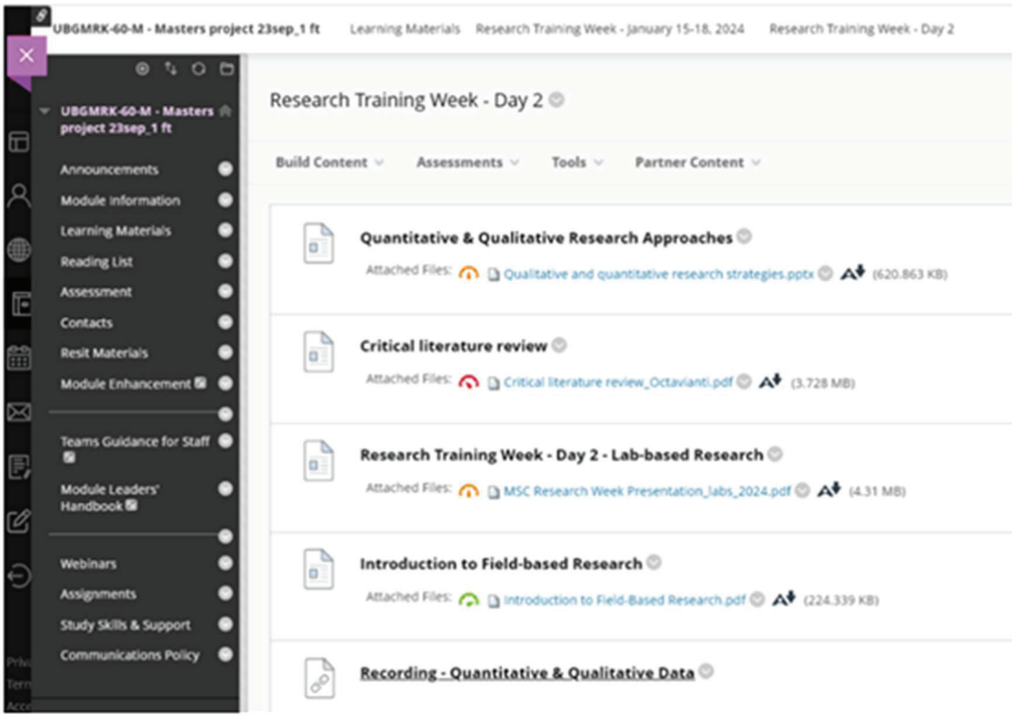

Figure 1. Recorded lectures and media files in UWE Blackboard

Based on the simulation, we identified the role of assistive technology in supporting accessibility for blind and low-vision students in the ITS environment. While ITS has promoted inclusion through internship programs and digital platforms such as myITS Classrom and myITS Student Connect, accessibility gaps still remain, particularly for students with visual impairments. To address this, the use of free assistive technologies such as the NVDA screen reader and the UserWay accessibility widget is recommended. The UserWay user interface in ITS Classroom is illustrated in Figure 2.

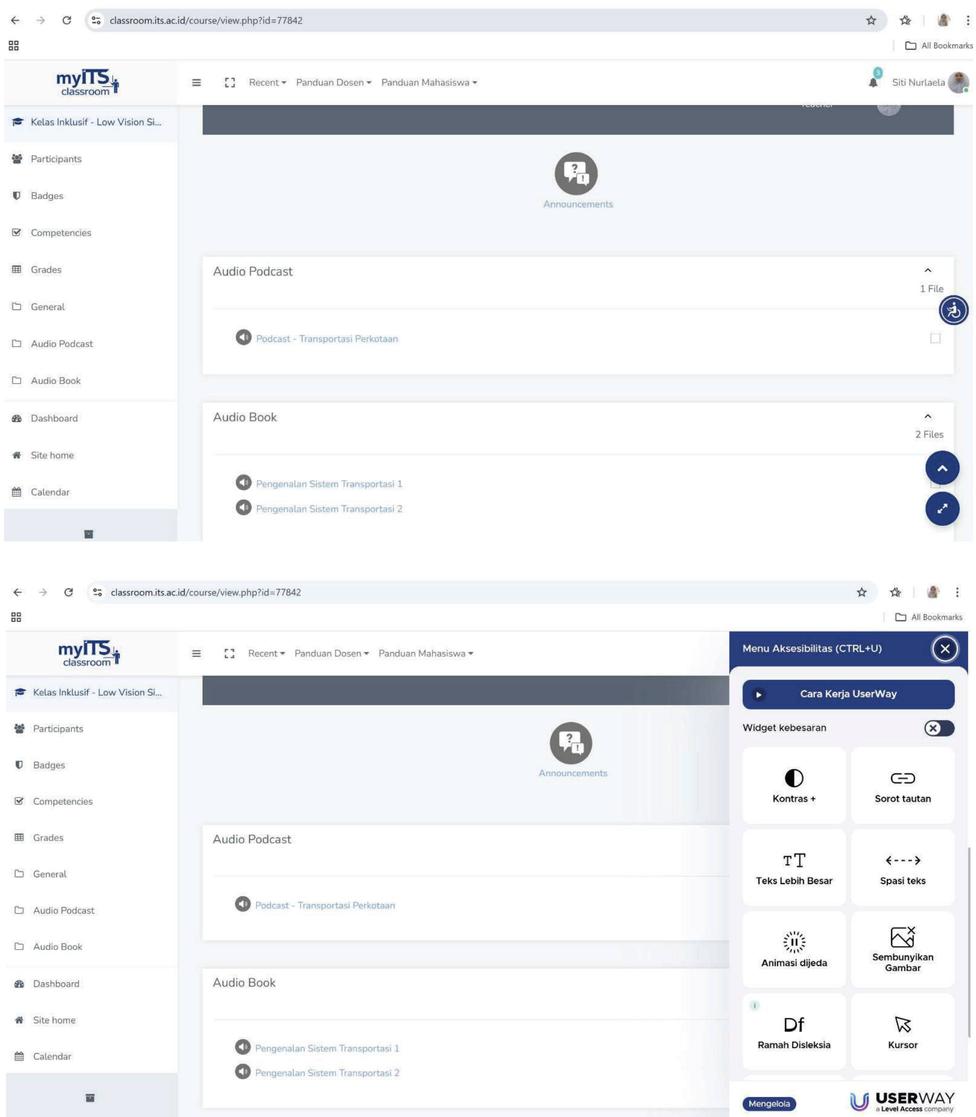

Figure 2. User Interface of ITS Classroom while Simulation

The findings of this research indicate that the integration of NVDA and UserWay in ITS systems provides a cost-effective, practical, and immediate step toward fulfilling ITS's commitment to inclusivity. By leveraging free assistive technologies, ITS can ensure that VIS have equal access to learning, internship opportunities, and digital resources, thereby strengthening its role as an inclusive higher education institution. The differences between NVDA and Userway (Free Version) as recommended alternatives are described in Table 3.

Table 3. The Differences between NVDA and UserWay (Free Version) as Alternatives Recommendation

Num	Component	Desktop Based assistance	
		NVDA	UserWay (Free Version)
1	Subscription	A free, open-source screen reader for Windows.	A free accessibility widget that can be easily installed on ITS websites and digital platforms.
2	Usages	Enables blind students to navigate the myITS portals, internship platforms, and digital learning materials using speech or Braille output.	Provides accessibility features such as text enlargement, contrast adjustment, cursor highlighting, and screen reader support.
3	Specific advantages	It is already widely used internationally, ensuring compatibility with Microsoft Office, web browsers, and e-learning platforms.	Particularly useful for students with low vision, dyslexia, or other reading difficulties.
4	Cost	Reduces financial barriers, as commercial screen readers are expensive.	Low maintenance and scalable across ITS websites and learning systems.
5	Manual/Guideline	The NVDA user manual is available	The UserWay user manual is available

4. Conclusion

Integrating NVDA and UserWay into ITS platforms provides a cost-effective, practical, and immediate step toward fulfilling ITS's commitment to inclusivity. By leveraging free assistive technologies, ITS can ensure that blind and low-vision students have equal access to learning, internship opportunities, and digital resources, strengthening its role as an inclusive higher education institution. Overall, NVDA's widespread adoption is supported by both empirical evaluation and prior research, particularly in terms of usability, extensibility, and community support. However, the findings also suggest that accessibility is a shared responsibility among screen reader developers, web designers, and application developers. Future research and development should focus on improving cross-platform usability, enhancing support for complex content such as data visualizations, and integrating intelligent assistance to further reduce accessibility barriers for students with visual impairments (VIS).

There are several policy recommendation based on the needs of VIS to access digital education, especially for transportation system course, namely: 1) Institutionalizing Assistive Technology, specifically by adopting NVDA as the official free screen reader for ITS students with blindness and integrating the UserWay free widget across ITS portals, myITS Student Connect, and faculty websites; 2) Providing training for students with visual impairments on using NVDA effectively, as well as training for IT staff and lecturers to design accessible documents, websites, and forms compatible with NVDA and UserWay.

Long-term programs should also involve establishing a disability support service that is responsible for ensuring continuous accessibility upgrades, offering consultation, technical support, and workshops for students and staff, as well as monitoring and evaluating ITS digital systems.

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