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Development of an AI-powered assistive technology-based learning model to improve learning accessibility for vocational students with disabilities

Sapto Haryoko [1], Hendra Jaya [1,*], Putri Ida Sunaryathy Samad [1], Lu'mu [1] and Basri [2]

[1] *Department of Electronics Engineering Education, Faculty of Engineering, Universitas Negeri Makassar.*
[2] *Department of Informatics Engineering, Hasan Sulur Institute.*

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Abstract

This study aims to develop an AI-Powered Assistive Technologies–based learning model to enhance learning accessibility for vocational students with disabilities. Using a Research and Development (R&D) approach and adopting the ADDIE model up to the development stage, this research produced a prototype of an adaptive and inclusive learning model equipped with intelligent assistive features, including text-to-speech, speech-to-text, automatic captioning, visual adaptation, and AI-driven navigation support. The needs analysis revealed significant accessibility barriers in vocational learning environments, particularly the limited availability of adaptive materials and insufficient assistive technology integration for students with sensory, cognitive, and motor impairments. The design and development phases resulted in a multimodal, AI-assisted learning framework aligned with principles of inclusive pedagogy. Expert validation involving specialists in vocational content, assistive technology, inclusive pedagogy, and language yielded an overall feasibility rating of 96.5%, categorised as highly feasible. In addition, user response testing involving 20 vocational students with disabilities demonstrated a positive acceptance rate of 99.4%, indicating that the AI-powered assistive features effectively enhanced engagement, comprehension, and independent learning. The findings affirm that the proposed model offers strong potential to support inclusive vocational education by addressing accessibility gaps and improving the learning experiences of students with disabilities. Although the study has not yet progressed to the implementation phase, the developed prototype provides a robust foundation for further empirical testing and large-scale application. Continued refinement is recommended to strengthen the ethical, pedagogical, and technological dimensions of AI integration in accessible learning environments.

Keywords: Assistive Technologies; Inclusive; Learning Accessibility; Vocational; Disabilities.

1. Introduction

Disability in vocational education refers to physical, mental, or sensory conditions that may affect an individual's ability to fully participate in the learning process [1]. The definition of disability encompasses various impairments that affect mobility, hearing, vision, and cognitive and intellectual abilities, which can create barriers for students with disabilities in achieving their academic potential [2]. The challenges faced by vocational students with disabilities in vocational colleges are often related to a lack of supportive infrastructure, such as limited physical accessibility to campus buildings, a lack of disability-friendly learning materials, and limitations in the use of technology that can help them interact with learning materials [3].

The lack of attention to accessibility needs in vocational colleges often exacerbates this situation, resulting in low academic success rates [4]. Students with disabilities often face indirect discrimination, are overlooked in the evaluation process, and lack adequate academic support [5]. The lack of adaptation in the curriculum and teaching to ensure

* Corresponding author: Hendra Jaya.

inclusivity can hinder their academic development, so they need policies and educational approaches that are more focused on accessibility needs in order to achieve success in vocational education [6].

Accessibility in learning is a basic right that must be fulfilled for every individual, including persons with disabilities, to ensure that they can obtain equal and quality education without physical, social, or technological barriers [7]. Limited access to educational facilities, resources, and learning materials that are not disability-friendly can hinder students with disabilities in reaching their academic potential [8]. This often results in low academic achievement and limited opportunities to participate in learning activities that can improve their competencies [9]. The inability to access assistive technology or appropriate learning materials can also cause them to fall behind in global competition and limit their career opportunities in line with their potential [10] (Anicésio & Anache, 2024). Therefore, it is important for educational institutions to create an inclusive and supportive learning environment, through the provision of adequate technology, infrastructure, and support, so that all students, including those with disabilities, can achieve optimal academic and career success [11].

Advances in educational technology have had a significant impact on overcoming accessibility barriers in higher education, especially for students with disabilities. One of the most important innovations is the use of Artificial Intelligence (AI)-based assistive technology, which helps students with disabilities access learning materials. Technologies such as screen readers for the visually impaired and voice recognition devices for the hearing impaired are highly effective tools in supporting their learning [12]. Furthermore, other adaptive applications, such as text size adjustment or background colour changes, enable students with visual impairments or dyslexia to follow lessons more effectively [13]. This technology not only improves accessibility, but also provides a more inclusive and individually tailored learning experience, which accelerates academic achievement for students with disabilities [14].

The gap in the use of assistive technology in vocational education is a major challenge that hinders the creation of an inclusive learning environment for students with disabilities. Research shows that although assistive technology has great potential to help students with disabilities achieve academic success, its use is often not optimal. Many vocational education institutions are not yet able to provide assistive technology facilities that meet the specific needs of students with disabilities, both in terms of hardware and software that can support their learning process [15]. In addition, other studies have found that the lack of training for teachers in the effective use of assistive technology also exacerbates the situation, so that teachers are often unable to maximise the use of technology to support the learning of students with disabilities [16].

Limited knowledge about the types of assistive technology that are appropriate and a lack of understanding about effective implementation lead to inequality in accessibility and educational opportunities for students with disabilities [17]. Therefore, it is important to develop an assistive technology-based learning model that not only provides the right tools but also improves educators' understanding of how to optimise these technologies in the context of vocational education [18]. By developing this model, it is hoped that an inclusive learning environment will be created that provides equal opportunities for all students, including those with special needs [19].

2. Literature Review

2.1. Inclusive Learning and Accessibility in Education

Inclusive learning is an approach that prioritises equal opportunities for all students, regardless of their physical, cognitive, or social abilities. In the context of higher education, particularly vocational education, learning accessibility is key to supporting the success of students with disabilities. This accessibility includes the provision of learning materials, teaching, and evaluation that are accessible to all students, including those with physical, sensory, or cognitive disabilities.

Inclusive learning and accessibility in education are two concepts that are very important in creating a fair and equitable educational environment for all students, including those with special needs. Inclusive learning aims to create an education system that accommodates all students regardless of their physical, intellectual, or social conditions. Research shows that inclusive education systems focus on providing equal access for all learners, including those with disabilities, to ensure that no one is marginalised in the learning process [20]. The application of varied learning methods, strategies, and materials is key to creating an environment that supports diversity, whether in terms of learning abilities, learning styles, or special needs [21]. Accessibility in education is also important to ensure that the infrastructure, curriculum, and attitudes of educators and education managers support the full participation of all students, including those who need special support [22] [23]. Therefore, integrating accessibility in education not only involves physical adaptations, but also requires changes in attitudes and teaching methodologies [24]. Implementing

policies that support accessibility and inclusivity in educational environments is a necessary step to remove barriers that students with special needs may face [25].

Accessibility in education is essential to ensure that every individual, regardless of their limitations, can access and participate in learning to the fullest extent possible. In the context of inclusive education, assistive technology plays a crucial role. This technology, such as software and tools that support students with visual or hearing impairments, provides equal opportunities for all students [26]. Artificial intelligence (AI) has a very important role in improving educational accessibility. AI-based applications, such as voice recognition and natural language processing, enable the adaptation of learning materials to the needs of each student, which expands opportunities for students with disabilities to participate fully in learning activities [27]. This technology also provides tools that can help students with visual, motor, or hearing impairments to access learning more effectively [28].

Technology also helps provide more inclusive learning solutions in online educational environments. The use of technologies such as screen readers and voice recognition allows greater access for students with various disabilities to access educational materials independently [29]. Thus, the application of assistive technology and AI in inclusive education is very helpful in reducing the barriers faced by individuals with disabilities, expanding access to educational opportunities, and ensuring that each individual can learn in the way that suits them best.

2.2. AI-Powered Assistive Technologies in Learning

AI-Powered Assistive Technologies in learning are innovations that can improve educational accessibility, especially for students with special needs. This technology uses artificial intelligence to create tools that can be tailored to individual needs, facilitating understanding of subject matter and enhancing interaction in the learning process [30]. AI enables personalised learning by adjusting content and pace based on each student's needs, as well as offering new ways to interact and improve accessibility for students with physical, visual and hearing disabilities [31]. Through technologies such as voice recognition, brain-computer interfaces, and text-to-speech software, students with disabilities can gain greater autonomy and participation in the classroom [30]. This technology also provides great opportunities to support students with visual impairments and limited mobility in increasing their independence in learning [32].

The integration of this technology must take into account ethical and accessibility issues to ensure that its benefits are felt by all students fairly without compromising their privacy or security [340]. Challenges such as data security and potential bias in AI algorithms need to be addressed to maximise the potential of this technology in empowering and including individuals with disabilities [33]. AI provides enormous opportunities to improve the quality of life and social participation for those who need support in education [34].

Smart assistive technology plays an important role in creating more inclusive learning for students with various limitations. Automatic translators for students with hearing impairments, for example, can facilitate better understanding of learning materials. Research shows that assistive technology can improve communication and participation of students with hearing impairments in educational settings, as well as increase their confidence and self-esteem [35]. In addition, software that supports students with dyslexia, such as reading aids, can help them overcome reading difficulties that often hinder their academic achievement [36]. The use of this technology in inclusive classrooms not only improves academic skills but also social skills, reducing the gap between students with and without physical or cognitive limitations [37].

2.3. Vocational Education and Persons with Disabilities

Vocational education is designed to prepare students with the practical skills needed in the workplace. However, for students with disabilities, access to practical materials and technical skills often poses an additional challenge. Kaur (2014) states that vocational programmes for students with disabilities must cover a range of skills that are adequate to help them integrate into society and the workplace [38]. This is compounded by the need to adapt teaching methods and facilities to ensure accessibility for all students, without exception.

Developing inclusive education programmes at the university level is crucial to assist students with disabilities, as explained by [39], who emphasises the importance of adjusting the curriculum and teaching methodologies in higher education to support students with disabilities [39]. Similarly, Muller [40] proposes the implementation of an individual educational trajectory model to help students with disabilities reach their full potential in a more flexible and tailored manner [40]. To create a more inclusive vocational education environment, there is a need for better support services, including special training for teaching staff and infrastructure adjustments that are more disability-friendly, as highlighted by [41], who points out that vocational teaching for students with disabilities needs to be carried out within a framework of cooperation between vocational educators and special educators [41].

The application of assistive technology, such as screen reader software for students with visual impairments or communication aids for students with hearing impairments, can facilitate their access to learning materials. Research shows that assistive technologies such as screen readers and braille are widely used by students with visual impairments to access information in standard formats that they previously could not access [42]. Meanwhile, the use of hearing aids has been shown to increase the self-efficacy of students with hearing disabilities in learning [43] Courses or practical training involving specific tools or devices also need to be considered to ensure that students with disabilities can use them in a manner appropriate to their needs. Artificial intelligence (AI)-based technology, as revealed in research on the "PeopleLens" system, can enhance the learning experience for students with visual impairments by providing more adaptive instructions and interfaces that are friendly to those with sensory limitations [44]. Furthermore, it is also important to involve teaching staff in the training and development process so that they better understand the specific needs of students with disabilities. This training can cover how to adapt learning materials, provide appropriate support, and how to create an inclusive classroom environment. Thus, vocational education can provide more equal opportunities for persons with disabilities to acquire the skills they need to compete in the world of work, as well as ensure that they can contribute optimally in various industrial sectors. Cooperation between vocational education institutions and industry is also crucial to ensure that graduates with disabilities have equal access to employment opportunities. Inclusive vocational education not only provides practical skills to students with disabilities, but also creates fair opportunities in the labour market, which ultimately contributes to a more inclusive and diverse society.

2.4. Personalised Learning through AI

Personalised learning is an approach that emphasises the adjustment of material, pace, and teaching methods to suit the characteristics and needs of individual students. This approach is important because each student has a unique learning style, and by using technology such as artificial intelligence (AI), teaching can be tailored to maximise their potential. This adjustment of learning has been proven to improve students' understanding of the material and motivation, as the material provided is more relevant to their individual needs and learning styles [44] [45]. AI technology enables a more adaptive learning experience, such as automatic learner profiling and material recommendations tailored to the individual progress of students, increasing their engagement and learning outcomes [46]. With the use of AI in education, learning content can be tailored to accommodate students' personal preferences and abilities, making it more flexible and efficient [47], [48]. AI not only supports the personalisation of material, but also adaptive assessment that provides real-time feedback, enabling more targeted and relevant teaching to the needs of each student [49].

AI can analyse data on students' interactions with learning materials, such as the time spent on each topic, the difficulties encountered, and their responses to various types of tasks. Using artificial intelligence (AI) algorithms, the data obtained can be processed to provide a learning experience tailored to the needs of each individual, including providing recommendations for more relevant materials [50]. In addition, AI enables the personalisation of learning experiences by adjusting the pace of learning and offering challenges that match students' abilities [51]. AI can also provide alternative learning strategies for students who may have difficulty with certain topics, using analytical data to design more effective learning paths [52]. The use of this technology can improve learning outcomes and accelerate student progress, especially by providing faster and more relevant feedback in line with their development [53]. Therefore, AI can play an important role in supporting the creation of a more relevant learning experience and improving student engagement and overall learning outcomes [54].

2.5. The Role of Student Experience in the Use of Assistive Technology

Student experience in using assistive technology plays a significant role in enhancing the effectiveness of learning for students with disabilities. Assistive technology provides students with visual impairments, such as screen readers, with freedom and independence in participating in learning [55]. However, for some students, the use of this technology requires additional adjustments or even creates new challenges, such as difficulties in operating the device or compatibility issues with existing learning materials [56]. For example, assistive devices for students with hearing impairments, such as automatic transcription applications, can be very helpful, but their operation can still be a barrier for some individuals who are not yet familiar with them [57]. Other studies show that students with physical disabilities also experience similar benefits, where assistive technology reduces the impact of their disabilities and improves their learning outcomes, although some technical and social challenges remain [58].

3. Research method

This study is a Research and Development (R&D) study that aims to produce an AI-Powered Assistive Technologies-based learning model to improve learning accessibility for vocational students with disabilities, as well as to test its feasibility and effectiveness. R&D research emphasises the process of producing valid and effectively usable educational products (Sugiyono, 2016). In the context of this study, the products developed are AI-based assistive technologies learning models, including implementation guidelines, adaptive learning tools, and prototypes of smart accessibility features (text-to-speech, AI-based captioning, and AI-based learning recommendations).

The development process was carried out using the ADDIE model, which consists of the Analysis, Design, Development, Implementation, and Evaluation stages. In the Analysis stage, an analysis of the learning needs of vocational students with disabilities was conducted through observation, interviews, and literature reviews related to smart assistive technologies, inclusive education, and adaptive pedagogy. This analysis included identifying student characteristics, learning barriers experienced (visual, auditory, mobility, cognitive), analysing vocational course competencies, and analysing the need for relevant AI-based assistive technology.

The Design stage included the design of learning model components, including the formulation of adaptive learning objectives, the development of model structures, the design of smart assistive technology usage flows, the selection of AI features (e.g., automatic captioning, image recognition for accessibility, AI voice assistants, or gesture recognition), the design of disability-friendly interfaces, and the development of assessment instruments. At this stage, the trial format and initial prototype design are also developed.

The Development stage includes the process of creating model prototypes, developing intelligent assistive technology components, compiling adaptive learning modules, and creating AI-based accessibility guidelines. At this stage, expert validation is also carried out, involving experts in educational technology, AI assistive technology, special education, and vocational materials. The experts provide assessments, suggestions, and recommendations for improving the model components and technology.

The Implementation stage was carried out through limited trials with vocational students with disabilities at one of the vocational colleges. The trials included the use of prototype models in real learning situations, observation of student interactions with AI assistive technology features, and data collection through questionnaires, interviews, and student performance assessments.

The final stage is Evaluation, which includes formative evaluation of the validation and trial process, as well as summative evaluation of the model's feasibility and effectiveness. At this stage, qualitative data in the form of expert advice and student responses are analysed, as well as quantitative data in the form of feasibility questionnaire scores and user responses. This evaluation is used to refine the model so that it is suitable for use in inclusive vocational learning.

3.1. Data Analysis Techniques

Data obtained from expert validation sheets (subject matter experts, AI-based assistive technology experts, inclusive pedagogy experts, and language experts) is analysed quantitatively using percentage analysis techniques to determine the feasibility of AI-Powered Assistive Technologies-based learning models. In addition, data on the responses of vocational students with disabilities to the application of the model was also analysed to determine the level of acceptance, ease of access, and effectiveness of AI features in supporting the learning process.

The analysis was conducted by calculating the percentage scores given by the validators and respondents using a feasibility formula commonly used in development research. The feasibility percentages of the material components, AI-based assistive technology features, inclusive pedagogical aspects, interface display and accessibility, and linguistic aspects were then interpreted using assessment criteria adapted from Riduwan (2016). These criteria provide an overview of the feasibility level of the developed product, whether the designed learning model meets the standards or still requires revision. The criteria for interpreting the feasibility of the learning model

Table 1 Interpretation Criteria for Assessing the Suitability of Intelligent Assistive Technology-Based Learning Models

Percentage	Interpretation Criteria
0% – 20	Highly Unsuitable
21% – 40	Unsuitable
41% – 60	Fairly Acceptable
61% – 80	Suitable
81%–100%	Highly Suitable

These criteria are used to interpret the assessment of all model components, ranging from the suitability of learning content, the relevance of AI assistive features (such as speech-to-text, text-to-speech, AI captioning, adaptive recommendations), disability-friendly interface display, and material presentation quality. Thus, this data analysis provides an objective basis for determining the suitability level of the learning model before it is widely used in inclusive vocational learning environments.

4. Results and discussion

The results of this study were compiled to answer the research question regarding the development of an AI-Powered Assistive Technologies-Based Learning Model aimed at improving learning accessibility for vocational students with disabilities. The model was developed using the ADDIE model, which consists of the *Analysis, Design, Development, Implementation,* and *Evaluation* stages. However, this study was only conducted up to the *Development* stage due to resource constraints, so the resulting model is *an* initial *prototype* that has undergone expert validation. This approach is in line with previous studies, such as those conducted by Maria U., Rusilowati A., and Hardyanto W. (2019), which also did not complete all stages of development due to researcher limitations, thus focusing only on product prototype development.

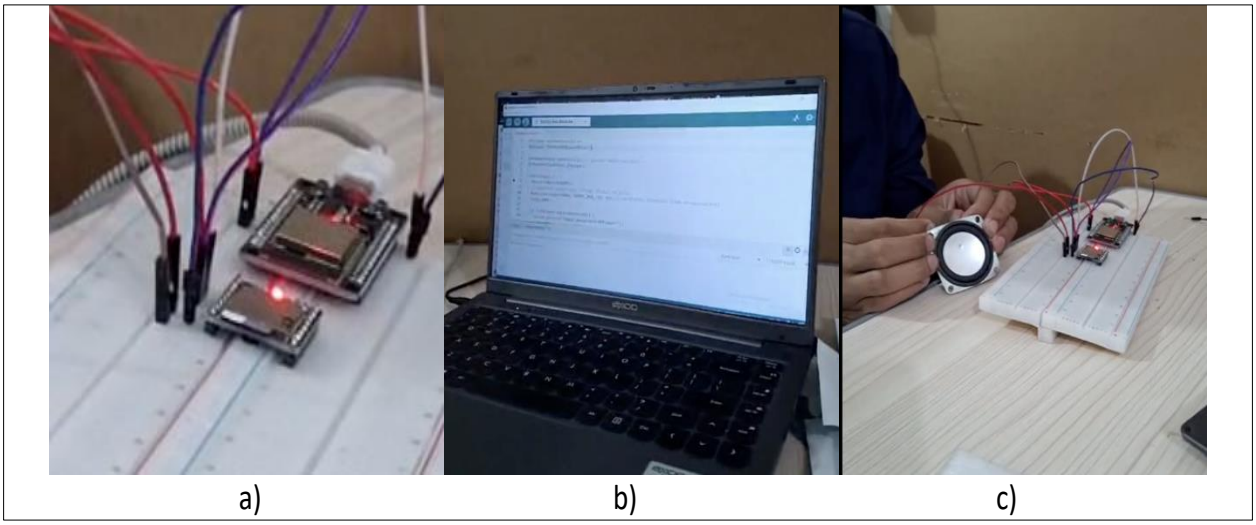

Figure 1 AI-Powered Assistive Technology. a) Electronic Circuit; b) Text to Speech Application Programming; c) Implementation of Text to Speech Application

In the Analysis stage, the researchers found various major problems related to the learning process for vocational students with disabilities, particularly the lack of assistive technology that could accommodate the sensory, cognitive, and motor needs of students. The available learning materials were not inclusive, were not adaptive, and did not provide accessibility features such as *text-to-speech, speech-to-text, automatic captioning,* high visual contrast, voice navigation, or AI support that could help students understand practical instructions. This condition had an impact on the low interactivity, engagement, and interest in learning among students. Vocational students aged 18–22 years need a more responsive, multimodal learning experience supported by technology that can accommodate individual needs, thereby increasing motivation and active participation. Therefore, at the analysis stage, the researchers conducted a needs

analysis, an analysis of the characteristics of students with disabilities, an analysis of vocational concepts and materials that require AI support, and an analysis of practical tasks that require intelligent assistive technology to improve accessibility.

The design stage then produced a preliminary design for an Intelligent Assistive Technology-based learning model that combines inclusive learning principles with artificial intelligence features. At this stage, the researchers designed an adaptive learning flow capable of adjusting the material based on student needs through the presentation of text, sound, adaptive visuals, and AI-based instructions. The main components designed include the integration of *text-to-speech* and *speech-to-text* features for blind and deaf students, *automatic captioning* to support verbal instruction comprehension, an automatic visual adjustment system for students with low vision, and AI-based object detection features to improve safety in practical activities. Additionally, researchers developed expert validation instruments covering content suitability, accessibility suitability, AI technology relevance, readability, and inclusive pedagogical design.

In the Development stage, the designed learning model was developed into an initial prototype that combined multimodal components and AI Assistive Technologies features. This prototype included the presentation of vocational material in various accessible formats, the integration of AI-based tools, and the development of technology usage guidelines for students with disabilities. The model was then validated by vocational material experts, educational technology experts , accessibility experts, and language experts. The validation aims to ensure that the model meets the aspects of content feasibility, effectiveness of smart assistive technology use, learning design suitability, and accessibility for various types of disabilities. The validation results form the basis for determining model design revisions before implementation in the next research stage.

4.1. Feasibility of AI-Powered Assistive Technology-Based Learning Models for the Accessibility of Vocational Students with Disabilities

The suitability of AI-powered assistive technology-based learning models is assessed through an expert validation process covering four main components, namely content suitability, pedagogical suitability, language suitability, and accessibility suitability. This validation process refers to adaptive learning device development instruments that have been aligned with higher education accessibility standards, particularly for students with disabilities. A component is considered feasible if it obtains a minimum percentage of ≥61%.

Based on the results of expert validation, it was found that the content feasibility component scored **97%** with a category *of highly feasible*, indicating that the material, structure, and relevance of the content were in line with vocational learning needs and supported the integration of intelligent assistive technology. The pedagogical suitability component achieved **96%,** categorised as *highly suitable,* indicating that the learning model is considered capable of facilitating an adaptive, interactive learning process that is appropriate for the characteristics of students with disabilities. The language suitability component obtained the highest score of **98%,** which is also categorised as *highly suitable,* reflecting the use of communicative, easy-to-understand, and inclusive language. Meanwhile, accessibility feasibility, as an important component—which includes ease of integration with screen readers, disability-friendly navigation, AI-based personalisation, and compatibility with various assistive **devices**—reached **95%,** placing it in the *highly feasible* category.

Table 2 Validation Results of the AI-Powered Assistive Technologies-Based Learning Model

No	Feasibility Component	Percentage (%)	Interpretation Criteria
1	Content Eligibility	97	Highly Suitable
2	Pedagogical Suitability	96	Highly Suitable
3	Language Suitability	98	Highly suitable
4	Accessibility Suitability	95	Highly Suitable
	Average	96.5	Highly Suitable

When all components are averaged, the score is **96.5%**, placing this learning model in the *highly feasible* category for use in supporting the learning process of vocational students with disabilities. This result is in line with Riduwan's (2016) opinion that a feasibility score in the range of 81–100% falls into the "highly feasible" category. Furthermore, the findings of this study are also consistent with the results of a study by Wardani et al. (2019), which reported that

adaptive technology-based learning media ( ) generally obtained a feasibility level in the range of 84–91% and were declared to be of good to very good quality.

4.2. Student Response to AI-Powered Assistive Technologies Learning Model to Improve Learning Accessibility for Vocational Students with Disabilities

Student responses to *the AI-Powered Assistive Technologies-Based Learning Model* among vocational students with disabilities indicate a very high level of suitability. In addition to obtaining scores from expert validation, researchers also need to know how students respond to the application of AI-based assistive technology as an adaptive learning medium. Student responses were assessed using the Guttman scale through a limited trial involving 20 students with disabilities who were selected at random.

Based on the pilot test results, a response percentage of **99.4%** (average of all indicators in Table 3) was obtained with an interpretation **of "very good**," so that the learning model was declared feasible because it met the feasibility standard of ≥ 61%. This finding is in line with the research by Churriyah & Nugraha (2019), which explains that student responses with a score of ≥ 61% are classified as "strong" or "very strong," and are therefore deemed feasible for use. It is also in line with the results of research by Musdzalifah & Rohayati (2018), which reported that digital teaching materials received a positive response with a percentage of 87.5% and an interpretation of "very feasible." Thus, the Intelligent Assistive Technology-based learning model is considered very feasible to use in improving accessibility and the quality of learning for vocational students with disabilities.

Table 3 Participants' Responses to the AI-Powered Assistive Technologies Learning Model**

No	Statement Discussed	Score	%
1	Intelligent Assistive Technology (AI-Assisted Tools) is presented in an engaging and accessible format for students with disabilities.	20	100
2	AI-based adaptive interfaces, navigation, and features simplify the learning process for students.	20	100
3	AI features support the alignment of materials with accessibility requirements specified in the learning syllabus.	19	95
4	AI-based assistive technology is a learning medium that meets the needs of students with disabilities in the current era.	20	100
5	AI-based learning models are attractive and easy to use.	20	100
6	AI interactive features make the learning process more enjoyable and less burdensome for students with disabilities.	20	100
7	Smart Assistive Technology helps create a more comfortable and inclusive learning experience.	20	100
8	Materials presented through the AI platform significantly improve students' understanding of learning topics.	19	95
9	Through AI adaptive features, students are more confident in understanding the material and completing exercises independently.	20	100

5. Conclusion

This study produced a prototype of an AI-Powered Assistive Technologies-Based Learning Model designed to improve accessibility and learning quality for vocational students with disabilities. Through a Research and Development (R&D) approach using the ADDIE model, which was implemented up to the development stage, this study shows that the integration of AI features such as text-to-speech, speech-to-text, automatic captioning, adaptive visuals, and disability-friendly navigation can significantly strengthen the principles of inclusive learning. Expert validation results indicate that the developed model is highly suitable for use, with an average suitability rating of 96.5% in terms of content, pedagogy, language, and accessibility. These findings confirm that the model design meets the quality standards for adaptive learning aimed at students with special needs. Furthermore, the response rate from students with disabilities reached 99.4%, indicating a very high level of acceptance, ease of use, and effectiveness of AI features in enhancing the learning experience. Thus, this model has the potential to be a strategic solution for vocational institutions to address accessibility gaps, strengthen the active participation of students with disabilities, and create a more inclusive and equitable learning environment. Although this research is still in the development stage, the results provide a strong

scientific basis for further implementation and testing on a broader scale. Continuous efforts are needed to refine the integration of AI in vocational education to make it more adaptive, secure, and sensitive to the diverse needs of students.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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