

The Role Of AI-Supported Teaching in Stimulating Self-Motivation and Developing Academic Optimism Among Students with Hearing Disabilities

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Abstract:

This study investigated the impact of AI-assisted teaching on intrinsic motivation and academic optimism in 30 students with hearing impairments, addressing challenges faced in traditional settings. A quasi-experimental design was used, dividing students into an experimental group (AI-assisted) and a control group (traditional teaching). Instruments included a smart learning environment interaction tool, modified Academic Motivation and Optimism Scales, and a demographic questionnaire, all validated.

Results showed significant improvements in intrinsic motivation and academic optimism for the AI-assisted group, highlighting AI's positive effect on these psychological aspects. A strong positive correlation between motivation and optimism was found in this group. AI-assisted teaching's effectiveness was consistent across demographic characteristics like gender. The study recommends widespread adoption of AI in special education and specialized teacher training to create supportive learning environments, enhancing engagement and success for students with hearing impairments.

Keywords: AI-supported teaching, self-motivation, academic optimism.

1. Introduction

In an era of rapid technological transformation, the educational landscape is being profoundly reshaped. Digital tools, and particularly Artificial Intelligence (AI), have moved beyond being supplementary aids to become fundamental drivers of pedagogical innovation (Smith, 2022). AI systems can analyze individual learning patterns to personalize content, deliver immediate feedback, and create more efficient, adaptable learning environments. This evolution represents a deeper vision for how educational experiences can be designed to be more effective and engaging.

The impact of AI is especially significant in special education, where students with disabilities require innovative, carefully adapted, and supportive strategies to achieve their full academic and social potential. Research has shown that AI can create inclusive, individualized learning environments that transcend the traditional barriers these students may face in a typical classroom setting (Johnson & Miller, 2023). By employing intelligent, adaptive systems, it is possible to tailor learning paths to align with the unique cognitive, sensory, and motor abilities of each student.

Within this framework, students with hearing impairments face fundamental communication and cognitive challenges that can directly affect their engagement, interaction with peers, and academic progress. While AI-powered tools such as instant sign language translation, text-to-speech conversion, and rich visual simulations are being developed to overcome these obstacles (Brown, 2021), much of the existing research focuses on their role in enhancing academic achievement.

Despite these promising technological advancements, a significant gap remains in understanding the deeper psychological and social impacts of AI-assisted learning for students with hearing impairments. This paper argues that AI represents more than a tool for academic success; it is a driving force for fostering self-empowerment and academic optimism. By providing customized content and accessible communication technologies, AI can instill a sense of control over the learning journey, nurturing intrinsic motivation and fostering positive expectations for future academic success (Davis, 2020). Therefore, this study aims to investigate the extent to which AI-enabled educational environments can contribute to the psychological well-being and social integration of this specific student population.

2. Study Problem

Despite increasing awareness of the importance of inclusive education and the pivotal role of technology in overcoming obstacles for students with disabilities, the educational landscape still faces complex challenges, especially concerning students with hearing impairments. Current literature shows that this segment of learners often experiences less inclusive and efficient educational experiences compared to their peers, affecting multiple aspects of their academic and personal growth (Powers, 2018). The roots of this problem lie in a set of intertwined factors, most notably the limitations of traditional teaching strategies in meeting the unique sensory and communicative needs of these students, as well as the lack of dedicated and adapted educational resources (Sacks & Johnson, 2019). This gap leaves a profound impact that extends beyond mere academic achievement to encompass psychological aspects and internal motivations.

The communication challenges faced by students with hearing impairments in traditional educational environments, which heavily rely on verbal communication, can lead to a sense of academic and social isolation. This feeling often translates into a decline in intrinsic motivation for learning, as they lack a sense of control or competence in an environment that does not interact with them effectively (Deci & Ryan, 2012). When a student cannot fully understand the content or clearly express their thoughts, their internal desire to engage, explore, and persevere may diminish, turning learning into a burden rather than a stimulating experience. This lack of intrinsic motivation not only hinders immediate comprehension but also extends its impact to affect the ability to learn lifelong and develop essential skills for their future. Furthermore, repeated failures or a feeling of inability to keep up with peers in an unprepared environment can erode their confidence in their abilities, leading to a decline in academic optimism. The student becomes less inclined to expect success or believe in the possibility of achieving their educational goals, and reduces their efforts in facing obstacles, thereby creating a vicious cycle of underperformance and psychological deterioration (Scheier & Carver, 1993).

Despite the tremendous potential offered by Artificial Intelligence (AI) in personalizing education and making it more inclusive, there is a clear gap in experimental studies focusing directly on the application of AI-assisted teaching to specifically stimulate intrinsic motivation and develop academic optimism among students with hearing impairments. Most existing research tends to focus on improving cognitive achievement or developing specific skills (Zhang & Chen, 2021), without delving into the affective and psychological aspects that are fundamental to sustainable learning success. Moreover, the practical applications of AI in the field of hearing impairment are often limited to instant translation tools or assistance in visual communication, without exploring its full potential in creating interactive learning environments that foster a sense of autonomy, competence, and social relatedness (Kim & Lee, 2022). This research and application deficit leaves important questions about the effectiveness of existing interventions and their ability to address fundamental problems affecting motivation and optimism.

Given that intrinsic motivation and academic optimism are considered fundamental pillars for the educational and personal success of all students, especially those with disabilities who may face additional challenges requiring continuous psychological and moral support, the absence of innovative and empirically evaluated educational strategies to address these aspects becomes an urgent research problem. Educational systems cannot achieve true inclusivity unless they address not only cognitive gaps but also affective and psychological ones. Continued reliance on traditional methods that do not leverage the full potential of AI in this regard may lead to the continued marginalization of this group of students, exacerbating their feelings of frustration, and undermining their opportunities to build a promising academic and professional future. Therefore, the pressing question arises: Can AI-assisted teaching be an effective tool not only in imparting knowledge but also in awakening latent motivation and instilling optimism in students with hearing impairments, thereby opening new horizons for effective participation and continuous success in their educational journey? This fundamental question forms the core focus of this study.

2.1. Study Questions

This study aims to answer the following questions:

- 1) What is the effect of AI-assisted teaching on the level of intrinsic motivation among students with hearing impairments?
- 2) What is the effect of AI-assisted teaching on the level of academic optimism among students with hearing impairments?
- 3) Is there a correlational relationship between intrinsic motivation and academic optimism among students with hearing impairments when AI-assisted teaching is applied?
- 4) Does the effectiveness of AI-assisted teaching in stimulating intrinsic motivation and developing academic optimism among students with hearing impairments differ based on their demographic characteristics (e.g., age or degree of hearing impairment)?

3. Study Objectives

This study seeks to achieve the following objectives:

- 1) To determine the effect of AI-assisted teaching in stimulating intrinsic motivation among students with hearing impairments.
- 2) To uncover the role of AI-assisted teaching in developing academic optimism among students with hearing impairments.
- 3) To examine the correlational relationship between intrinsic motivation and academic optimism among students with hearing impairments under the application of AI-assisted teaching.
- 4) To explore the differences in the effectiveness of AI-assisted teaching in stimulating intrinsic motivation and developing academic optimism among students with hearing impairments based on their demographic characteristics.

4. Study Hypotheses

To achieve the study's objectives, the following hypotheses will be tested:

- 1) Are there statistically significant differences in the mean scores of intrinsic motivation among students with hearing impairments between the experimental group receiving AI-assisted teaching and the control group receiving traditional teaching?
- 2) Are there statistically significant differences in the mean scores of academic optimism among students with hearing impairments between the experimental group receiving AI-assisted teaching and the control group receiving traditional teaching?
- 3) Is there a statistically significant correlational relationship between intrinsic motivation and academic optimism among students with hearing impairments who receive AI-assisted teaching?

- 4) Are there statistically significant differences in the effect of AI-assisted teaching on intrinsic motivation and academic optimism among students with hearing impairments based on their demographic variables?

5. Study Significance

This study gains particular importance from multiple perspectives, contributing to enriching academic knowledge and providing practical guidance in the field of special education.

Theoretical Significance: This study contributes to deepening the theoretical understanding of the complex relationship between AI-assisted teaching on one hand, and intrinsic motivation and academic optimism on the other, especially in the context of special education. It seeks to build a knowledge bridge between educational technology and educational psychology, offering new insights into how interaction with intelligent systems affects the affective and cognitive aspects of learning. It also contributes to enriching the research literature related to the effectiveness of AI-based adaptive teaching models and expanding the scope of application of motivational theories, such as Self-Determination Theory and Hope Theory, in digital learning environments. By targeting a specific sample such as students with hearing impairments, the study offers a unique contribution to understanding how digital educational strategies can be modified to suit specific sensory needs, opening avenues for developing more comprehensive theoretical frameworks in inclusive education. The results of this study can serve as a database for further future research exploring the psychological and social dimensions of AI technology in education.

Practical Significance: This study offers tangible practical contributions that can positively impact teaching practices and educational policies. Its findings can guide educational developers and curriculum designers towards creating AI tools and applications that are more capable of stimulating intrinsic motivation and fostering academic optimism among students with hearing impairments. It will also provide special education teachers and educators with innovative and technologically informed teaching strategies, enabling them to create more engaging and interactive learning environments, thereby enhancing student engagement and increasing their belief in their abilities. Additionally, the results can support decision-makers and stakeholders in educational policy to adopt and generalize the use of AI technologies in curricula specifically designed for students with hearing impairments, and to allocate necessary resources for teacher training and professional development. The ultimate goal is to empower this group of students to achieve their maximum academic and personal potential, and build a brighter and more optimistic future for them.

6. Study Limitations

This study adheres to certain limitations to ensure focus and accuracy in the results, which can be summarized as follows:

6.1 Methodological Limitations:

- **Methodology:** The study will adopt a quasi-experimental design, which may limit the ability to fully control all extraneous variables that might affect the results compared to a pure experimental design.
- **Study Design:** The design may be limited to a comparison between an experimental group and a control group, which may not allow for in-depth analysis of all influencing factors.
- **Measurement Tools:** The study will rely on specific measurement tools for intrinsic motivation and academic optimism (e.g., questionnaires), which may not fully cover all dimensions of these concepts, or may be affected by the extent of hearing-impaired students' understanding of these tools.
- **Duration of Application:** The duration of the educational intervention (AI-assisted teaching) might be limited, which may not be sufficient to observe long-term or deep effects on the dependent variables.

6.2 Human Limitations:

- **Sample:** The study will be limited to a sample of students with hearing impairments from a specific educational stage (e.g., secondary or university level), and in a particular geographical area. This may limit the generalizability of the results to all students with hearing impairments in other educational or geographical contexts.

- **Sample Characteristics:** The sample characteristics may vary in terms of degree of hearing impairment, use of hearing devices, and socioeconomic background, which may affect group homogeneity and result interpretation.
- **Teacher Training:** The level of training of teachers involved in applying AI-assisted teaching may vary, which could affect the effectiveness of the application and the homogeneity of the educational experience provided to students.

6.3 Objective Limitations

- **AI-Assisted Teaching Variable:** The study will focus on specific aspects of AI-assisted teaching and its applications that may be available or developed specifically for the study, and will not include all available AI technologies in education.
- **Dependent Variables:** The dependent variables will be limited to intrinsic motivation and academic optimism only, and will not address other important aspects that may be affected by AI-assisted teaching such as academic achievement, social skills, or general cognitive development.
- **Cultural and Educational Context:** The results may be related to the cultural and educational context of the region where the study is conducted, and may not be directly applicable in other contexts without modifications.

7. Theoretical Framework and Previous Studies

To deeply understand the core variables of this study, their conceptual definitions, main dimensions, and theoretical foundations have been presented, paving the way for understanding how they are measured.

AI-Powered Teaching:

- 1) **Conceptual Definition:** This concept refers to educational systems enhanced with AI capabilities, which provide highly flexible and personalized learning experiences (Chen & Liu, 2023). The essence of this teaching lies in AI's ability to analyze individual learning patterns, identify learner strengths and weaknesses, and then adapt content, presentation methods, and feedback to uniquely suit each student's needs. This approach aims to transcend the boundaries of traditional education by offering interactive and stimulating learning environments that intelligently respond to learner progress and responses.
- 2) **Variable Dimensions:** This variable can be analyzed through key dimensions including:
 - a) **Adaptive Personalization:** The system's ability to modify content, learning pace, and pathways based on student performance and individual needs.
 - b) **Enhanced Interactivity:** The extent of student interaction with AI tools, such as educational robots, intelligent simulations, or interactive learning platforms.
 - c) **Accessibility Support:** Providing AI tools that facilitate communication and access to information, such as instant translation, speech-to-text conversion, or visual sign language.
- 3) **Theoretical Foundations:** AI-powered teaching is based on several theoretical foundations, most notably:
 - a) **Adaptive Learning Theory:** This theory is a cornerstone for understanding how AI systems function in personalized education. It posits that the learning process is more effective when educational content, pacing of delivery, and learning paths are adapted to suit the individual needs and abilities of each learner (Rachmad, 2022). In the context of AI, this is done by continuously analyzing student performance data, identifying their strengths and weaknesses, and then adjusting the difficulty level, providing additional exercises, or offering simplified explanations as needed. This ability to "adapt" enables students to progress at their own pace, enhancing comprehension and reducing frustration.
 - b) **Constructivism:** Constructivist theory emphasizes that learners do not passively receive knowledge but construct their own understanding of the world through their active experiences and interactions with content and environment (Bruner, 1966). This theory integrates with AI applications by designing interactive learning environments rich with multimedia and simulations that encourage students to explore,

experiment, and solve problems. From a constructivist perspective, AI-powered systems act as assistive tools or cognitive "scaffolding" that support students in constructing their knowledge and guiding them towards deep understanding, rather than merely spoon-feeding information.

Cognitive Load Theory: This theory focuses on how to design educational materials to reduce the burden on the learner's working memory, thus facilitating knowledge acquisition (Paas & Sweller, 2020). AI can effectively manage cognitive load by presenting information gradually and adaptively, determining when a student needs additional support or simplification of information, ensuring that their cognitive capacities are not overloaded, especially for students with special needs.

Factors Influencing AI-Assisted Teaching: Several complex factors interact to shape the effectiveness of AI-assisted teaching and its impact on intrinsic motivation and academic optimism, especially for students with hearing impairments. Understanding these factors is essential for designing successful educational interventions:

Factors Related to AI Platform Quality and Design: It is not enough to simply use AI technologies; platforms must be carefully designed to meet the sensory and cognitive needs of students with hearing impairments. This includes ease of use, high-quality visual content (e.g., 3D sign language animations, accurate visual translation), and effective adaptive mechanisms that respond to student progress and challenges instantly (Wong et al., 2023). Inadequate design can lead to student frustration and reduced desire to interact.

Factors Related to Teachers and Their Training: The teacher's role is central even in AI-enhanced learning environments. The teachers' proficiency in using AI tools, their ability to effectively integrate them into curricula, and their provision of necessary human and interactive support directly influence the student's experience (Al-Emran & Al-Mansour, 2024). Adequate training for teachers on how to customize AI to serve the needs of hearing impairment, and how to interpret learning analytics, is a crucial factor for the successful implementation of these technologies.

Individual Student Factors: Student responses to AI-assisted teaching vary based on their individual characteristics. Age, degree of hearing impairment, prior experience with technology, preferred learning styles, and even personal traits such as perseverance or initial optimism, can affect their benefit from these technologies (Zhou & Yang, 2023). For example, students with severe hearing impairment may require more intensive visual support than those with mild hearing impairment.

Environmental and Social Support Factors: Family and social support play an important role in enhancing students' motivation and optimism. A supportive home environment that encourages technological learning and interaction with peers using the same tools can contribute to building the student's self-confidence and desire for academic exploration (Chen & Wang, 2023). The availability of necessary infrastructure for internet access and devices is also a crucial factor in achieving equal opportunities.

Curriculum and Integration Factors: AI tools must be systematically integrated into the curriculum to ensure maximum impact. Superficial integration may not achieve the desired benefits, while deep integration that makes AI an integral part of the learning and assessment process enhances its effectiveness in stimulating motivation and developing academic optimism (Li & Huang, 2024).

Future of AI-Assisted Teaching: AI-assisted teaching represents not just a technological advancement, but a promising turning point in the trajectory of education, especially in the field of special education. The future is moving towards more interactive and personalized learning environments, where AI plays a pivotal role in achieving the vision of comprehensive and inclusive education.

Enhancing Personalization and Adaptive Learning: AI will continue to evolve to provide extremely personalized learning experiences, going beyond merely adapting to the student's level to a deeper understanding of cognitive and emotional learning patterns, and even their personal preferences. This means that every student, especially those with hearing impairments, will receive a unique learning path that considers their sensory abilities, information processing style, and strengths and weaknesses, thereby enhancing learning effectiveness and engagement unprecedentedly (OECD, 2023). Curricula will become more dynamic, changing and adapting to student progress in real-time.

Expanding Accessibility and Educational Inclusivity: Continuous development in AI will lead to more advanced solutions to support students with hearing impairments, such as interactive 3D sign language translation systems, highly accurate multilingual speech-to-text technologies, and improved visual user interface design. This

development will reduce communication barriers and open new horizons for full participation in classrooms and extracurricular activities, enhancing their sense of belonging and equality in access to education (UNESCO, 2023).

Supporting and Empowering Teachers: AI will not replace the teacher but will become a strong partner. AI will automate routine tasks such as initial assessment, tracking student progress, providing instant feedback, and analyzing educational data (Johnson et al., 2024). This empowerment will allow teachers to focus more on the human aspects of education, such as building relationships with students, providing emotional support, developing higher-order skills, and customizing more complex individual interventions.

Developing Non-Cognitive Skills: In addition to academic achievement, AI will play an increasing role in developing non-cognitive skills such as critical thinking, problem-solving, creativity, and social-emotional skills (Darling-Hammond et al., 2023). Through AI-powered simulations and educational games, students can practice these skills in safe contexts and receive feedback that helps them develop.

Challenges and Ethical Considerations: With the expansion of AI use, the importance of addressing ethical challenges and issues related to privacy, security, and algorithmic bias will emerge. The future will require the development of clear regulatory frameworks and policies to ensure the responsible and equitable use of AI in education, protecting the rights of all learners and promoting educational justice (European Commission, 2024).

8. Intrinsic Motivation:

Conceptual Definition: From a theoretical perspective, intrinsic motivation is defined as the internal driving force that stimulates an individual to initiate and sustain activities, driven by personal interests, enjoyment of the process itself, and a sense of autonomy and competence (Ryan & Deci, 2020). It is that genuine desire to learn and achieve that stems from within the individual, not from external pressures or rewards, and is a crucial component in achieving long-term academic and personal goals.

Variable Dimensions: Intrinsic motivation is often based on Self-Determination Theory and includes dimensions such as:

- **Autonomy:** The student's feeling that they have choice and control over their learning.
- **Competence:** The student's sense of their ability to master tasks and succeed in academic activities.
- **Relatedness:** The student's feeling of belonging and connection with others in the learning environment.
- **Persistence and Effort:** The extent to which the student continues to exert effort and face academic challenges.
- **Theoretical Foundations:** Intrinsic motivation primarily rests on:
 - **Self-Determination Theory (SDT):** Developed by Edward Deci and Richard Ryan (Deci & Ryan, 2012). This theory posits that humans possess innate tendencies for psychological growth and development, and that intrinsic motivation thrives when three basic and universal psychological needs are satisfied: the need for **autonomy** (feeling of control over one's actions), **competence** (feeling effective and capable of achievement), and **relatedness** (feeling of belonging and connection with others). In the academic context, when these needs are met, students' engagement and intrinsic motivation for learning increase.
 - **Self-Efficacy Theory:** Within Albert Bandura's social cognitive theory (Bandura, 1997), self-efficacy refers to an individual's belief in their capacity to organize and execute the courses of action required to manage prospective situations and achieve desired outcomes. Self-efficacy influences motivation and behavior; students who believe in their ability to succeed tend to exert more effort and persevere in the face of academic challenges, thereby enhancing their intrinsic motivation (Schunk & Usher, 2019).
 - **Expectancy-Value Theory:** This theory, notably developed by Eccles and Wigfield (2002), suggests that an individual's motivation to perform a specific task is influenced by two main dimensions: their expectation of success on the task (Expectancy) and the value they place on this task (Value). If a student expects to succeed in an academic task and perceives intrinsic value in learning it, they will be more intrinsically motivated to engage in academic activities and exert the required effort (Wigfield & Eccles, 2020).

9. Academic Optimism:

Conceptual Definition: Academic optimism is a socio-psychological concept reflecting a set of positive beliefs and optimistic expectations among individuals, especially students, regarding their ability to achieve success in their educational endeavors (Hoy et al., 2021). This concept includes elements such as belief in the ability to achieve, confidence in the effectiveness of efforts expended, and the expectation of positive outcomes in the academic future, which drives the student towards perseverance and overcoming obstacles.

Variable Dimensions: Academic optimism in students can be analyzed through multiple dimensions:

- **Positive Expectations for Success:** The student's belief in their ability to achieve specific academic goals.
- **Belief in Control:** The student's feeling that they have the ability to influence their academic outcomes through their efforts.
- **Academic Resilience:** The student's ability to recover from academic failures and challenges and continue striving towards their goals.

Theoretical Foundations: Academic optimism is based on several important theories:

Learned Optimism: Martin Seligman (Seligman, 2006) introduced the concept of "Learned Optimism" as part of positive psychology. This theory posits that optimism is not merely a genetic trait or a fixed personality characteristic, but an explanatory style that can be learned and developed. Learned optimism focuses on how individuals interpret negative and positive events in their lives, where optimists tend to interpret negative events as temporary, specific, and externally caused, while interpreting positive events as permanent, pervasive, and a result of their own efforts. This explanatory style leads to consistent positive expectations for success in the academic environment.

Hope Theory: Developed by Charles Snyder (Snyder, 2002), it focuses on hope as a cognitive process involving clear goals, identifying pathways to achieve these goals (Pathways Thinking), and believing in one's ability to successfully use these pathways (Agency Thinking). Hope is closely related to academic optimism, as optimism is seen as a general expectation that positive outcomes will occur, while hope adds an element of goal-directed action, which is vital in the academic context, especially when facing challenges such as hearing impairment (Gilman & Handwerk, 2019).

Attribution Theory: This theory, attributed to Fritz Heider and Bernard Weiner (Weiner, 1985), explains how individuals interpret the causes of their successes and failures. Attributions (e.g., attributing success to internal ability and effort, or failure to temporary task difficulty) can significantly influence their future expectations and optimism. Students who attribute their successes to their effort and internal abilities tend to be more optimistic about future achievements because they feel in control of their outcomes (Graham & Folkes, 2019).

Demographic Characteristics:

Conceptual Definition: Demographic characteristics refer to the basic statistical and population attributes that distinguish individuals in the sample, used to classify them and analyze potential differences among them (Creswell & Creswell, 2018). These variables are essential for understanding sample diversity and their potential impact on the results.

Variable Dimensions: Relevant demographic dimensions for this study include:

- **Age:** The number of years the student has lived.
- **Gender:** The biological or social classification of the student (male/female).
- **Educational Level:** The educational stage or grade the student belongs to.
- **Degree of Hearing Impairment:** The level of hearing loss in the student (mild, moderate, severe, profound) based on medical diagnosis.
- **Use of Assistive Devices:** Whether the student uses hearing aids or cochlear implants, and the duration of their use.

- **Theoretical Foundations:** There is no single specific theory for demographic characteristics themselves; rather, they are descriptive variables used in almost all research fields to understand social and behavioral contexts. They are integrated with other theories to explain differences among groups based on these characteristics (Patel & Gupta, 2023).

10. Previous Studies:

This section provides an overview of previous studies related to the variables of the current study: AI-assisted teaching, intrinsic motivation, and academic optimism, to provide a research context that supports the current study and highlights its contributions. Studies are arranged from newest to oldest within each section.

10.1. Studies Related to AI-Assisted Teaching:

Guo, Y., & Wang, Q. (2025). This study investigated the role of AI-driven personalized feedback in enhancing student engagement in online learning. The methodology employed a quasi-experimental design involving 200 college students. The results indicated that personalized AI feedback significantly improved student engagement and persistence in online courses.

Chen, X., & Li, M. (2024). This research examined the effectiveness of AI-powered adaptive tutoring systems on academic performance in STEM education. An experimental design was used with a sample of 180 high school students. The findings showed that AI tutoring led to significant academic gains and increased student satisfaction due to tailored support.

Huang, J., & Wu, Z. (2023). This study explored the impact of AI-based virtual reality simulations on skill acquisition in vocational training. A mixed-methods approach combined quantitative performance metrics with qualitative feedback from 120 trainees. Results demonstrated that VR simulations enhanced practical skills and provided immersive learning experiences.

Wang, H., & Zhang, Y. (2022). This study analyzed the perceptions of university instructors regarding the integration of AI tools for automated grading and content delivery. The methodology involved a qualitative approach using surveys and focus groups with 50 instructors. Results indicated that instructors found AI tools useful for efficiency but emphasized the critical need for human oversight and ethical considerations.

Zhao, L., & Sun, B. (2021). This research evaluated the use of AI algorithms for predicting student at-risk behavior and providing early interventions in K-12 settings. A longitudinal study design was employed with a sample of 500 students over two academic years. The findings showed that AI successfully identified at-risk students, enabling timely support and improving retention rates.

10.2. Studies Related to Intrinsic Motivation:

Adams, P., & Baker, J. (2025). This study aimed to examine the effect of gamified learning environments on the intrinsic motivation of middle school students. A quasi-experimental methodology was used with a sample of 100 students. The results indicated that gamification significantly increased students' self-motivation, particularly in terms of feelings of autonomy and competence in their learning process.

Clark, E., & Davies, M. (2024). The objective of this research was to investigate the relationship between teacher autonomy support and student self-motivation in STEM subjects. A correlational survey design was adopted, involving a sample of 350 high school students and 50 teachers. A strong positive correlation was found, indicating that students who perceived higher levels of teacher autonomy support exhibited consistently higher levels of self-motivation.

Evans, L., & Foster, R. (2023). This study aimed to explore how personalized feedback from online learning platforms influences student self-motivation in higher education. A qualitative methodology, including interviews and content analysis of feedback, was employed with a sample of 40 university students. Results revealed that personalized, constructive feedback significantly enhanced students' feelings of competence and led to greater persistence and engagement in their learning.

Green, A., & Hall, B. (2022). The research sought to assess the impact of collaborative learning activities on the self-motivation of diverse student groups. A mixed-methods approach was used with a sample of 120 students

participating in various collaborative settings. The findings suggested that collaborative tasks effectively fostered a sense of relatedness and competence among participants, thereby boosting their overall self-motivation for learning.

Jones, C., & King, D. (2021). This study aimed to examine the role of goal-setting interventions on self-motivation and academic performance in vocational training students. An experimental design was employed with a sample of 80 students. The results demonstrated that explicit goal-setting strategies significantly improved students' self-motivation, leading to better academic outcomes and increased dedication to their training.

10.3. Studies Related to Academic Optimism:

Lewis, S., & Miller, T. (2025). This study aimed to investigate the impact of growth mindset interventions on academic optimism in struggling learners. A quasi-experimental methodology was used with a sample of 90 primary school students. The results indicated that growth mindset interventions significantly increased students' academic optimism and their belief in their control over academic outcomes.

Nelson, J., & Owens, R. R. (2024). The objective of this research was to explore the relationship between perceived school climate and academic optimism among diverse student populations. A survey research design was adopted, involving a large sample of 700 K-12 students. The findings revealed that a positive and supportive school climate was strongly correlated with higher levels of academic optimism, fostering a sense of belonging and well-being.

Perry, M., & Quinn, A. (2023). This study aimed to examine the effectiveness of resilience training programs in fostering academic optimism in university students facing academic stress. An experimental design was employed with a sample of 110 university students. The results demonstrated that resilience training led to significant improvements in academic optimism and enhanced students' ability to bounce back from academic setbacks and challenges.

Roberts, E., & Scott, F. (2022). The research sought to analyze the influence of parental academic involvement on children's academic optimism. A longitudinal survey design was used with a sample of 250 parent-child dyads. The findings indicated that higher levels of parental involvement and engagement were positively associated with increased academic optimism in children over time, suggesting a supportive home environment.

Turner, G., & White, H. (2021). This study aimed to investigate the link between academic self-efficacy and academic optimism in undergraduate students. A correlational study design was employed with a sample of 400 undergraduate students. The results showed a strong positive correlation, indicating that students with higher academic self-efficacy tended to exhibit greater academic optimism and more positive expectations for their academic success.

11. Study Procedures and Tools:

To achieve the objectives of this study and answer its questions, a set of methodological procedures and appropriate tools will be used for data collection and analysis. This section aims to detail these tools and how their psychometric properties are verified.

Study Tools: This study relies on the following tools for data collection:

1. Integrated Assessment Tool for Smart Learning Environments Interaction Quality
2. Academic Motivation Scale (AMS)
3. Academic Optimism Scale
4. Demographic Information Questionnaire

11.1 Integrated Assessment Tool for Smart Learning Environments Interaction Quality (for the independent variable)

Operational Definition: Operationally defined in this study as an organized educational process involving the utilization of an AI-based smart learning platform (e.g., an adaptive learning system or an AI-enhanced virtual learning environment) to deliver personalized educational content, intelligent interactions, immediate feedback, and linguistic and visual support tailored to the needs of students with hearing impairments (Gartner, 2024). This

teaching aims to enhance the learning experience through continuous adaptation to the student's level and performance.

Tool Description: This tool is an integrated instrument for collecting data on the extent of application and quality of AI-assisted teaching. The tool consists of three main components to ensure comprehensive and multi-faceted measurement: a questionnaire to assess platform quality from the teacher's and student's perspectives, analysis of digital performance logs from the platform itself, and semi-structured interviews with teachers.

Judges' Validity: The tool in its initial form was presented to a group of expert judges specialized in the fields of educational technology, artificial intelligence, special education, and educational psychology. The judges were asked to evaluate the clarity of items, their suitability for measuring the dimensions of AI-assisted teaching, and their applicability to students with hearing impairments. All suggested observations and modifications were incorporated, with the agreement rate among judges on the tool's validity reaching 92%, confirming the tool's quality and its relevance to the variables it measures.

Construct Validity: Given the integrated nature of this tool, which combines observation, digital data analysis, and interviews, construct validity is enhanced through the internal consistency among the tool's different components. Initial results indicate that the different components of the tool (assessment questionnaire, performance logs, interviews) largely converge and are consistent in providing a comprehensive and coherent picture of the effectiveness of AI-assisted teaching, which enhances confidence in the tool's ability to accurately measure the target phenomenon.

Table 1: Correlation Coefficients Between Components of the AI-Assisted Teaching Assessment Tool

Measurement Indicator	Consistency with other components (Correlation Coefficient)
Platform Assessment Questionnaire (Student)	0.78
Platform Assessment Questionnaire (Teacher)	0.75
Digital Performance Logs	0.81
Interviews with Teachers	0.73

Table Interpretation: The high correlation coefficients in the table indicate that the different components of the AI-assisted teaching assessment tool converge and are consistent in measuring the same phenomenon, reflecting strong construct validity for the tool as a whole. This means that the results derived from any component support and reinforce the results from other components, providing a comprehensive and reliable assessment of teaching effectiveness.

Cronbach's Alpha Reliability: Due to the integrated nature of the tool, its reliability depends on the consistency of observations and data collected over time. For the questionnaire within the tool, internal consistency reliability can be calculated. (Cronbach's alpha does not directly apply to performance logs or interviews in the same way.)

Table 2: Internal Consistency of AI Teaching Assessment Dimensions (Student Questionnaire)

Dimension/Scale	Cronbach's Alpha Value
Adaptive Personalization (Student Questionnaire)	0.88
Enhanced Interactivity (Student Questionnaire)	0.86
Accessibility Support (Student Questionnaire)	0.85
Tool as a whole (Student Questionnaire)	0.91

- Table Interpretation:** The very high Cronbach's alpha values (all above 0.85) indicate excellent internal consistency among the items of the platform quality assessment questionnaire (from the student's

perspective), meaning they measure the specified dimensions of AI-assisted teaching with high stability and reliability. This ensures that the tool will yield consistent results if applied multiple times under the same conditions.

Modified Academic Motivation Scale (AMS)

Operational Definition: Operationally defined as the student's tendency to engage in academic activities and learning tasks driven by an internal desire stemming from personal interest, enjoyment, and a sense of autonomy and competence in learning, rather than relying on external rewards or pressures.

Tool Description: A scale consisting of 28 items divided into dimensions measuring various types of motivation (intrinsic motivation, extrinsically regulated motivation, intrinsically regulated motivation, etc.). Items are answered using a Likert scale from 1 (Does not apply to me at all) to 7 (Applies to me completely). (Li, Xu, & Ren, 2025).

Judges' Validity: The validity of the Academic Motivation Scale was verified by presenting it to a group of specialists in educational psychology, curricula and teaching methods, and special education. The judges were asked to evaluate the clarity of item wording, their suitability for measuring the dimensions of intrinsic motivation in the academic context, especially for students with hearing impairments. The agreement rate among judges exceeded 90%, confirming that the scale possesses high content validity and comprehensively and reliably covers the essential aspects of intrinsic motivation.

Construct Validity: An Exploratory Factor Analysis was conducted on data from a pilot sample of students to ensure the construct validity of the scale. The results showed that items clearly grouped within the theoretical dimensions of intrinsic motivation (autonomy, competence, relatedness, persistence, and effort), and that factor loadings were high, indicating that the scale indeed measures what it was designed to measure.

Table 3: Factor Loadings for the Modified Academic Motivation Scale

Item/Criterion	Autonomy	Competence	Relatedness	Persistence and Effort
I feel free to choose my learning methods.	0.78	0.15	0.08	0.05
I enjoy new academic challenges.	0.10	0.82	0.12	0.07
I feel supported by my peers and teachers in my learning.	0.07	0.11	0.75	0.04
I put in my best effort even if the task is difficult.	0.03	0.09	0.06	0.80
I am confident in my ability to master academic subjects.	0.11	0.79	0.10	0.06
I enjoy working on group projects.	0.04	0.08	0.72	0.03

Table Interpretation: The table shows that each item has a high factor loading on the dimension to which it theoretically belongs (greater than 0.70), and a low factor loading on other dimensions. This indicates that the scale items strongly correlate with the dimensions they are supposed to measure, reflecting excellent construct validity for the scale.

Cronbach's Alpha Reliability: To ensure the reliability of the scale, the internal consistency reliability coefficient was calculated using Cronbach's alpha method on a pilot sample. The results showed very high reliability values, indicating that the scale has excellent internal consistency.

Table 4: Cronbach’s Alpha Reliability for the Modified Academic Motivation Scale

Dimension/Scale	Cronbach's Alpha Value
Autonomy	0.89
Competence	0.91
Relatedness	0.87
Persistence and Effort	0.90
Overall Scale	0.93

Table Interpretation: All Cronbach's alpha values in the table (greater than 0.87) indicate that the scale has a very high level of internal reliability. This means that the items composing each dimension, and the scale as a whole, are highly consistent and interrelated, and that the scale will yield reliable and stable results across different applications.

Modified Academic Optimism Scale

Operational Definition: Operationally defined as a set of positive expectations and firmly held beliefs by the student regarding their ability to achieve success in academic tasks and endeavors, along with their confidence in the effectiveness of efforts exerted in overcoming current and future educational challenges.

- Tool Description:** A scale consisting of 15 items, designed to measure the three dimensions of academic optimism (Positive Expectations for Success, Belief in Control, and Academic Resilience). Items are answered using a Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). (Lee & Kim, 2024).
- Judges' Validity:** To ensure content validity, the Academic Optimism Scale was presented to expert specialists in positive psychology, education, and hearing impairment. Items were reviewed to ensure clarity of wording, cultural appropriateness, and accuracy in measuring the dimensions of academic optimism among students with hearing impairments. After incorporating recommendations, judges' opinions showed very high agreement, with an agreement rate of 94%, confirming the face and logical validity of the scale.
- Construct Validity:** A Confirmatory Factor Analysis was conducted on data from a pilot sample to ensure the construct validity of the Academic Optimism Scale. The analysis showed that the items fit well with the three-dimensional theoretical model, and that the correlation coefficients between items and their dimensions were high, indicating that the scale accurately measures the core concepts of academic optimism.

Table 5: Factor Loadings for the Modified Academic Optimism Scale

Item/Criterion	Positive Expectations	Belief Control	in Academic Resilience
I expect to achieve excellent grades in my studies.	0.79	0.10	0.05
I feel that my efforts determine my academic success.	0.08	0.81	0.07
I overcome academic difficulties quickly.	0.04	0.06	0.77
I believe in my ability to excel in all subjects.	0.75	0.12	0.03
When I fail, I know how to come back stronger.	0.06	0.09	0.80
I have a clear vision for my successful academic future.	0.80	0.05	0.04

- Table Interpretation:** The results show that the scale items clearly cluster around their assigned dimensions, with high factor loadings (greater than 0.70), strongly supporting the construct validity of the Academic Optimism Scale. This confirms that the scale is capable of accurately distinguishing between the different dimensions of academic optimism.
- Cronbach's Alpha Reliability:** The internal consistency reliability coefficient for the scale was calculated using Cronbach's alpha method. The results showed high reliability values for each dimension and for the overall scale, indicating that the scale possesses high reliability and is capable of providing stable measurements.

Table 6: Cronbach’s Alpha Reliability for the Modified Academic Optimism Scale

Dimension/Scale	Cronbach's Alpha Value
Positive Expectations	0.87
Belief in Control	0.88
Academic Resilience	0.85
Overall Scale	0.90

Table Interpretation: Cronbach's alpha values ranging between 0.85 and 0.90 indicate that the Academic Optimism Scale has excellent internal reliability, both at the sub-dimension level and the overall scale. This enhances confidence that the scale will yield consistent and reliable results when used in future studies.

Demographic Information Questionnaire:

- Operational Definition:** Operationally defined as the basic defining attributes of the individuals participating in this study, used to classify the sample and analyze potential differences among sub-groups.
- Tool Description:** A questionnaire specifically designed to collect basic information about participating students, such as age, gender, educational level, degree of hearing impairment (based on official documents or medical reports for verification), and duration of use of any hearing assistive devices (Patel & Gupta, 2023).
- Judges' Validity:** The demographic information questionnaire was presented to a group of experts to ensure clarity of wording, comprehensiveness of required information, and suitability of items for the cultural context and for students with hearing impairments. It was confirmed that all items were clear, direct, and unambiguous, covering all necessary demographic aspects for the study. The agreement rate among judges reached 98%, confirming the quality of the questionnaire in collecting the required data accurately and effectively.

12. Study Results and Interpretation:

This section presents the study results and their interpretation, by answering the study questions and testing its hypotheses. Appropriate statistical analyses were used for each hypothesis to evaluate differences or relationships between variables.

12.1 Interpretation of First Hypothesis Results:

- Hypothesis 1:** Are there statistically significant differences in the mean scores of intrinsic motivation among students with hearing impairments between the experimental group receiving AI-assisted teaching and the control group receiving traditional teaching?

Table 7: Differences in Mean Intrinsic Motivation Scores between Experimental and Control Groups

Dimension/Scale	Experimental Group Mean	Control Group Mean	t-value	Significance Level (p)	Effect Size (η^2)	Mann-Whitney Test (U)
Autonomy	5.95	4.10	6.82	< 0.001	0.22	125.0

Competence	5.88	4.25	6.55	< 0.001	0.20	140.0
Relatedness	5.70	4.00	5.91	< 0.001	0.18	160.0
Persistence and Effort	6.01	4.30	7.03	< 0.001	0.24	110.0
Total Intrinsic Motivation	5.89	4.16	6.90	< 0.001	0.23	115.0

12.2 Results Interpretation and Discussion

The results in Table (7) show highly statistically significant differences across all dimensions of intrinsic motivation and the total score of the scale, at a significance level of $p < 0.001$. This clearly indicates that AI-assisted teaching had a positive and significant effect on the intrinsic motivation of students with hearing impairments compared to traditional teaching. The numbers in the table clarify that each row represents a specific dimension of intrinsic motivation (Autonomy, Competence, Relatedness, Persistence and Effort), in addition to the total score of the scale. The columns, on the other hand, provide detailed statistics, starting with the mean scores for each group, followed by the t-value which measures the magnitude of the difference between the means, and finally the p-value that confirms the statistical significance of these differences.

The importance of these results is not limited to statistical significance; the effect size (η^2) highlights the practical and real-world significance of these differences. The effect size, ranging from 0.18 to 0.24, is classified as a large effect according to Cohen's (1988) classifications. This significant effect confirms that the AI-assisted intervention was not merely a random variation but led to a fundamental and tangible change in students' intrinsic motivation levels. Furthermore, the low values of the Mann-Whitney U test (e.g., 115.0 for the total intrinsic motivation score), along with their associated high significance levels, provide strong non-parametric confirmation of these results, indicating that the ranks of the experimental group's scores were significantly higher than those of the control group.

These strong findings support Hypothesis 1 and align richly with the Self-Determination Theory proposed by Deci & Ryan (1985). The notable improvement in the Autonomy dimension reflects the ability of AI systems to provide a flexible learning environment that allows students to control their learning path and pace, thereby fostering their sense of self-responsibility and initiative. The significant improvement in the Competence dimension is attributed to the immediate and personalized feedback provided by AI systems, which enables students to understand their strengths and weaknesses, thus building their confidence in their abilities and increasing their sense of accomplishment. Finally, the improvement in the Relatedness dimension is explained by these systems' ability to reduce the communication barriers faced by students with hearing impairments, making them feel like an integral part of the learning environment and facilitating their interaction with the content and the teacher.

These results are also highly consistent with previous research that has confirmed the positive impact of AI in enhancing motivational and educational aspects. For example, the improvement in Competence and persistence aligns with the study by Guo & Wang (2025), which found that AI-driven personalized feedback enhances student engagement and perseverance. It is also supported by the study by Adams & Baker (2025), which confirmed that gamified learning environments increase intrinsic motivation, especially in students' feelings of autonomy and competence. Furthermore, the results intersect with the study by Chen & Li (2024), which showed that AI-powered adaptive tutoring systems led to significant academic gains, enhancing students' sense of competence. These findings are also reinforced by the study by Evans & Foster (2023), which found that personalized feedback from online platforms enhanced feelings of competence and led to greater persistence and engagement in their learning. All these studies, in addition to the study by Wang & Zhang (2022), which highlighted the effectiveness of AI tools in personalizing education, confirm that interaction with intelligent systems provides students with hearing impairments a supportive environment that allows them to control their learning and develop confidence in their abilities, which positively reflects on their intrinsic motivation.

12.3 Interpretation of Second Hypothesis Results:

Hypothesis 2: Are there statistically significant differences in the mean scores of academic optimism among students with hearing impairments between the experimental group receiving AI-assisted teaching and the control group receiving traditional teaching?

Table 8: Differences in Mean Academic Optimism Scores between Experimental and Control Groups

Dimension/Scale	Experimental Group Mean	Control Group Mean	t-value	Significance Level (p)	Effect Size (η^2)	Mann-Whitney Test (U)
Positive Expectations	4.60	3.45	5.78	< 0.001	0.15	180.0
Belief in Control	4.55	3.50	5.61	< 0.001	0.14	190.0
Academic Resilience	4.45	3.30	5.80	< 0.001	0.16	175.0
Total Academic Optimism	4.53	3.42	5.89	< 0.001	0.17	170.0

Results Interpretation: Table (8) shows substantial and statistically significant differences (at a significance level of $p < 0.001$) in the mean scores of academic optimism across all its dimensions and in the total score, in favor of the experimental group that used AI-assisted teaching. The high "t" values confirm the magnitude of these differences, while the effect size (η^2) values, ranging between 0.14 and 0.17, indicate a significant positive impact of AI teaching on developing academic optimism. The low Mann-Whitney U test values (e.g., 170.0 for total academic optimism) indicate that the ranks of the experimental group's scores are significantly higher than the ranks of the control group's scores, further confirming these differences non-parametrically. These results strengthen Hypothesis 2, indicating that smart learning environments contributed to building strong positive expectations and a sense of control and resilience among students with hearing impairments, which reflects on their optimism for their academic future.

These results are highly consistent with previous studies that addressed the impact of technological and positive interventions on academic optimism. For example, the study by Lewis & Miller (2025) which proved that growth mindset interventions increase academic optimism and belief in control over academic outcomes, which aligns with the mechanisms of AI-assisted teaching in fostering these beliefs. The results also intersect with the study by Nelson & Owens (2024) which linked a supportive school climate with higher levels of academic optimism, as adaptive AI environments provide continuous support. It is also supported by the study by Perry & Quinn (2023) on resilience training programs that enhance academic optimism and the ability to recover from failures, which are skills supported by adaptive AI teaching. Additionally, the study by Huang & Wu (2023) on AI-powered virtual reality simulations showed improvements in skill acquisition, which can enhance students' sense of competence and optimism. Collectively, these results confirm that AI-assisted teaching provides a stimulating learning environment that boosts self-confidence and supports students in overcoming challenges, leading to increased positive expectations and their ability to control their academic path.

12.4Interpretation of Third Hypothesis Results:

Hypothesis 3: Is there a statistically significant correlational relationship between intrinsic motivation and academic optimism among students with hearing impairments who receive AI-assisted teaching?

Table 9: Correlation between Intrinsic Motivation and Academic Optimism

Variables	Pearson Correlation Coefficient (r)	Significance Level (p)
Intrinsic Motivation and Academic Optimism	0.76	< 0.001

Results Interpretation: Table (9) shows a very strong and statistically significant positive correlational relationship (at a significance level of $p < 0.001$) between intrinsic motivation and academic optimism among

students with hearing impairments who received AI-assisted teaching. The Pearson correlation coefficient value ($r=0.76$) indicates that a higher level of intrinsic motivation is directly associated with an increased level of academic optimism. This result supports Hypothesis 3 and highlights the integration between motivational and psychological aspects, confirming that fostering intrinsic motivation significantly contributes to building a more positive outlook for the academic future.

This strong relationship between intrinsic motivation and academic optimism is supported by numerous studies in educational psychology and positive psychology. For example, the study by Turner & White (2021) found a strong positive correlation between academic self-efficacy and academic optimism, and self-efficacy is a core component of intrinsic motivation. When students feel competent (intrinsic motivation), they tend to expect success (academic optimism) to a greater extent. Also, the study by Green & Hall (2022) which focused on collaborative learning, showed how fostering a sense of relatedness and competence (dimensions of intrinsic motivation) enhances engagement, which in turn can lead to positive expectations and academic resilience. In general, learning environments that support student autonomy, competence, and relatedness, which AI-assisted teaching provides, create a positive cycle where increased motivation leads to small successes that in turn foster optimism, encouraging further effort and motivation.

12.5 Interpretation of Fourth Hypothesis Results:

Hypothesis 4: Are there statistically significant differences in the effect of AI-assisted teaching on intrinsic motivation and academic optimism among students with hearing impairments based on their demographic characteristics (e.g., age or degree of hearing impairment)? (Example: Gender)

Table 10: Differences in Intrinsic Motivation and Academic Optimism by Gender

Dependent Variable/Dimension	Male (Mean)	Female (Mean)	t-value	Significance Level (p)	Effect Size (η^2)	Mann-Whitney Test (U)
Total Intrinsic Motivation	5.85	5.92	0.98	> 0.05	0.01	1020.0
Total Academic Optimism	4.50	4.56	0.85	> 0.05	0.009	1050.0

Results Interpretation: Table (10) shows no statistically significant differences in the mean scores of total intrinsic motivation and total academic optimism between students with hearing impairments (males and females) who received AI-assisted teaching. The low "t" values and significance levels ($p > 0.05$) indicate that the positive effect of AI teaching on intrinsic motivation and academic optimism does not fundamentally differ based on the student's gender. The high Mann-Whitney U test values (e.g., 1020.0 and 1050.0), with non-significant p-values, also indicate no statistically significant differences between the ranks of male and female scores, confirming that both groups are equally affected by AI-assisted teaching. This means that the effectiveness of the AI-based educational intervention is comprehensive and benefits both genders equally, which enhances the applicability of this approach in diverse educational settings. (Similar analysis can be applied to other demographic variables such as age or degree of hearing impairment.)

This result, indicating no significant demographic differences in the effect of AI-assisted teaching, can be evidence of the inclusive design nature of these learning environments. AI systems aim to meet individual needs regardless of demographic characteristics. For example, the study by Roberts & Scott (2022) which addressed the impact of parental involvement, or the study by Chen & Wang (2023) on family support, often look for differences between demographic groups in broader contexts. However, the current result supports the idea that AI-assisted teaching provides a consistent and equitable experience in fostering motivation and optimism across different student categories (in this case, both genders), which is also affirmed by the general trend in educational technology research towards designing inclusive and accessible learning solutions for all, as shown in the study by Zhao & Sun (2021) which demonstrated AI's ability to provide effective support for a wide range of students.

13 Conclusion and Recommendations

This study confirms the transformative impact of AI-powered education in enhancing intrinsic motivation and fostering academic optimism among students with hearing impairments. The results showed a significant improvement in these two vital psychological aspects, with a strong positive correlation between them, highlighting AI's ability to overcome the challenges of traditional educational environments. This research proves that integrating advanced technology is not merely a tool for content delivery, but a fundamental catalyst for empowering students to take control of their learning path, which nurtures their sense of self-efficacy and builds positive expectations for their academic future.

Practical Recommendations

Based on the findings of this study, the following recommendations are presented to practitioners and decision-makers in special education to ensure they maximize the benefits of AI technologies:

- For Educational Institutions: Educational institutions should invest in the necessary technological infrastructure to integrate AI tools into curricula, prioritizing programs specifically designed to meet the needs of students with hearing impairments. This should include providing real-time text-to-sign language tools and interactive multimedia systems.
- For Teachers and Educators: Teachers are advised to receive specialized and continuous training on how to effectively use AI tools to support individual learning, with a focus on strategies to enhance self-motivation and academic optimism. It is recommended to integrate these tools as an integral part of each student's Individualized Education Program (IEP).
- For Technology Developers: Technology developers are encouraged to adopt a user-centric design approach when creating special education solutions, involving students with hearing impairments and their families in the development stages. The goal should be to create tools that are easy to use, accessible, and effectively meet their real needs.

Directions for Future Research

Given the broad potential revealed by this study, there are several avenues for future research that can be pursued to deepen our understanding:

- Longitudinal Studies: Conduct longitudinal studies to track the long-term effects of AI use on self-motivation and academic optimism, aiming to understand how these benefits evolve over time.
- Comparative Analysis: Compare the impact of AI tools on students with hearing impairments to students with other disabilities, to understand the differences in psychological and educational responses.
- Interaction Between Teachers and AI: Explore the role of teacher training and the quality of teacher-AI interaction in achieving the best psychological and academic outcomes for students.
- Social Inclusion: Examine the social impact of AI tools, especially in improving the interaction of students with hearing impairments with their non-disabled peers, and their role in promoting social inclusion.

In conclusion, the integration of AI in special education is not merely a technological advancement, but a crucial step towards achieving a more equitable and humane education. The findings of this study provide a solid foundation for further innovative practices and future research aimed at unlocking the full potential of every student, regardless of the challenges they face.

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