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The Contribution of the AI-Powered Audemy Platform to the Musical Skills of Visually Impaired Individuals

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Annotation. This study examines the contribution of the AI-powered Audemy platform to the musical skills of visually impaired individuals. In this qualitative study, semi-structured interviews were conducted with eight students aged 13–20 who had been using Audemy for at least three months. Data were analyzed using content and descriptive analysis, and positive effects on accessibility, motivation, technical skills, and independent learning were identified.

Keywords: *visually impaire, artificial intelligence, audemy platform, music education technologies, education for disabled individuals.*

Introduction

In today's world, education systems require flexible and effective therapies to accommodate different learning speeds, characteristics, and areas where these characteristics are not specified. Rapid global developments continue to make comprehensive education an indispensable part of the modern world. Technology plays a key role in education that can meet the needs of the entire modern world (Kaymak & Titrek, 2021). With technological advancements, significant improvements have been made in accessing musical notation and resources for the visually impaired. In particular, digital music archives based on the Braille notation system are used in learning development.

However, these systems also have various limitations. For example, preparing Braille music education takes a long time, has extensive content, and does not provide feedback. Today's educational solutions move beyond simply presenting information and utilize shared and personalized learning. Understanding the environment is as important for visually impaired individuals as perceiving obstacles, as they need to respond effectively to their surroundings (Ainary, 2025). Advances in technology have significantly transformed the dimensions of education by changing teaching and learning processes. For example, adaptive learning technologies offer content and methods tailored to individual needs through digital tools, supporting inclusive and sustainable education (Yaseen et al., 2025). Providing equal and effective educational opportunities for children with disabilities is both a legal and moral responsibility. Traditional teaching methods may be repetitive and unengaging for visually impaired children, which can reduce motivation and learning efficiency (Choudhary, 2023). Assistive technologies help children with disabilities actively participate in educational activities (Uçar, 2007).

At this point, artificial intelligence stands out as a significant solution. AI can create personalized learning paths, provide instant feedback, and improve teaching processes through data analysis. For individuals with special educational needs, AI-supported systems facilitate access to education and improve the quality of learning. Tools such as AI-based voice feedback systems, adaptive learning software, and individual performance tracking support visually impaired individuals not only in accessing information but also in understanding and using that information. Therefore, traditional teaching methods are insufficient to meet today's needs; AI-based educational tools are becoming a necessity, not a luxury.

Literature Review

Music education and language development in visually impaired individuals

Music education can be said to develop visually impaired individuals by actively integrating them into life, helping them discover their talents, and improving their socialization. The development of visually impaired individuals is grouped into four areas: motor development, language development, cognitive/mental development, and social development, and researchers have indicated that each of these four areas can be improved through music education. Dilsiz (2017) supports this idea with the statement, "According to the data, findings indicate that, apart from socialization, motivation, and changes in musical interest, the given music education program can support the mental, social, psychomotor, and language development of children." (p. 36). For example, it can be said that elements such as dancing to songs, performing body percussion, playing instruments for hand-arm coordination, performing movements in accordance with the rhythm of percussion instru-

ments, and imitating sounds contribute to motor development, which is stated as the first element in the development of visually impaired individuals. This idea is supported by the statement, "Activities such as animal walks, imitating sounds, walking in accordance with the rhythm of drums, walking like a soldier, using percussion instruments, and dancing to music are effective in the motor development of these children" (Baydağ, 2013).

Another important element in the individual development of visually impaired people is language development. According to Megep (2013), visually impaired people generally do not experience problems in language development, but they tend to speak in the same tone and shout, their speech speed is slow, they are inadequate in using gestures and facial expressions while speaking, and they use lip movements less. It is thought that songs containing repetitive words or sentences, aimed at improving language development through music education, can contribute to balancing this problem. In addition, rhymes and songs with appropriate intervals, prosody, correct sentences, and emphasis can also be effective for this language development. Audemy also features games designed to improve language skills. In these games, individuals develop their language skills through constant repetition while also improving their rhythm and melody repetition skills, which are essential for musical development. Musical memory and the memory used for language development are the same, and this skill can be improved through games.

Music Education With Visually Impaired People

Music education and musical activities for visually impaired individuals not only support language and auditory development but also play a significant role in socialization and participation in society (Ermiş & Kapçak, 2022). However, the music education process for visually impaired individuals presents various challenges due to the limited nature of traditional teaching methods. These individuals may experience difficulties in areas such as reading musical notation, receiving technical guidance, and dependence on the teacher. Therefore, many studies have focused on piano education for visually impaired individuals. In their study, "A Case Study on Piano Education for Visually Impaired Students," published in 2013, Pirgon and Babacan examined the problems encountered in piano education and offered solutions to these problems.

The findings revealed that faculty members lack training for the visually impaired. Visually impaired students experience significant difficulties accessing resources. A lack of technological materials and financial constraints negatively impacts students' motivation. A lack of visual imagery leads to problems with piano sitting posture and practice techniques. Faculty members are found to lack pedagogical competence. Öz's thesis, "Student Opinions on the Problems Visually Impaired Students Face in Music Education in Türkiye," concluded that weekly one-hour music lessons are insufficient for visually impaired students. It was also noted that music classrooms lacked the necessary physical resources for both teachers and students to effectively use Braille.

Music classrooms are physically inadequate, teachers need in-service training, and resources for visually impaired students are lacking. In his 2019 thesis, Satılmış found similar findings: university students receiving visually impaired piano training had difficulty accessing Braille-based written resources. He also found that there were difficulties in the field of music for the visually impaired in Turkey due to the scarcity of written resources. He also found that transcribing notes was limited unless piano teachers were dedicated. He also found that the lesson time allocated for piano was insufficient, and the piano education approach was inadequate.

Accessing equal educational opportunities for individuals, whether with or without special needs, is now much easier in today's world, thanks to artificial intelligence. The opportunities offered by artificial intelligence in a wide variety of fields support the development and advancement of individuals. E. Huff and J. Brinkley emphasized in their studies that the most significant challenges for BVI students in the online environment are difficulty accessing course materials, lack of social interaction with other students, and a feeling of falling behind. Visually impaired students experience various difficulties due to the physical and sensory limitations they face in the learning process. These difficulties, combined with feelings of inadequacy and anxiety about failure, can negatively impact students academically and psychologically. In some cases, while mainstream education methods do not have the expected impact on these students, approaches sensitive to individual needs become necessary. In this context, students who show significant differences in learning compared to their peers are considered within the scope of special education (Kıvrak, 2003). In recent years, AI-powered digital education platforms have been developed to enable this group of students to participate more effectively in learning processes, and experimental and observational studies increasingly demonstrate their effectiveness. Most digital games on portable devices, personal computers, and video game consoles rely on visual feedback for user interaction. This makes it difficult for visually impaired children to participate in such digital entertainment, often leading to their exclusion (Coppoolse & Van Dam, 2015). Recent advancements in AI-based applications help reduce the difficulties visually impaired individuals, particularly those without specialized training, face in accessing appropriate educational training and teaching methods. These developments promote equal opportunities in education. AI-powered applications designed to meet the specific needs of visually impaired individuals enable them to be more independent and perform tasks more effectively. In this context, improving the quality of life for all individuals in line with an inclusive society is both an ethical responsibility and a requirement of social justice. To achieve this goal, continuous and collaborative efforts among students, teachers, families, and other stakeholders are necessary (Sax et al., 2015).

In recent years, AI-powered audio feedback systems, haptic technologies, and intelligent analysis tools have offered alternative solutions in the field of special

education. Technological innovations used in special education environments support the development of individuals' diverse skills. Gamification stands out as an effective method for improving the skills of individuals with special needs (Hussein et al., 2023). Parallel to these developments, AI-based programs are being developed to support music education for visually impaired individuals. The aim of this study is to examine the effects of games on the AI-powered Audemy Education Platform on the musical skills of visually impaired individuals during piano and music education. Within the scope of the study, the contributions of the audio guidance systems and personalized learning algorithms used on the platform to the development of rhythm and timing, auditory memory, musical perception, instrument recognition, sound discrimination, creativity, and improvisation skills were evaluated. Furthermore, the study aims to reveal the potential of the Audemy platform to increase the participation of visually impaired individuals in the learning process, support their motivation and self-confidence levels, adapt to their individual learning needs, and reduce the limitations experienced in accessing music education. Accordingly, the study aims to determine the role of AI-powered accessible digital education applications in providing positive and sustainable learning experiences in the music education processes of visually impaired individuals.

Audemy Education Platform

Crystal Yang is the founder and CEO of Audemy, an educational platform for visually impaired students. In 2025, she was accepted into the Jerome Fisher Management and Technology (M&T) Program at the University of Pennsylvania. She conducted research on voice interfaces at the Accessibility Research Laboratory (SRL) at Texas A&M University. This work includes projects such as "Heard-le", an audio version of the Wordle game for visually impaired students. Yang, who won an award at the 2024 Intel Global Artificial Intelligence Festival, created Audemy, a voice-based, AI-powered digital learning platform designed to support the learning process for visually impaired individuals.Audemy uses adaptive learning techniques to customize content based on a student's accuracy, speed preference, and interaction patterns. The platform has been progressively developed with feedback from over 20 educators specializing in accessibility and currently serves over 2,000 students in the British Virgin Islands. The educators' insights highlight key elements for accessible AI, including the importance of interaction, intuitive design, compatibility with existing assistive technologies, and maintaining student motivation through positive reinforcement (Yang & Taele, 2025). The platform includes 16 different games that support cognitive development, including language games and math games.

The Audemy platform was created through a meticulously planned and implemented development process aimed at making learning more accessible and effective for visually impaired individuals. This process includes research, design, development, testing, and continuous improvement using an iterative approach focused on student needs.

All of the platform's AI-powered features run natively on advanced AI computing hardware provided by Intel. This allows user data to be processed directly on the device without being transferred to the cloud. This ensures data security and creates a privacy-friendly system infrastructure in private educational environments. Audemy's native processing-based architecture offers significant advantages in rapid prototyping and creating student-specific solutions. This entire structure aims to provide children and educators with a safe, personalized, and ethically sound digital learning experience.

Despite living in the digital age, engaging and interactive tools like games for the visually impaired are insufficient. More specifically, mobile games that involve spatial memory, and especially mobile-based virtual spatial games for children, are lacking (Chai, 2018). Games are also used to assist individuals with various disabilities, as they help train and monitor many aspects of a person's development, such as coordination, memory development, communication skills, and socialization. For example, an interactive rhythm game uses the Kinect sensor to capture children's movements and translate physical actions into game interactions. This method not only makes therapy sessions more enjoyable but also helps improve motor skills, spatial awareness, and cognitive abilities (Kumar, 2023). In 2018, Konya investigated whether games using motion sensing technology could improve life skills and eye-body coordination in visually impaired children. The experiment showed that games using motion sensing systems could be an important rehabilitation tool for the visually impaired. Visual acuity tests for children can be disguised as a highly entertaining game (Battistin et al., 2022). Numerous studies support the contribution of digital games to children's cognitive development. Various materials are used in learning environments to improve children's phonological awareness skills. Today, tablets and smartphones are indispensable for children's daily lives, and digital games are among their preferred play options and attract attention (Mertala & Meriläinen, 2019). In particular, the early adoption of multisensory learning-based educational approaches will increase and improve learning opportunities for visually impaired individuals (Cappagli et al., 2019).

This study investigated the impact of the AI-powered Audemy platform, which is highly valuable in terms of integrating accessible and personalized learning approaches in music education for visually impaired individuals, on the development of these students' musical skills.

In this context, the research problem statement is "What is the impact of the games on the Audemy Platform on the piano and music education skills of visually impaired individuals?" The sub-problems are as follows:

1. Does the voice guidance system in the games on the Audemy Platform contribute to the development of rhythm and timing in music?
2. Does the voice guidance system in the games on the Audemy Platform contribute to the development of auditory memory and musical perception?
3. Does the voice guidance system in the games on the Audemy Platform contribute to the development of instrument recognition and sound discrimination?

4. Does the voice guidance system in the games on the Audemy Platform contribute to creativity and improvisational skills?
5. What technical, theoretical, and practical benefits can visually impaired students achieve when using the Audemy Platform?
6. To what extent can the Audemy Platform's personalization algorithms adapt to the individual learning needs of students?
7. How does the voice guidance system in the games on the Audemy Platform affect the motivation and self-confidence of visually impaired individuals?
8. What technical or access limitations do students encounter when using the platform? What are they?
9. How have the games available on the Audemy platform contributed to the musical skills of visually impaired individuals (their ability to correctly repeat rhythmic elements and melodies, which demonstrates their musical memory)?

Method

The research is a qualitative one, and data were collected using the methods required by a qualitative approach: individual interviews, interviews, literature reviews, and interview forms. A semi-structured interview method was used. Semi-structured interviews are frequently preferred by researchers due to their standardization and flexibility, their ability to eliminate the limitations of written and completed tests and surveys, and their ability to provide in-depth information on a specific topic (Yıldırım & Şimşek, 2003). Descriptive and content analyses were conducted. Qualitative data were presented by content analysis and coded under themes based on participant responses.

Participants

The study group consisted of eight visually impaired individuals, aged 13 to 20, who received voluntary music training in Ankara and used the Audemy platform for between 3 and 8 months. The personal information and names of the visually impaired individuals participating in the study were kept confidential in accordance with ethical rules and were coded as P1, P2, and P8.

Data Collection Tool and Analysis

The researcher developed a semi-structured interview form to determine the improvements visually impaired individuals make in their musical skills by playing games on the Audemy platform. The prepared questions were evaluated by three experts for content, language, and clarity. The experts were asked to rate the questions as (3) if they were sufficient, (2) if they were sufficient but needed revision, and (1) if

they were inadequate. The scores obtained from the three different experts are shown in the table below.

Table 1

Content Analysıs Based On Expert Opınıons Evaluation Criteria of Experts' Semi-Structured Interview Form

Question	Expert 1			Expert 2			Expert 3		
	Language	Content	Understandability	Language	Content	Understandability	Language	Content	Understandability
1	3	3	3	3	3	3	3	3	3
2	3	3	3	3	3	2	3	2	3
3	3	2	3	3	3	3	3	3	3
4	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	2	2	3	3
6	3	3	3	3	3	3	3	3	3
7	3	3	3	3	3	3	3	3	3
8	3	3	3	3	3	3	3	3	3
9	3	3	3	3	3	3	3	3	3

According to the results in the table, necessary corrections were made to 5 items and a 9-question semi-structured interview form was created. The interview coding keys and interview transcripts of the interview form applied to 8 visually impaired individuals were prepared by the researcher.

Analysis of Data

The qualitative data obtained within the scope of the research was analyzed using a combination of descriptive and content analysis methods. During the analysis process, participants' statements were first examined in detail using open coding, and meaningful excerpts from these statements were coded and classified. The coded data were grouped under subthemes based on shared meaning and structural similarities; these subthemes were then transformed into broader themes aligned with the research questions and the theoretical framework.

During the analysis process, the audio recordings and written interview forms obtained from the participants were transcribed in detail and analyzed using content analysis. The aim of this process was to obtain meaningful conclusions from the data while adhering to the principles of validity and reliability of the research. Descriptive analysis enabled the data to be organized according to predetermined themes and presented with direct quotations from participants. Content analysis, on the other hand, allowed for more in-depth analysis of the data and interpretation of inter-theme

relationships. This analysis process was supported by expert opinion to enhance the reliability of the research, and care was taken to approach the data systematically.

Findings

Findings on the Contribution of the Audio Guidance System to the Development of Rhythm and Timing in Music in Games on the Audemy Platform

Table 2

Participant Codes Regarding the Category of Contribution of the Audio Guidance System to the Development of Rhythm and Timing in Music in Games on the Audemy Platform

Codes	Participants
Rhythm detection	8
Detection in tempo	4
Timing skill	8

Table 2 presents participants' opinions on the contribution of the voice prompts system in games on the Audemy platform to the development of rhythm and timing in music. Most participants stated that the games improved their rhythm and timing skills. P1 stated, "The regular voice prompts help me feel the tempo and adapt to the rhythm more easily," while P4 explained, "The prompts in the games work like a metronome, which greatly helps me stay in rhythm."

The fact that the findings regarding tempo perception are more limited compared to rhythm and timing skills can be explained by the fact that the concept of tempo exhibits a more cognitively complex structure. Tempo requires not only the perception of rhythmic patterns but also the maintenance of the speed of these patterns in a continuous manner. However, the participants' statements indicating that the audio instructions functioned like a metronome show that this system indirectly contributed to the preservation of the sense of tempo. This finding parallels approaches that argue that the use of metronomes in music education improves timing and tempo control.

Findings regarding timing skills indicate that game-based learning environments support the development of musical synchronization and auditory skills. Thanks to audio instructions, participants were seen to improve their ability to respond at the right time and synchronize with the music. When evaluated within the framework of constructivist learning theory, this confirms the pedagogical power of digital game-based environments that support learning through active participation and immediate

feedback. In conclusion, the findings of this study show that the audio instruction system used on the Audemy platform is an effective learning tool that supports the development of musical skills such as rhythm and timing. The results support the usability of auditory feedback-based game-based learning approaches in music education and offer significant theoretical and practical contributions to digital music education applications.

Findings Regarding the Contribution of the Audio Guidance System in Games on the Audemy Platform to the Development of Auditory Memory and Musical Perception

Table 3

Participant Codes Regarding the Category of Contribution of the Audio Guidance System to the Development of Auditory Memory and Musical Perception in Games on the Audemy Platform

Codes	Participants
Perception through melodizing	6
Remembering musical patterns	8
Auditory Memory and Perception	8

Table 3 presents participants' thoughts on the contribution of the voice prompt system in games on the Audemy platform to the development of auditory memory and musical perception. P3 stated, "When prompts are given rhythmically, I perceive them as melodic and learn faster," while P5 stated, "I make voice prompts memorable by making them melodic; this method also supports musical analysis." P6 made a similar statement: "Melodying strengthens my auditory memory, and with voice prompts, I grasp musical concepts more clearly."

Table 3 shows that the audio guidance system used in the games on the Audemy platform significantly contributed to the development of participants' auditory memory and musical perception skills. The concentration of participants' opinions, particularly in the categories of remembering musical patterns and auditory memory and perception (8 participants for both codes), reveals that audio guidance supports the retention of musical information in the mind.

Participants who expressed opinions in the category of perception through hybridization (melodification) stated that presenting audio guidance in a rhythmic and melodic manner strengthened perception. This finding shows that participants perceived auditory cues not only as verbal instructions but also as a musical structure. The acquisition of melodic characteristics by audio guidance contributed to making auditory stimuli more meaningful and accelerating the learning process.

The findings in the category of remembering musical patterns show that repetitive and structured audio guidance helped participants mentally encode musical patterns. The fact that participants stated that they remembered melodic instructions more easily suggests that auditory memory is strengthened through musical structuring. This situation reveals the strong relationship between pattern recognition and memory in musical learning.

Findings related to the auditory memory and perception category show that auditory guidance helps participants perceive musical concepts more clearly. Participants stated that thanks to melodic auditory guidance, they were able to not only follow instructions but also analyze musical structures. These results reveal that auditory guidance functions as a learning tool that deepens musical perception.

Overall, it can be said that the auditory guidance system on the Audemy platform offers an effective learning environment that strengthens auditory memory and supports musical perception. The findings show that auditory guidance based on melodic and rhythmic structuring in music education supports lasting and meaningful learning.

Findings on the Contribution of the Audio Guidance System to the Development of Instrument Recognition and Sound Discrimination in Games on the Audemy Platform

Table 4

Participant Codes Regarding the Category of Contribution of the Audio Guidance System to the Development of Instrument Recognition and Sound Discrimination in Games on the Audemy Platform

Codes	Participants
Recognizing their voices	8
Distinguish sound quality	7
Focus on sound differences	3

Table 4 presents participants' opinions on the contribution of the audio guidance system in games on the Audemy platform to the development of instrument recognition and sound discrimination. All participants emphasized that their ability to recognize and distinguish sounds was stimulated. This perception suggests that these individuals will have an easier time recognizing and perceiving various instrument sounds in music.

Table 4 shows that the audio guidance system used in the games on the Audemy platform supports the development of participants' instrument recognition and sound discrimination skills. The concentration of participant opinions. particularly in the categories of recognizing instrument sounds (8 participants) and distinguishing sound

quality (7 participants), reveals that audio guidance is effective in increasing auditory awareness.

The findings regarding the instrument sound recognition category show that participants began to perceive the sound characteristics specific to different instruments more consciously. The repetitive and emphatic presentation of audio guidance during the game process helped participants recognize instrument sounds with their distinctive features. This suggests that auditory exposure and attentive listening play an important role in the development of instrument recognition skills.

The findings obtained in the sound quality discrimination category reveal that participants were able to perceive not only the source of the sound but also its qualitative features such as timbre, intensity, and character. Different sound samples presented through audio guidance deepened participants' auditory perception, enabling them to focus on subtle differences between sounds.

The lower number of participants reporting feedback in the category of focusing on sound differences (3 participants) can be explained by the fact that this skill requires a higher level of auditory attention. However, feedback regarding this category suggests that the audio guidance system has the potential to direct participants' auditory attention to specific sound features.

Overall, it can be said that the audio guidance system on the Audemy platform provides an effective learning environment that supports participants' ability to recognize and distinguish instrument sounds. The findings reveal that structured auditory stimuli in digital game-based music learning environments significantly contribute to the development of auditory perception and discrimination skills.

Findings Regarding the Contribution of the Audio Guidance System to Creativity and Improvisation Skills in Games on the Audemy Platform

Table 5

Participant Codes Regarding the Category of Contribution of the Audio Guidance System to Creativity and Improvisation Skills in Games on the Audemy Platform

Codes	Participants
Expressing words with musical tones	6
Creating my own melody by imitating words	7

Table 5 presents participants' opinions on the contribution of the audio prompt system to creativity and improvisational skills in games on the Audemy Platform. P3 stated, "When I repeat the words in the games with music, they stick in my mind, and this repetition gives me the opportunity to improvise." P4 stated, "When I express the words I hear with musical tones, I learn better, and my melodic expression improves."

Visually impaired music students emphasized that they supported their word memory with melodies while playing sound-based games and were successful in the game.

Table 5 shows that the audio guidance system used in the games on the Audemy platform plays a significant role in developing participants' creativity and improvisation skills. Participant opinions were particularly concentrated in the categories of expressing words with musical tones (6 participants) and creating their own melody by imitating words (7 participants). This finding demonstrates that the voice guidance system not only contributes to the development of technical skills but also supports musical expression and creative production.

The participants' statements that they can retain words in their minds through melodic repetitions and thus have the opportunity to improvise reveal that melodic repetition functions as a mechanism that supports creativity. Expressing words with musical tones both supports memory and offers participants the opportunity to develop their own melodic expressions.

The findings obtained in the category of creating one's own melody through word imitation confirm the importance of the imitation and adaptation strategy, which is frequently emphasized in music education. After imitating the given melodic examples, participants can modify them with their own interpretations, thereby improving both their auditory-motor coordination and gaining musical autonomy. From the perspective of visually impaired participants, these findings highlight the importance of the audio guidance system in presenting auditory information in a structured way for memory and creative production. The fact that participants strengthened their vocabulary and succeeded in the game thanks to melodic support shows that the audio guidance system functions as both a pedagogical and motivational tool. In general, it can be concluded that the audio guidance system provides an effective learning environment that enhances both the creative and improvisational skills of the participants. This result shows that in digital game-based music learning environments, melodic and rhythmic auditory cues are an important tool that supports students' creative expression abilities.

Findings Regarding Theoretical and Practical Gains of Visually Impaired Students While Using the Audemy Platform

Table 6

Participant Codes Regarding the Theoretical and Practical Gains of Visually Impaired Students While Using the Audemy Platform

Codes	Participants
Recognizing their voices	8
Distinguish sound quality	7
Focus on sound differences	3

Table 6 presents participants' thoughts on the theoretical and practical gains they gained while using the Audemy platform. All participants emphasized that their motivation to respond quickly increased during game play. P1 stated, "Different types of audio questions enriched my theoretical knowledge while also teaching me to produce quicker solutions." P3 stated, "Responding quickly during games increased my mental agility, and my theoretical knowledge was solidified." P6 stated, "Encountering a variety of questions was challenging, but it increased my ability to make quick decisions and apply theoretical knowledge."

Table 6 shows that the Audemy platform significantly contributes to the development of both theoretical knowledge and practical application skills in visually impaired students. All participants stated that their motivation to respond quickly increased during the game process and that the platform offers an interactive and time-constrained learning environment.

Participant opinions were particularly focused on the areas of quick decision-making (4 participants), mental agility under time pressure (6 participants), and quick thinking (8 participants). These findings demonstrate that the platform effectively contributes to students putting their theoretical knowledge into practice and developing their quick thinking and problem-solving skills during gameplay.

For example, P1's statement, "Different types of audio questions helped me improve my theoretical knowledge while also enabling me to solve problems quickly," demonstrates that students' application of knowledge accelerated and that learned theoretical information was reinforced. Similarly, P3 and P6's opinions reveal that the variety of questions encountered during the game supported students' mental agility and quick decision-making skills.

These findings show that visually impaired students effectively combine theoretical knowledge with practical skills through auditory feedback and audio guidance. In particular, the time-constrained game environment enhances students' attention and focus, supporting higher-level cognitive processes such as quick decision-making and problem-solving.

Overall, the Audemy platform offers an interactive and motivating learning environment that simultaneously enhances the theoretical and practical skills of visually impaired students. These results highlight the pedagogical value of digital game-based auditory learning tools in terms of both reinforcing knowledge and developing mental agility and quick thinking skills.

Findings on the Ability of the Audemy Platform's Personalization Algorithms to Adapt to Students' Individual Learning Needs

Table 7 presents participants' opinions about the Audemy platform's ability to adapt its personalization algorithms to individual learning needs. P1 stated, "I continue without giving up because the difficulty level is right for me. The audio feedback makes

learning easier." P5 said, "Level-based progression and instant explanations allow me to learn from my mistakes." P6 stated that the platform offered both fast-paced and thought-provoking activities, which positively contributed to the learning process. P7, on the other hand, indicated that the audio feedback provided at each stage helped them understand what was right and wrong, allowing them to progress in a way that suited their own learning level.

Table 7

Participant Codes for the Adaptability of the Audemy Platform's Personalization Algorithms to Students' Individual Learning Needs Category

Codes	Participants
Guidance based on difficulty level	8
Personal feedback	8

Table 7 shows that Audemy's personalization algorithms are effective in adapting to students' individual learning needs. All participants stated that they found the platform's difficulty level-based guidance (8 participants) and personalized feedback (8 participants) features useful. This indicates that the algorithms increase motivation and optimize the learning process by offering activities appropriate to students' knowledge levels. Participant statements clearly demonstrate that the level-based progression system and real-time feedback mechanism on the platform support the learning process. For example, P1, stating, "I continue because the difficulty level suits me, and the audio feedback makes learning easier," emphasizes that the algorithm's adaptation to individual needs increases students' motivation and desire to continue learning. Similarly, P5's statement, "Level-based progression and real-time explanations help me learn from my mistakes," shows that the platform supports error-based learning through structured feedback.

Overall, the personalized learning algorithms used on the Audemy platform make the learning process more effective by offering activities tailored to students' learning pace, knowledge level, and individual needs. Participants' positive feedback regarding the difficulty level and feedback mechanism highlights the importance of individualized digital learning environments in increasing motivation, learning quality, and individual success.

Findings on the Effect of Audio Guidance System on Motivation and Self-Confidence of Visually Impaired Individuals in Games on the Audemy Platform

Table 8 shows that the audio guidance system used on the Audemy platform positively affects the motivation and self-confidence levels of visually impaired individuals. All participants stated that the audio guidance offered by the platform positively contributed

to both the feeling of success (8 participants), increased motivation (8 participants), and self-confidence and intrinsic empowerment (7 participants).

Table 8

Participant Codes Regarding the Category of the Effect of the Audio Guidance System on the Motivation and Self-Confidence of Visually Impaired Individuals in Games on the Audemy Platform

Codes	Participants
Sense of accomplishment	8
Increased motivation	8
Self-confidence and inner empowerment	7

Participant statements indicate that the audio guidance system provides emotional and psychological support in the learning process. For example, P1's statement, "My self-confidence increased when I felt successful. Auditory guidance motivates me," demonstrates that the feeling of success increases self-confidence and strengthens motivation. Similarly, P2's statement, "Auditory confirmations after each correct answer make me feel good and increase my self-confidence," reveals that the system provides positive reinforcement through immediate feedback. P4 and P6 also stated that auditory feedback both increased motivation and supported students' self-confidence.

These findings show that game-based learning environments support not only cognitive but also emotional and psychological processes. Auditory feedback and immediate confirmations increase intrinsic motivation by allowing students to recognize their achievements and encourage active participation in the learning process. In this way, students develop both theoretical and practical skills while also becoming psychologically stronger.

Overall, the findings in Table 8 reveal that the audio guidance system of the Audemy platform supports the motivation, self-confidence, and intrinsic empowerment of visually impaired individuals. This shows that digital game-based auditory learning environments are valuable not only in terms of cognitive gains but also in terms of emotional and motivational gains.

Findings Regarding the Technical or Access Limitations Encountered by Students While Using the Platform

Table 9

Participant Codes Regarding the Technical or Access Limitations that Students Encountered While Using the Platform

Codes	Participants
Application errors	2
Sound confusion	2

Table 9 shows that the Audemy platform has relatively few technical or accessibility limitations for visually impaired students. The majority of participants reported experiencing no technical issues, while only a small number of students (2 participants) encountered limitations such as application errors and confusion in voice commands.

Participant statements indicate that most of the problems encountered were related to internet connection and did not significantly affect the overall operation of the platform. For example, P3 stated, "When the internet slows down, the application freezes and commands are delayed," indicating that performance is largely related to network speed. This finding points to the impact of technical infrastructure on accessibility and user experience in online audio learning platforms.

Minor confusion in voice commands can be a critical factor in terms of perceptual accuracy and user satisfaction, especially for visually impaired students. However, the limited number and mild nature of the problems demonstrate that the platform is generally accessible and user-friendly.

Findings Regarding Contributions Provided by Games on the Audemy Platform

Table 10

Participant Codes Regarding the Contributions Category Provided by Games on the Audemy Platform

Codes	Participants
Increased self-confidence	8
Obtaining working order and principles	8

Table 10 shows that the games on the Audemy platform make significant contributions to both personal development and the advancement of musical skills for visually impaired students. All participants (8 people) shared the opinion that the games increased their self-confidence and helped them acquire a structured study routine and basic musical principles.

Participant feedback indicates that games are effective in helping students focus their attention and complete tasks systematically. For example, P1 stated, "It helps me improve my musical skills and increases my self-confidence," indicating that games support both motivation and skill development. Similarly, P4's statement, "Following auditory cues helps me focus my attention and contributes to my musical development," reveals that auditory cues enhance students' attention and performance in the learning process. P5 and P6's statements indicate that the mental challenges presented by the games strengthen students' sense of accomplishment and self-confidence. P5 stated that completing tasks improved their mental abilities and increased their self-confidence, while P6 specifically noted that their self-confidence increased as they gave correct

answers in the areas of rhythm and intonation. These findings support the idea that game-based learning approaches have positive effects on motivation and self-efficacy development.

Furthermore, the games' presentation of regular and structured tasks allows students to develop study habits and learn fundamental musical principles systematically. This demonstrates that digital game-based learning environments are significant not only in terms of cognitive gains but also in terms of emotional and motivational contributions.

Overall, the findings in Table 10 reveal that the games used on the Audemy platform are effective in increasing self-confidence, improving attention and focus, and acquiring basic musical knowledge. These results highlight the importance of game-based learning tools that support both the academic and individual development of visually impaired students.

Discussion

The findings of this study demonstrate that the auditory guidance system used in music games on the Audemy platform effectively contributes to the development of participants' rhythm and timing skills. Participant feedback, particularly focusing on rhythm perception and timing skills, reveals that auditory guidance is a significant supportive element in the music learning process. This finding is consistent with theoretical approaches that emphasize that the development of rhythm and timing in music education largely relies on auditory feedback.

The findings are consistent with research in the field of music psychology, which emphasizes the importance of auditory cues in the development of rhythm perception and timing accuracy. According to Hallam (2006), rhythmic proficiency develops as students learn temporal structures through repeated auditory experiences and active participation. The audio guidance system used on the Audemy platform supports this learning process by providing students with regular and consistent rhythmic examples.

In the literature, the development of rhythm perception is associated with an individual's ability to distinguish regular sound patterns and respond to these patterns simultaneously. According to Gordon's Theory of Music Learning, individuals need continuous and structured auditory stimuli to internalize musical rhythm. In this context, it can be said that the auditory prompts used in Audemy games support the development of rhythm perception by providing participants with a regular auditory reference.

From a cognitive perspective, Berkowitz (2010) notes that timing and rhythm accuracy in music are related to procedural learning and real-time decision-making processes. The audio guidance system, which participants described as a metronome-like function, supports students in focusing on coordination and musical accuracy by

reducing temporal uncertainty. This demonstrates that real-time feedback plays a significant role in maintaining learning engagement and skill development, especially in game-based learning environments.

Rogers (2013) emphasizes that context and external constraints play a significant role in shaping musical improvisation and rhythmic performance. While the findings of this study do not directly focus on improvisation, structured auditory stimuli can be considered contextual elements guiding students' temporal behavior. The regular rhythmic structure presented by the system helps students develop control over timing, which can support the development of higher-level musical skills such as expressive timing variations and improvisational fluency in the later stages.

In the context of accessible music education, the findings yield significant results. Research shows that visually impaired students benefit significantly from well-structured auditory aids that supplement or replace visual information (Hallam, 2006).

The audio guidance system used on the Audemy platform effectively addresses this need by improving rhythm accuracy, temporal awareness, and student confidence. Therefore, the system not only supports the development of technical music skills but also contributes to inclusive and equitable music education practices.

Overall, the findings demonstrate that the audio guidance system used in music games on the Audemy platform is a pedagogically effective tool for developing rhythm and timing skills. This system, which provides a consistent auditory reference similar to a metronome and is integrated into an interactive learning environment, improves students' perception of rhythm and timing control. These results support the use of game-based approaches with audio guidance in music education, particularly for visually impaired students, and highlight the importance of auditory-focused instructional design in accessible learning technologies.

Studies conducted on the Audemy platform show that the audio guidance system used in the games is effective in improving participants' auditory memory and music perception skills. The concentration of participant feedback, particularly in the areas of musical pattern recall and auditory memory and perception, reveals that audio guidance supports the learning and long-term storage of musical knowledge. These findings are consistent with theoretical approaches that emphasize the fundamental role of structured auditory experiences in music learning (Hallam, 2006).

The participants' perception of auditory instructions as melodic and rhythmic points to the regulatory role of melody in the development of musical perception. Research in the field of musical cognition shows that melodic structures strengthen perception and accelerate the learning process by transforming auditory stimuli into meaningful wholes (Deutsch, 2013). In this context, it can be said that the melodic auditory instructions used in Audemy games contribute to participants internalizing musical information more quickly and effectively.

The findings in the category of remembering musical patterns show that repetitive and structured auditory instructions play a significant role in the development of auditory memory. According to Gordon's Theory of Music Learning, individuals' ability to mentally store and recall musical patterns depends on their regular interaction with these patterns (Gordon, 2012). The participants' statement that they remembered melodic instructions more easily reveals that auditory instructions support the learning of musical patterns.

The strong relationship between auditory memory and musical perception is frequently emphasized in the literature on music psychology. Hallam (2006) states that musical perception requires not only immediate auditory processing but also the retrieval of musical information stored in memory. In this study, the participants' statements that they perceived musical concepts more clearly thanks to auditory prompts demonstrate that auditory memory deepens musical perception.

From the perspective of constructivist learning theory, the audio guidance system on the Audemy platform allows learners to construct musical meaning through active participation. Instantaneous auditory feedback provided in game-based learning environments offers an experiential structure that supports the learning process (Jonassen, 1999). Furthermore, findings suggesting that digital games enhance learner motivation and support cognitive processes are consistent with the results of this research (Gee, 2003).

The audio guidance system used in the games on the Audemy platform has been shown to be effective in improving participants' instrument recognition and sound discrimination skills. The fact that all participants reported that their sound recognition and discrimination skills were stimulated highlights the importance of structured auditory input in improving musical perception. This result aligns with theoretical approaches that argue that listening skills, a fundamental component of music education, can be developed through conscious and guided auditory experiences (Hallam, 2006).

Findings in the instrument *sound recognition* category show that participants were able to more easily distinguish the timbre characteristics specific to different instruments. Studies in the field of music cognition reveal that instrument recognition is largely based on timbre perception and that timbre plays a decisive role in the listener's identification of the sound source (McAdams & Giordano, 2009). The audio cues used in Audemy games, which presented instrument sounds with their distinct characteristics, may have contributed to participants' more conscious perception of these timbre cues.

Findings in the *sound quality discrimination* category show that participants began to notice not only the source of the sound but also its qualitative characteristics, such as brightness, intensity, and color. This aligns with views emphasizing that musical listening is a multidimensional perceptual process. According to Deutsch (2013), individuals' ability to distinguish sounds is closely related to the auditory system's capacity

to resolve subtle acoustic differences. Comparative sound samples presented through auditory prompts may have supported this resolution process.

The lower number of participants who commented in the category of *focusing on sound differences* can be explained by the fact that this skill requires a higher level of auditory attention and awareness. According to Hargreaves (1986), musical discrimination skills improve as listening experience increases and the individual consciously orients themselves towards the sound. In this context, it can be said that the audio guidance system on the Audemy platform strongly supports instrument recognition and general sound discrimination skills, especially at the beginner level, while focusing on more detailed sound differences can develop over time.

From the perspective of constructivist learning theory, the auditory guidance system allows participants to construct musical meaning through active listening. Interactive and repetitive auditory stimuli presented in game-based learning environments improve learners' listening skills while also increasing their motivation (Gee, 2003). This supports the lasting development of perceptual skills such as instrument recognition and sound discrimination.

Participants' statements, such as "repeating the words in the games with music allows me to improvise," indicate that melodic and rhythmic repetition supports the internalization of musical material and facilitates spontaneous creation. This is consistent with the theoretical approach that argues that musical creativity emerges through active interaction with auditory patterns and the process of transforming these patterns into new expressions (Berkowitz, 2010). Similarly, the expression of words through musical tones can be considered a musical encoding process in which learners associate verbal information with melodic and rhythmic structures. This process contributes both to strengthening memory and to the creation of creative output.

The category of creating one's own melody by imitating words reflects the principle of imitative learning, which is widely recognized in music education as a foundational strategy for developing improvisational skills (Rogers, 2013). Students have the opportunity to experiment with musical ideas by imitating melodic patterns and making small changes to these patterns over time. This process helps students strengthen their auditory-motor coordination and develop a sense of musical independence. Participant feedback indicates that the audio guidance system offers structured learning support that facilitates such creative exploration, especially for visually impaired students whose primary learning channel is auditory cues.

According to the constructivist approach, active participation and experiential learning play a significant role in the development of creativity. Games that include vocal commands allow students to interact with sounds, experiment with melodic expressions, and receive immediate feedback. These processes support the development of improvisation skills (Jonassen, 1999; Gee, 2003). Furthermore, the combined use of

auditory and verbal elements can activate different parts of the brain simultaneously, contributing to the simultaneous development of linguistic and musical creativity.

In conclusion, the findings demonstrate that the audio guidance system used in games on the Audemy platform supports not only memory and musical perception but also creative expression and improvisation skills. These results reveal that game-based and audio-guided learning environments, utilizing structured auditory support, have the potential to be an effective tool in developing higher-level musical skills for visually impaired students.

Participant statements indicate that the platform played a significant role in both reinforcing knowledge and improving cognitive skills. For example, P1's statement, "Different types of audio questions helped me improve my theoretical knowledge while also enabling me to produce solutions faster," reveals that it supported the application of learned information and accelerated mental processes. Similarly, P3 and P6 stated that the different auditory tasks encountered during the game improved their mental agility and decision-making skills under time constraints. These findings are consistent with theoretical approaches showing that interactive and game-based auditory learning environments support cognitive flexibility (Gee, 2003; Jonassen, 1999).

From a cognitive psychology perspective, these findings are consistent with research showing that problem-solving tasks performed under time pressure support executive functions such as working memory, attention control, and processing speed (Diamond, 2013). The instant auditory feedback and varying difficulty levels offered on the Audemy platform allow students to combine theoretical knowledge with real-time practice. Such experiential learning processes align with constructivist learning approaches, which emphasize active student participation and learning through experience (Piaget, 1973; Vygotsky, 1978).

For visually impaired students, auditory feedback is a primary source of sensory information. Therefore, structured and interactive audio-based games are highly effective in the learning process. The combination of repetitive activities, auditory cues, and time-bound tasks supports students not only in learning information but also in applying this information to new situations. This is of great importance in terms of both academic learning and problem-solving skills in daily life (Hallam, 2006).

In conclusion, the findings show that the Audemy platform supports both theoretical knowledge and practical application simultaneously, increasing both the cognitive flexibility and subject mastery of visually impaired students. In this context, it can be said that interactive auditory games are a valuable pedagogical tool not only for acquiring subject knowledge but also for developing higher-order thinking skills.

These findings are consistent with research on adaptive learning systems, which demonstrate that personalized instruction delivered through adjustable difficulty levels and real-time feedback supports both cognitive development and student motivation (Brusilovsky, 2001; Shute & Zapata-Rivera, 2012). Adaptive algorithms progressively

advance the learning process by presenting students with tasks that are neither too easy nor too difficult, ensuring progression appropriate to each student's learning level (Vygotsky, 1978).

The auditory feedback component is particularly important for visually impaired students, as it serves as a key source of information, allowing them to instantly recognize their performance and understanding of the subject matter.

From a constructivist perspective, the Audemy platform supports students' active participation in the learning process. The platform allows students to make decisions, evaluate their own performance, and adjust their learning strategies based on the personalized feedback they receive (Jonassen, 1999). The combination of progress tailored to individual learning pace and immediate, explanatory feedback creates a learning environment where students can reinforce theoretical knowledge and effectively apply it in practical situations.

In conclusion, the findings demonstrate that the personalization algorithms on the Audemy platform are effective in adapting to individual learning needs, increasing motivation, supporting learning from mistakes, and improving both theoretical and practical learning outcomes. This highlights the significant pedagogical value of adaptable and feedback-rich digital learning environments, particularly for visually impaired students.

The findings show that visually impaired students feel more competent and successful in learning environments based on auditory feedback. Audio guidance systems help students monitor their own performance and recognize their achievements, which increases their interest and effort in the learning process. This supports the strong relationship between learning motivation and self-confidence (Deci & Ryan, 2000; Schunk & DiBenedetto, 2020).

Participant feedback also confirms this. For example, P1's statement, "Different types of audio questions enriched my theoretical knowledge while also teaching me to produce solutions faster," shows that the platform both reinforced knowledge and improved cognitive skills. Similarly, P3 and P6 stated that the auditory challenges encountered during the game helped them think faster and make better decisions under time pressure. These findings reveal that interactive and game-based auditory learning environments support students' cognitive flexibility (Gee, 2003; Jonassen, 1999).

From a cognitive psychology perspective, these results demonstrate that problem-solving tasks performed under time pressure improve executive skills such as working memory, attention, and processing speed (Diamond, 2013). The instant auditory feedback and varying difficulty levels offered on the Audemy platform allow students to immediately apply the theoretical knowledge they have learned during gameplay.

This type of learning process allows students to actively participate in the lesson and supports learning through experience. This is consistent with constructivist learning approaches, which argue that learning occurs through active participation (Piaget, 1973;

Vygotsky, 1978). For visually impaired students, auditory feedback is a fundamental source of information; therefore, structured and interactive audio-based games are highly effective in the learning process. The combined use of repetition, auditory cues, and time-based tasks supports students not only in acquiring information but also in applying what they have learned in different situations. This is important for both academic learning and everyday problem-solving skills (Hallam, 2006).

In conclusion, the findings demonstrate that the Audemy platform enhances both the cognitive flexibility and subject matter mastery of visually impaired students, providing both theoretical and practical gains. This reveals that interactive audio games are valuable pedagogically, not only for acquiring subject knowledge but also for supporting the development of higher-order thinking skills.

Although rare, minor glitches in the voice commands used on the Audemy platform may have a limited impact on the perceptual accuracy and user satisfaction of visually impaired students. However, the infrequent and low-level occurrence of these problems indicates that the platform is generally accessible and user-friendly. This finding is consistent with the Universal Learning Design (LLD) approach, which advocates for the design of digital learning environments in accordance with the principles of accessibility and inclusion (Al-Azawei et al., 2016).

Overall, these findings demonstrate that the Audemy platform offers a technically reliable and accessible learning environment, enabling visually impaired students to participate seamlessly in the learning process. The platform's adaptive algorithms, audio guidance system, and gamified structure, combined, provide a continuous and effective learning experience in cognitive, musical, and motivational areas.

Participants reported that the games were cognitively challenging and contributed to the reinforcement of learned skills; they emphasized that completing tasks increased their self-confidence, particularly in the areas of rhythm and intonation. These findings are consistent with the game-based learning literature, which shows that structured and interactive games can simultaneously support skill development, motivation, and self-efficacy (Gee, 2003; Hamari et al., 2014). In particular, the immediate feedback and gradual difficulty levels offered in the games contribute to maintaining students' intrinsic motivation by strengthening their feelings of competence and mastery (Deci & Ryan, 2000).

Furthermore, the structured tasks included in the games are seen to be consistent with constructivist learning principles and support students' systematic learning. These tasks help students better understand and internalize fundamental musical principles over time. Students' participation in goal-oriented and active games allows them to combine theoretical knowledge with practical applications, strengthening both their cognitive and emotional gains (Jonassen, 1999; Shute & Zapata-Rivera, 2012). Because visually impaired students rely heavily on auditory input, these game-based interactions provide an effective learning environment that combines auditory guidance with active

problem-solving and skill-based practice. This allows students to participate more actively in the learning process. In short, the games on the Audemy platform not only contribute to the development of musical skills but also improve the self-confidence, attention, and learning strategies of visually impaired students. The results demonstrate that gamified, adaptive, and accessible learning environments are of significant value in supporting cognitive and emotional development in music education.

Conclusions

The Audemy platform is considered an effective tool for enhancing the learning experiences of visually impaired individuals in music education. The platform aims to reduce the challenges students face in developing their perceptual skills. Thanks to its personalized and accessible structure, Audemy supports equal opportunities in education by offering solutions tailored to students' individual needs. Audemy makes significant contributions to accessibility, independence, and motivation in the music education process for visually impaired students. The platform's audio guidance system, personalization algorithms, and comprehensive content help students develop skills such as rhythm, timing, auditory memory, instrument recognition, creativity, and self-confidence.

However, there are some minor technical and accessibility limitations. Audemy, with its newly developed and highly adaptable foundation, is believed to have already contributed to many visually impaired individuals and will continue to do so in many other areas.

Aknowledgment

The author declares that this research was conducted in accordance with ethical standards. All participants were informed to consent before inclusion in the study. Confidentiality of participant data was ensured, and all relevant guidelines for human or animal research were followed. This research received no external funding.

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Dirbtinio intelekto valdomos „Audemy“ platformos indėlis ugdant regos negalią turinčių asmenų muzikinius įgūdžius

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Santrauka

Šiame tyrime nagrinėjama, kaip dirbtinio intelekto valdoma „Audemy“ platforma prisideda ugdant silpnaregių asmenų muzikinius įgūdžius. Šią negalią turintys asmenys susiduria su įvairiais iššūkiais, kurie kyla dėl prieigos prie tradicinių vizualinių muzikos mokymo metodų ir jų taikymo. Tyrimo tikslas – atskleisti technologinių sprendimų, pavyzdžiui, „Audemy“ platformos, vaidmenį mažinant šias kliūtis, taip pat jų poveikį mokymosi procesui. Buvo taikytas kokybinis tyrimo metodas, atliekant pusiau struktūruotą interviu su aštuoniais 13–20 metų amžiaus regos negalią turinčiais studentais, kurie „Audemy“ platformą naudojo ne trumpiau kaip tris mėnesius. Surinkti duomenys buvo analizuoti taikant aprašomąją ir turinio analizės metodus, o rezultatai sugrupuoti į devynias temas remiantis atviru kodavimu. Be to, buvo pateiktos trijų ekspertų nuomonės; ekspertai rekomendavo padidinti garso atsiliepimų reguliarumą, padidinti prieinamumo testų skaičių ir integruoti savireguliacijos strategijas į platformą. Iš tyrimų rezultatų matyti, kad „Audemy“ platforma palengvina mokymosi procesą regos negalią turintiems asmenims dėl jos pritaikomos struktūros, garso signalų ir navigacijos sistemų bei prieinamo dizaino. Nustatyta, kad ši platforma padeda gerinti studentų savarankiško mokymosi įgūdžius, skatina jų motyvaciją mokytis ir stiprina jų techninius įgūdžius. Dėl techninių patobulinimų ir gausaus pedagoginio turinio daroma išvada, kad „Audemy“ platforma regos negalią turintiems asmenims siūlo tvarias ir prieinamas muzikos mokymosi galimybes.

Esminiai žodžiai: *regos negalią turintys asmenys, mokymas groti pianinu, dirbtinis intelektas, „Audemy“ platforma, muzikos mokymo technologijos, neįgaliųjų švietimas.*

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