

The application of music therapy intervention path assisted by information technology in special education

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ABSTRACT

The field of special education has long faced the challenges of significant individual differences among students and the inefficiency of traditional intervention methods. However, music therapy activates multisensory integration through non-verbal channels, and the rapid development of information technology provides technical support for this treatment method. Therefore, this paper discusses how information technology and music therapy can support special education, aiming to provide special students with support that combines emotional warmth and technical precision, optimizing their learning experience, promoting physical and mental health development, and advancing special education's personalized and inclusive development.

KEYWORDS

information technology; music therapy; special education; personalized intervention

In the mid-1990s, special education students could not receive effective support in the traditional classroom due to their language development delay, social impairment, and attention deficit. As a non-verbal communication medium, music was used in special education. Music rhythm, melody and harmony can effectively regulate emotional state. However, the effectiveness of music therapy relies heavily on the therapist's experience and judgment. In the education process, there are often problems, such as unstable intervention effects and difficulty quantifying the process. Information technology provides new ideas for these problems. Wearable smart devices can monitor physiological indicators in real-time, such as heart rate and brain waves, and identify behavior patterns through data analysis of machine learning algorithms. The combination of traditional music therapy and technology improves the precision of the intervention and lowers students' preparedness in a relaxed way. Given this situation, this paper combines traditional music therapy with technology to study different intervention strategies, which can be applied to different types of obstacles and build a practical and inclusive special education ecology. This study can make music therapy break traditional education's limitations, provide reliable guarantees for special students' education, and promote the fairness of education.

1 The theoretical basis of music therapy and information technology

1.1 The healing function of music

Music therapy is a systematic and scientific mental intervention method that uses the influence of music on mood to change people's mental states and physical and mental changes. It can use the influence of music on mood to play a healing role, to help people reduce the level of cortisol, alleviate anxiety, and stimulate the secretion of dopamine, completely change their mental state and physical and mental changes, with a certain degree of systematic and scientific, the healing power of music comes from its deep interaction with the brain: soothing rhythms lower cortisol levels and reduce anxiety. In contrast, high-pitched melodies stimulate dopamine and bring a sense of pleasure. The healing function of music is based on the two-way regulation of human physiological and psychological systems. When listening to soothing melodies or rhythms, the limbic system, which is responsible for emotion processing and memory storage, can be affected by stimulating emotional response and physiological regulation. It also has the characteristics of directness and non-language. From the above analysis, music therapy can effectively stabilize the emotions of special education groups with limited language expression ability or cognitive impairment and is worthy of wide practice and application^[1]. The second major function of music therapy is to promote cognitive development and learning. Generally speaking, during the process of listening to music, the human brain simultaneously processes key information such as rhythm, melody, and harmony and promotes the coordinated work of four brain areas: first, the auditory cortex, which is responsible for receiving sound signals; second, the motor cortex, which needs to coordinate bodily movements; third, the prefrontal cortex, which predicts changes in rhythm promptly and adjusts responses. Repetitive musical activities can help individuals establish stable neural pathways. In special education, therapists use music therapy to attract students' attention, further develop their higher-order thinking skills, such as logic and reasoning, and effectively organize musical

activities to enhance their basic cognitive abilities.

1.2 The role of information technology in music therapy

In music healing, the application of information technology by Healers is reflected in the following two aspects: one is the smart device represented by the smart bracelet, which is equipped with special sensors that can continuously collect data on heart rate and skin conductance of students', analyze and evaluate their emotional tension. Second, the combination of camera and image recognition technology can capture the changes in students' facial expressions and body movements and automatically generate a music intervention scheme suitable for the current state after algorithm processing, pointing out the specific direction of intervention for the healer. Third, mobile applications and remote collaboration platforms mainly provide a customized music library, allowing students and other users to obtain healing resources at any time according to their own needs and complete independent learning and exploration. The latter will connect schools, families and professional treatment institutions in series to realize the synchronous update of intervention plans and real-time tracking of progress, thus expanding the coverage and sustainability of music therapy. With the continuous renewal and development of modern science and technology, the importance of music therapy for special groups has become increasingly apparent, which is the basis for ensuring the continuity and effectiveness of interventions; it also provides strong support for better growth and development of special groups^[2].

2 The intervention path of information technology-assisted music therapy

2.1 Development and application of digital music resources

The development of digital music resources is centered on user needs and uses artificial intelligence and data analysis technology to deconstruct and reorganize music elements. Developers need to transform the parameters of music, such as rhythm, pitch, and harmony, into a digital signal and analyze the individual physiological feedback behavior characteristics of special groups to establish a correlation model between musical attributes and physical and mental states. Based on this model, the therapist can adjust the music parameters in real time according to the special students' specific needs and physiological feedback to optimize the therapeutic effect. The application scenarios of digital music resources cover personalized intervention and group collaborative therapy. At the individual level, mobile apps and smart wearables could provide 24/7 autonomous treatment for specific groups by integrating music databases. When a distraction signal is detected, the headphones play background music at a specific frequency to help focus attention. At the group level, rhythm training music is played simultaneously through wireless networks, allowing students to interact with the rhythm using smart instruments. Such intervention can maintain the emotional resonance characteristics of music healing and provide hierarchical support for students with different cognitive levels and behavioral characteristics while lowering the operating threshold.

2.2 Immersive interventions in virtual reality (VR) and augmented reality (AR)

Virtual Reality (VR) technology through head-mounted devices and three-dimensional sound field technology can put the user completely in the virtual scene, under the synergistic effect of music rhythm, melody and dynamic change of virtual scene, enabling users to relax and focus their attention deeply. Therapists can calm anxious students by designing slow-moving river scenes and combining them with low-frequency natural sounds to dampen the stress response in their amygdala. Augmented reality (AR) has also played an important role in the intervention of special groups by integrating virtual music elements into their real life and learning environments. Specifically, the therapist can project dynamic rhythmic patterns on the classroom walls, and students can interact with gestures and virtual notes for fun. This interaction activates the brain areas related to emotional regulation and motor coordination to improve their physical coordination ability gradually. For students with posttraumatic stress disorder and autism, AR technology may provide relief^[3]. When the students' muscle tension is detected, the VR scene will automatically switch to the open grassland and slow down the music, gradually restoring their relaxed mental and physical state.

2.3 Data-driven individualized intervention programs

Data-driven personalized intervention programs are designed based on individual differences. Through continuous collection and analysis of multi-dimensional data, the sensitivity and adaptability of individuals to specific musical elements are identified. Based on the results of data analysis, a music healing scheme is generated, which not only fits the user's immediate state changes but also adapts to the dynamic adjustment needs of long-term intervention goals. The application of personalized intervention programs should run through the life cycle and diversified scenarios of special

groups. In the initial stage, music therapy focuses on emotional comfort and rhythm training can be introduced to enhance cognitive control in the medium term. In the later stage, social expression can be promoted through complex melodic combinations^[4]. The Healer should play soothing music for students new to healing, with a smart bracelet that can monitor heartbeat and breathing. When the device detects that the student is nervous, it automatically lowers the tempo of the music and adds natural sounds, such as birdsong, to help students relax their bodies. When the student is emotionally stable, the healer can design a "Drum beat challenge" on the tablet computer, where the student taps the drum surface on the screen with his hand. If the game is correct three times in a row, it will automatically reward a happy melody to encourage them to keep practicing. At a later stage, the healer could have two students each wear a smart bracelet while standing on a mat with motion sensors while they wave and jump face to face; sensors capture the force and direction of the movements to produce different instrumental sounds and the two need to coordinate their movements to get the two melodies in sync, which they play back to the students after class to help them understand how their actions affect others. Throughout this process, information technology provides both the musical tools for each stage and the recording of the student's progress. The Healer can adjust the difficulty according to the data and, step by step, help the student stabilize his mood and improve his ability. Finally, they learn to use music to communicate with others.

3 The practical application of information technology-assisted music therapy in special education

3.1 music intervention for students with language and social impairment

As a cross-cultural and cross-age universal language, music can bypass the limitations of oral expression and directly activate areas of the brain related to emotional resonance and motor coordination. Teachers and therapists can design collaborative percussion, melodic relays, and role-playing music games to guide students to communicate their ideas through instrument percussion, sound imitation, etc. In this process, information technology can convert students' drumming actions into visual animation projections in real-time, capture their emotional fluctuations in voice production through voiceprint analysis, generate corresponding color feedback, and assist the healer in adjusting the intervention regimen to ensure the intervention is always effective. In addition, teachers and therapists should design interactive interfaces with body movements to trigger notes for students with low verbal ability and add multi-role collaborative musical plot tasks for high-functioning students. Musical elements should be combined with phonetic training for students with language disorders. Their oral muscle control should be trained through melodic rising and falling tones to subtly strengthen their pronunciation ability in singing in order to take into account the individual needs of students with different abilities, promote their social interaction, cognitive development and emotional expression, and finally, realize the deep integration of music therapy and special education.

3.2 Rhythm feedback training for students with attention deficit and mood disorder

There is a natural synchronization effect between the periodic fluctuation of music rhythm and the physiological rhythm of human respiration and heartbeat. Therefore, healers can use equipment to capture students' heart rate variability and skin electrical signals and generate a basic rhythm template to match it. As the students followed the visual rhythmic dots, their movement accuracy and beat fit were translated into sound intensity in real-time, and this immediate sensory feedback forced the brain's prefrontal cortex to remain focused on the task at hand, thus inhibiting attentional distraction. The Healer can also adjust the tempo and complexity dynamically based on heart rate and brain wave data. When a child with special needs is detected to have increased anxiety, the healer automatically switches to slow and steady music to guide his breathing to slow down and relax^[5]. In the intervention, students can directly control the virtual instrument's pitch, volume and timbre by adjusting their breathing rate and muscle tension, such as deep breathing, to reduce anxiety. The virtual harp gradually softens and extends into a longer tone, translating abstract emotions into actionable musical output to help them learn to regulate their emotions. In addition, teachers and healers can develop rhythm prediction games that allow students to memorize and reproduce progressively longer drum sequences, strengthening their concentration and memory. Ultimately, it will help improve their physical coordination, verbal expression, and emotional regulation.

4 Conclusion

In conclusion, the intervention path of music therapy assisted by information technology provides an innovative solution with scientific and humanistic care for special education, aiming at students with language and social impairment. Music therapy can effectively reduce social anxiety and promote emotional expression through rhythmic

synchronization and non-verbal interaction. For individuals with attention deficit and mood disorders, the combination of rhythm training and biofeedback can enhance their attention stability and emotional management abilities, thereby promoting the improvement of cognitive functions. In the future, lightweight and low-invasive intelligent sensing devices can be developed, and a standardized evaluation system can be established to make music therapy play a more effective role and create an inclusive growth environment for students with more types of disabilities.

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