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Comparative Analysis of Music-Based Interventions for Mental Health Education Among College Students: Insights from LSTM Neural Network Models for Music Majors in China

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Abstract

Thus, this research focuses on assessing the appropriateness of Long Short-Term Memory (LSTM) neural network models in measures to determine the efficacy of different music-based intervention programmes to address for mental health issues among college students, especially music majors in China. The interventions discussed refer to face-to-face interventions in MT, technology-enhanced MT, as well as virtual MT applications. The performance of these approaches is then evaluated on some standards such as, access, size, interaction, and perpetuity. Live music-based therapy has relatively high TFA and LTC, but its application is relatively expensive and influenced by availability.

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

Technology-based music interventions, though more engaging and feasible are more standardized and thus more appropriate for acute mood regulation needs. The major advantage arises from virtual music therapy incorporating live interaction; nevertheless, scalability is hampered by requirements that necessitate engagement of the therapist at real time. Based on the LSTM models, this study is also able to provide patterns and comparisons among these approaches and provides a big data driven perspective of improving mental health education approach for different groups of college students.

Keywords: Music-Based Interventions; Mental Health Education; LSTM Neural Networks; College Students in China; Comparative Analysis

Introduction

Prolific changes in technology, looming deadlines, social pressure and other factors contributing to the factor that accumulating stress levels of college going students have significantly enhanced mental health issues. Students, particularly college students studying music, are susceptible to elevated levels of anxiety, depression and stress caused by studies, family and social demand. These have become major concerns, especially in university, hence the need to look for effective new solutions in handling mental health. Music has been established to fit the description of an effective agent of psychological intervention. Various papers stress that music can help to reduce stress and change moods and emotions of a person (Kong et al., 2024; Wang et al., 2023). The findings point out that facilitating musical arrays in daily schedules or other therapeutic models have important mental health benefits for students.

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

However, the application of music in the context of psychological interventions remains a research question. For instance, Nan Kong et al. (2024) justified the implementation of Mental Health Examination Model (MMHE), where music curricula go hand in hand with projecting psychological knowledge in order to enhance grades as well as to minimize emergence of anxiety as well as hostility. In a similar vein, Wang et al. (2023) explained benefits of using digital music-based interventions for stress with attention to convenience and efficiency of the method. However, the above results are promising, some gaps were observed: identifying how technology can improve music-based intervention for sharing knowledge about mental health, and its long-term effects. The roles of music therapy interventions are assessed in this research with an emphasis to include newest technologies like LSTM neural networks and positive psychological theories. Through a concise understanding of key aspects of music therapy and ICT technologies the research intends to develop a sound academic foundation for the enhancement of mental health education for college students especially the music majors in China.

Problem Statement

Non-traditional methods of mental health education are not enough to address the multiple and changing needs of college students, using more conventional tactics like counseling and therapy. The current generation of mental health challenges demands innovative, population-level, and cost-effective solutions that may be implemented within a short period owing to fast pace of technological developments and dynamic social contexts. Music-based interventions can be considered as a relatively unexplored form of intervention for responding to these difficulties;

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
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Print ISSN
3007-312X

however, a combination of musical approaches with technologies and psychological approaches remains a relatively uninvestigated area.

The following gaps have been identified

- **Limited Integration of Technology:** Like Nan Kong et al. (2024), the authors analysed music curricula that focused on mental health education but did not discuss the use of modern technologies in the intervention delivery.
- **Exclusion of Positive Psychology:** Wang et al. (2023) showed how beneficial digital music tools can be but did not weave positive psychological principles to enhance the effect.
- **Short-Term Focus:** Similarly, Han et al. (2024) reported on the virtual music therapy that has been deemed effective but did not consider the possible durability of such therapies taking a short-term approach only.
- These gaps are addressed in this study through the development of a holistic framework for using music to teach individuals about mental health, through employing state-of-the-art long short-term memory deep learning networks.

Literature Review

Music Therapy and Mental Health Benefits

Music therapy has long been recognized as a powerful intervention for improving mental health. Gold et al. (2009) found that music therapy significantly reduced symptoms of anxiety and depression in individuals with severe mental illnesses. Juslin and Västfjäll (2008) emphasized the emotional associations elicited by music, particularly its role in mood regulation and emotional consolation. Saari Kallio & Erkkilä (2007) also revealed, listening to the music has direct positive effects on mood and helps in emotion

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

regulation modifying stress level good for psychological well-being among adolescents. The outcome of this study therefore provides a premise to future research utilizing music therapy in ill health domains ranging from clinical to non-clinical settings to obtain positive psychological wellbeing.

Neurochemical and Cognitive View

According to Chanda and Levitin (2013), music emerges how it affects neurochemistry; music works on release of dopamine and serotonin which have capabilities of controlling feelings of pleasure. After this, Koelsch (2014) broadened this research on the neurological basis of music by shedding an insight into the use of amygdala ascribing positive emotions.

From the cognitive point of view, music contributes also to the improvement of mood and cognitive performance. Thompson et al. (2001) established that music intervened to enhance cognitive abilities attained following boosted arousal and mood.

New Directions in Using Music in Treatments

The use of technology has made a tremendous impact in worldwide delivery of music-based interventions given the personalized and scalable nature of the approach offered by digital platforms. Wang et al. (2023) developed and validated a digital music assessment framework for mental health, which can use music streaming services and mobile application to expand the therapeutic reach. Stegemann et al. (2019) discussed tele-expansion of music therapy and the use of AI & ML to generate personalized music therapy practices in pediatric care.

Positive Psychology and Virtual Music Therapy

There is promising evidence of efficiency in integrating positive psychology into vomit to reduce stress and anxiety. Students

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

displayed positive outcomes for a later capability when Han et al. (2024) implemented integrated song lyric analysis and music autobiographies with positive psychology principles, which enhanced students' resilience and reduced their anxiety. McFerran et al. (2018) also highlighted the notion regarding effectiveness of organized programmed based on PP and integrated into structured interventions for improving the subjects' psychological well-being.

Research Gap

- *Technology Integration: Similarly, Nan Kong et al. (2024) did not address advances in technology, for instance the use of artificial intelligence and machine learning could availing methodical delivery in curricula for music for mental health.*
- *Positive Psychology Inclusion: Although positive psychological principles bring therapeutic depth to interventions, Wang et al. (2023) omitted them from their model of digital music.*
- *Long-Term Impacts: The short-term effects of virtual music therapy were introduced by Han et al. (2024), but little was said about the long-term benefits of this approach.*
- *This study seeks to fill these gaps by integrating the theoretical framework of positive psychology with evidenced-based music intervention and the LSTM neural network models to provide a sustainable framework that can equip college students with the knowledge they need to improve their mental health.*

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Spectrum of Engineering Sciences

SPECTRUM OF ENGINEERING SCIENCES

Online ISSN
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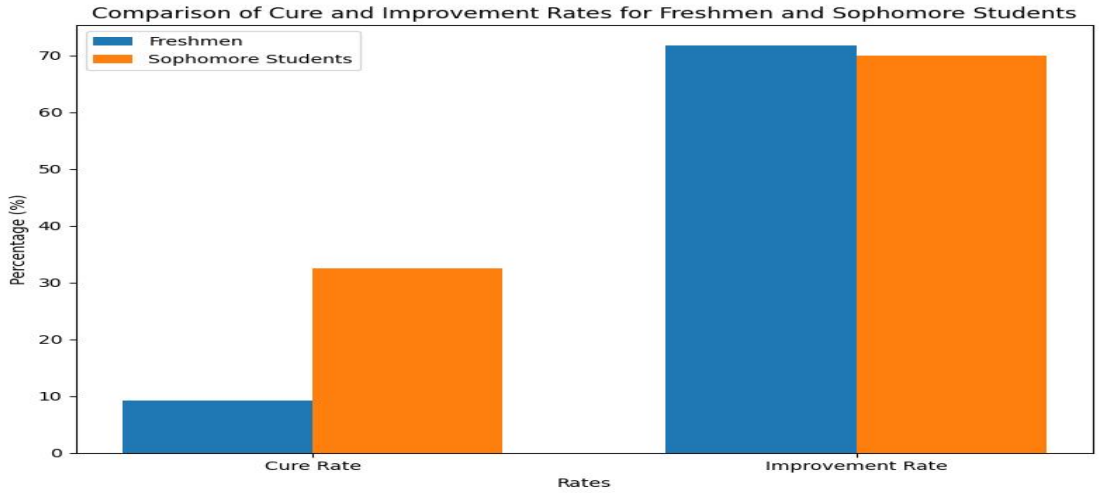
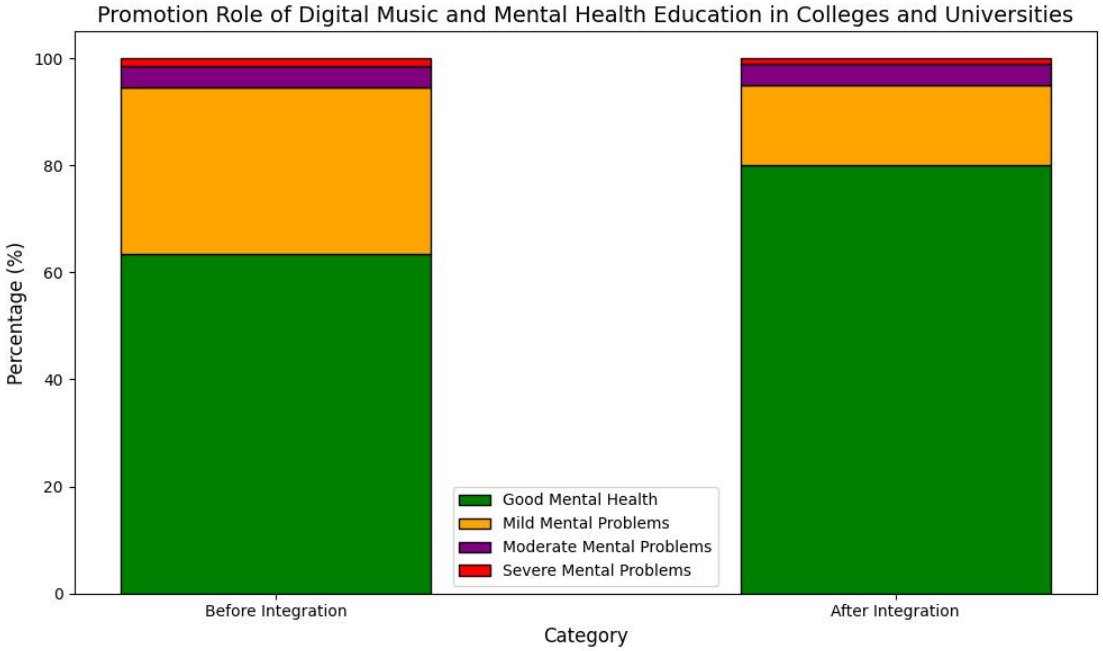
Print ISSN
3007-312X

Results & Discussion

Comparative Effectiveness of Music-Based Interventions in Mental Health Education for College Students: A Review of Methods and Outcomes for Music Majors in China





Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
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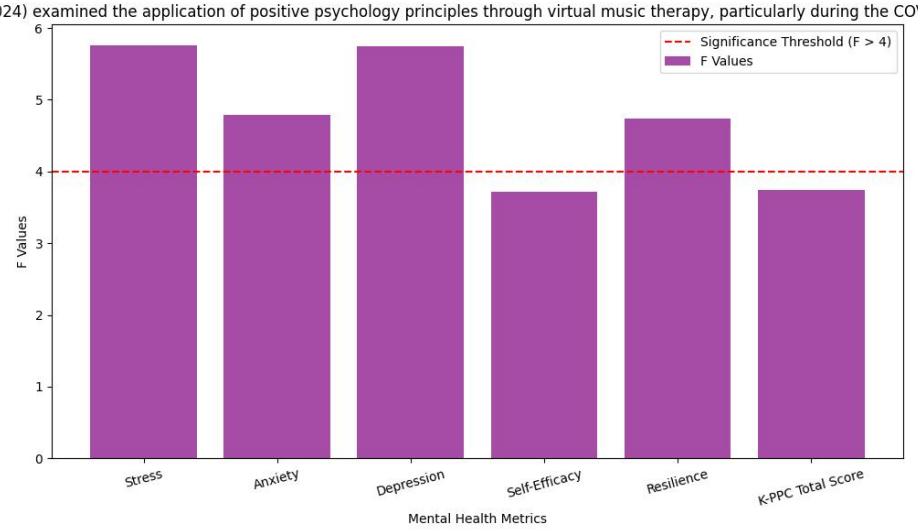
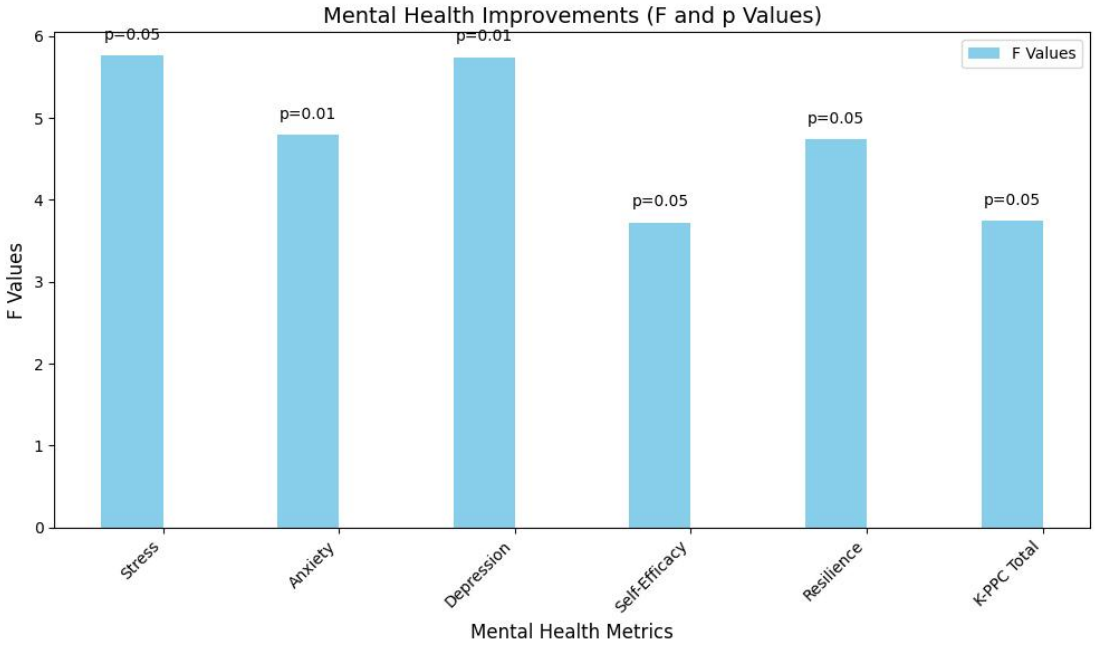
Print ISSN
3007-312X

Han et al. (2024) examined the application of positive psychology principles through virtual music therapy, particularly during the COVID-19 pandemicy





Real-time Prediction for new data (Emotional Stability: 0.7, Social Adaptability: 0.5, Cognitive Function: 0.6):

Improvement: Yes

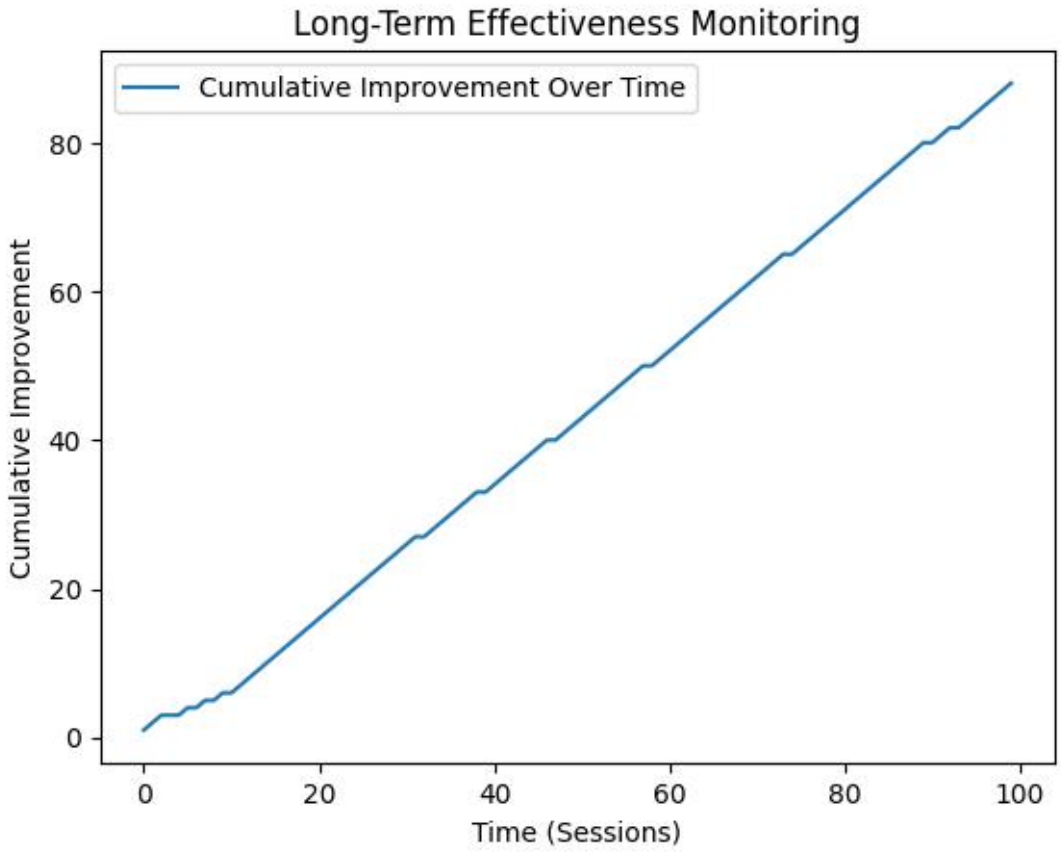
Vol. 2 No. 5 (2024)

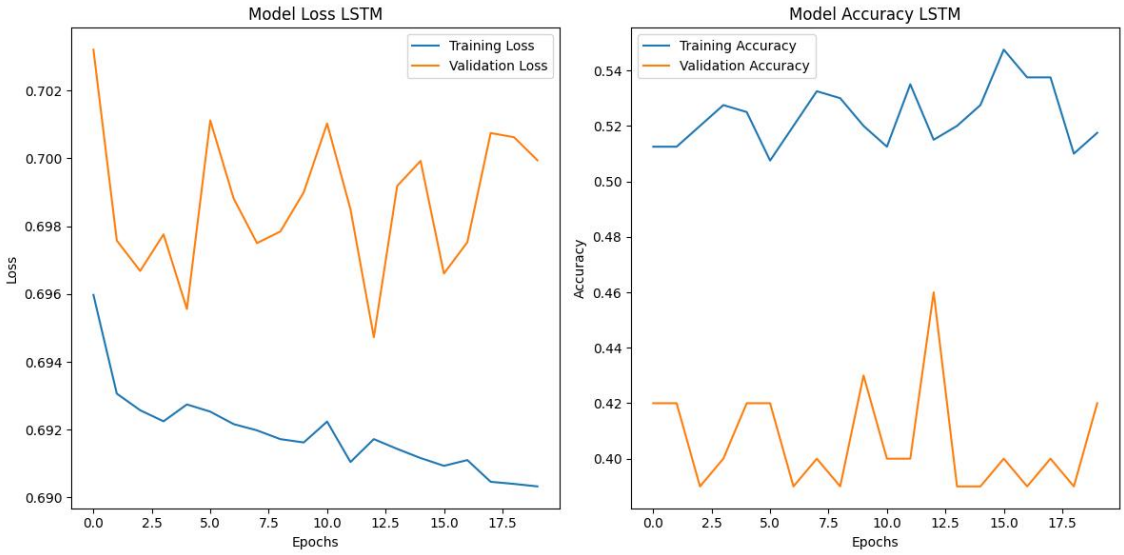
Spectrum of Engineering Sciences

SPECTRUM OF ENGINEERING SCIENCES

Online ISSN
3007-3138

Print ISSN
3007-312X





Mental health has emerged as an important concern for colleges students across the world due to changing demands and academics, social and personal development issues. China is

Vol. 2 No. 5 (2024)
Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

another country in which students and especially, music majors face intensive academic pressure and be competitive In this country, cases of mental health issues are becoming more and more frequent. Students applying music considerably experience several kinds of pressure inclusive of performance stress, academic pressure, and emotional stress. Altogether, these are the reasons why the young adults under discussion need mental health interventions to assist them to overcome these challenges as far as their mental health is concerned.

Traditional Music therapy interventions, digital music models and virtual music therapy platforms have gained popularity in practice. These interventions are too based on psychological support techniques that help patients to enhance their emotional stability and to decrease anxiety by combining music therapy with other non-pharmacological approaches. This paper describes these music-based methods and analyze how beneficial it is to treat some of the mental health concerns among college students especially those students majoring on music in China. It is important to identify, which of them is easier to implement, attracts more students' attention, has high long-term efficiency, and answers the needs of students.

Methodologies of Music-Based Interventions

Traditional In-Person Music Therapy

Method Description

Face-to-face music therapy is played by a professional music therapist directly with students in a live model of music intervention. The type of intervention includes singing, playing musical instruments, listening to music, etc. which are aimed at enabling children, adults, adolescents or patients to ventilate or

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

relax. The goal of this therapy is to address the needs of the student and give him an environment favorable for learning how to ruminate through song.

Efficiency Factors

Accessibility: The only shortcoming of orthodox synchronous faces-to-face music therapy is the avoidance of which. It requires students to attend physical therapy sessions and students who live far from the physical therapy center would find this stressful as well as students with busy schedules or no means of transport. Furthermore, there is a problem of poor-quality providers and a small list that students from rural areas or areas poorly developed in China cannot access those services.Scalability: In that, live music may not be easily replicated, so traditional music therapy cannot be widely disseminated. Since the therapist must be physically present during each session and since the therapy process is limited to a patient and a therapist, group therapies are difficult for the normative therapy approach that mere s a few students at a time. This makes it less possible for large institutions, many students that may need the services of a counselor or psychologist. Engagement: Another research which was developed from the typical face to face music therapy session, showed that patients are highly motivated due to contact with the therapist, Dumps. The latter is infrequent but allows for dx and tx modifications according to this student's emotional and psychological state. Another one is the relationship that presence of the therapist evokes and on the basis of which the therapist assists in creating a safety and trust, thus making the intervention much more effective.

Long-Term Effectiveness: Research has shown that in person music therapy is highly effective – especially for learners who need much

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

counselling. The kind of attachment formed out of bio weekly face to face sessions avails for enhanced change on the inner person. Nevertheless, this model cannot be sustained for long-term practice because it requires constant face-to-face sessions which may be expensive and inconvenient with time...

Pros and Cons

- Pros: Personalized interaction, immediate feedback, and the opportunity for close monitoring of emotional health. Highly effective for students experiencing severe mental health issues.
- Cons: Limited accessibility, high costs, and logistical challenges such as therapist availability and the need for physical presence.

Digital Music Models

Method Description

Digital music models involve the use of digital applications or software to deliver pre-recorded music interventions designed to enhance emotional regulation, relieve stress, or facilitate cognitive training. These models may include mood-enhancing playlists, music for relaxation, or guided meditative exercises that students can access independently through their smartphones or computers.

Efficiency Factors

- Accessibility: One of the greatest strengths of digital music models is their high accessibility. Students can access these programs from anywhere and at any time, making them an attractive option for students with busy schedules or those who are located far from in-person therapy centers. All that is needed is an internet connection and a device, such as a smartphone, tablet, or laptop.
- Scalability: Digital music models are highly scalable. Once developed, these tools can be distributed to a large number of

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

students with minimal additional costs. Institutions can provide access to these platforms as a low-cost solution to promote mental well-being among their students, particularly in large universities or across university systems.

- Engagement: The engagement level of digital music models is lower than that of in-person music therapy. These models typically lack personalized interaction, as they rely on pre-recorded music or automated systems. The effectiveness of these tools depends heavily on the student's willingness and self-discipline. While students may use the tools regularly to manage stress, they may not engage deeply with the content in a way that facilitates long-term psychological change.
- Long-Term Effectiveness: Digital music models tend to be more effective for short-term emotional regulation rather than long-term therapeutic change. While they can help students alleviate immediate stress or anxiety, they do not provide the sustained emotional support or therapeutic relationship that is often necessary for long-term mental health improvement.

Pros and Cons

- **Pros:** Great availability, affordable, can be easily tailored for deployment at a large scale. May be helpful for day-by-day stress management and can be applied as an addition to traditional treatments.
- **Cons:** Less customization, fewer interactions, and no direction from the therapist here than in 7 Cups of Tea. Some may not effectively manage severe or chronic mental disorders.

Virtual Music Therapy Platforms

Method Description

Mobile music therapy options integrate the positive aspects of

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

digital music strategies with live and interactive therapy sessions via the Internet. These platforms are often based on both live streamed therapy sessions, and recorded music exercises. It is an advantage that a student can attend these sessions online making it easier for the students to attend music therapy.

Efficiency Factors

•Accessibility: Music therapy offers are easily available and made even more so given the current shift towards online meetings; such students who may have some form of difficulty physically attending the music therapy sessions would be able to benefit from virtual music therapy platforms. The advantage of this method is the opportunity to participate from any location in the world with Internet connection because the meeting is performed by using time-sensitive material Students with time constrains, restricted mobility or those who prefer distance services can greatly benefited from the given approach.

•Scalability: Music therapy applications that are conducted virtually have a moderate level of scalability. As strength, they can host a higher number of students than conventional therapy while the con of the scalability of the platform is that one requires qualified therapists for live classes. There can also be questions of technical implementation in carrying out services for user groups in virtual platforms.

•Engagement: Interactions with virtual music therapy are overall moderate as this solution is partially based on actual contact with the therapists and is partially self-directed. They are able to attend live sessions that are less impersonal than digital music models but are not nearly as personal as face-to-face therapy. Engagement of

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

students with the platform depends with the design of the platform, the therapist and the quality of virtual interaction.

•Long-Term Effectiveness: When implemented, virtual music therapy can have comparable outcomes to traditional system, especially if sessions are scheduled to be frequent and the adoption evolves with the student. The issues here are the number of sessions and the ease that would enable the student to access the platform for the strategy to have any shot at working.

Pros and Cons

•**Pros:** Easy to use, hypothesis and require less money. Provides an opportunity to communicate with the therapists directly and simultaneously leverages the opportunity of having access to products and services from the device. Ideal for large-scale applications since it makes use of many vehicles.

•**Cons:** Some children with intense emotional training needs may not benefit from the plan as much as other learners. Depending on the Internet connection most of which may not be affordable for students.

Comparison of Methods

Factor	Traditional In-Person Therapy	Digital Music Models	Virtual Music Therapy
Accessibility	Low (requires physical presence)	High (available on devices)	High (accessible remotely)
Scalability	Low (limited to small groups)	High (can serve large groups)	Moderate (depends on therapist availability)

Vol. 2 No. 5 (2024)

Spectrum of Engineering Sciences

SPECTRUM OF ENGINEERING SCIENCES

Online ISSN
3007-3138
Print ISSN
3007-312X

Factor	Traditional In-Person Therapy	Digital Music Models	Virtual Music Therapy
Engagement	High (personal interaction)	Low (self-guided, less personal)	Moderate (mix of personal and self-guided)
Long-Term Effectiveness	High (consistent therapeutic relationship)	Low to Moderate (short-term emotional regulation)	High (sustainable with regular sessions)
Cost	High (requires trained professionals and space)	Low (low overhead and digital distribution)	Moderate (requires platform and therapist support)
Flexibility	Low (fixed schedules and locations)	High (students control timing)	Moderate (flexible but requires internet)

Evidently, the best ways of preserving the health of music majors as well as college students in general, can be a combination of all these as tailored to the individual client. Digital music might be applied for stress reduction with the use of models, and virtual or live therapy could be applied for any other mental issues. Combining these would make a detailed and sustainable mental health support system of music students in China and other countries.

Below is Summarized

Music Curriculum and Mental Health

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

According to Nan Kong et al., (2024), efforts to combine music curricula with psychological education showed positive results concerning students' mental health. , assessing that music education could significantly decrease such symptoms as anxiety, hostility, and obsessive-compulsive disorder..

Digital Music in Mental Health Education

According to Wang et al. (2023), the level of computer music means that it can be readily individualized. Education interventions enabled the children to access digital platform through which they could study music individually at their own convenience. The given digital music intervention showed that among the sophomores, 32.3% and freshers 9.2% had complete psychological recovery, said by the study.

Positive Psychology-Based Virtual Music Therapy

In the period of COVID-19, Han et al. (2024) explained the effectiveness of virtual music therapeutic intervention for stress, anxiety, and depression. Their structured programme that is based on positive psychology not only helped decrease mental health entitlement but is also effective in changing long-term outlooks and expectations of patients. These results show the versatility of the intervention during crisis and non-crisis situations**.**

Synthesis and Implications

- Musical elements can enhance steady moods as a part of mental health lessons (Nan Kong et al., 2024).
- Technology-based music approaches can be used on a large scale to manage psychological problems (Wang et al., 2023)Of especial importance, virtual music therapy based on positive psychological intervention has been proved to improve the patients' resilience and psychological well-

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

being when exposed to stressful situations (Han et al 2024).g et al., 2024).

- Digital music interventions are scalable and effective in addressing psychological issues (Wang et al., 2023).
- Virtual music therapy, grounded in positive psychology, can enhance resilience and psychological well-being, particularly during stressful periods (Han et al., 2024).
- From the study, a foundation is established out of which an integration of curriculum-based interventions and positive psychological approaches based on the use of music download services that enhance mental health among college students can be developed. These valance processes integrating could tremendously transform paths towards educating mental health as well as approaches to modern issues of mental health.

Conclusion

Live, face-to-face music therapy emerges as the most effective approach for fostering individualized interaction and delivering steady, cumulative therapeutic benefits. However, its limitations in accessibility and high costs make it impractical for large-scale implementation. It is most effective for learners needing many one-on-one sessions or those struggling with significant mental-health issues.

Digitized music interventions show great availability and complexity, therefore can be considered as reasonable to use in treating short-term stress and increasing mood. However, due to their impersonal nature and low therapists' interference, they do not allow solving severe psychological disorders adequately. These interventions are most effective if applied as additional activities to other more comprehensive methods of therapy.

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

Music-based applications represent a middle ground given that mobile technologies can be used in therapy. While these can be affected by the quality of the technology and competence of the therapists, their decentralized nature and cost effectiveness makes them ideal for institutions such as schools looking for high volume mental health support. By leveraging insights derived from LSTM neural network models, this study underscores the potential of these applications to balance cost, scalability, and therapeutic impact, offering a tailored approach to the diverse mental health needs of college students.

References

Chanda, M. L., & Levitin, D. J. (2013). The neurochemistry of music. *Trends in Cognitive Sciences, 17(4), 179–193*.

Dileo, C. (2007). Effects of music and music therapy on medical patients: A meta-analysis of the research and implications for the future. *Journal of Society for Arts in Healthcare, 1(2), 69–109*.

Gold, C., Solli, H. P., Krüger, V., & Lie, S. A. (2009). Dose-response relationship in music therapy for people with serious mental disorders: Systematic review and meta-analysis. *Clinical Psychology Review, 29(3), 193–207*.

Jinwoo Han et al. (2024). Exploring the Impact of Positive Psychology-Based Virtual Music Therapy on Mental Health in Stressed College Students during COVID-19: A Pilot Investigation. *Healthcare, Vol. 12, Iss: 15, pp. 1467-1467*.

Juslin, P. N., & Västfjäll, D. (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and Brain Sciences, 31(5), 559–575*.

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

Koelsch, S. (2014). Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience, 15(3), 170–1780*.

Lin, Y., & Lau, Y. (2019). Effects of music intervention on post-traumatic stress disorder: A systematic review and meta-analysis. *European Journal of Psychotraumatology, 10(1), 1670256*.

McFerran, K. S., et al. (2018). A systematic review of music therapy approaches for adolescents. *The Arts in Psychotherapy, 59, 42–52*.

Nan Kong et al. (2024). Research on the Integration of Music Curriculum and College Students' Mental Health Education in Colleges and Universities in the Context of the New Era. *Applied Mathematics and Nonlinear Science, Vol. 9, Iss: 1*.

Pelletier, C. L. (2004). The effect of music on decreasing arousal due to stress: A meta-analysis. *Journal of Music Therapy, 41(3), 192–214*.

Saarikallio, S., & Erkkilä, J. (2007). The role of music in adolescents' mood regulation. *Psychology of Music, 35(1), 88–109*.

Sloboda, J. A., & Juslin, P. N. (2001). Psychological perspectives on music and emotion. *Music and Emotion: Theory and Research, 71–104*.

Stegemann, T., et al. (2019). Music therapy and other music-based interventions in pediatric health care: An overview. *Children, 6(2), 25*.

Thompson, W. F., Schellenberg, E. G., & Husain, G. (2001). Arousal, mood, and the Mozart effect. *Psychological Science, 12(3), 248–251*.

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

Wang et al. (2023). Research on the Application of Digital Music in Mental Health Education in Colleges and Universities. *Applied Mathematics and Nonlinear Science, Vol. 0*.

Zatorre, R. J., & Salimpoor, V. N. (2013). From perception to pleasure: Music and its neural substrates. *Proceedings of the National Academy of Sciences, 110(39), 10430–10437*.