

The Effect of Piano Improvisation Training on Musical Creativity and Emotional Expression

Li Li

Academy of Music of Ningxia University, Yin chuan, Ningxia Hui Autonomous
Region, 750021, China
lilixiaotao@sina.com

Abstract: Piano improvisation training has a positive influence on musical creativity and emotional expression. Through the practice of improvisation, players can continuously improve their musical creativity and emotional expression, and make music more expressive and infectious. At the same time, improvisation can also expand the players' musical cognitive vision and enhance their musical cooperation ability, laying a solid foundation for their better development in their future musical career. This paper discusses the effects of piano improvisation on musical creativity and emotional expression, explains the importance of piano improvisation training, and proposes some specific methods of piano improvisation training.

Keywords: Piano Improvisation Training, Musical Creativity, Emotional Expression

1. INTRODUCTION

Piano improvisation is a skill of improvising and performing music without prior preparation. It requires the performer to combine piano playing skills, keyboard harmony techniques, and knowledge of compositional theory, and under the limitations of melodic conditions, to carry out instantaneous artistic re-creation, which is a special skill in the art of music performance. The main forms of piano improvisation are motivic development improvisation, thematic variation improvisation, propositional improvisation, situational improvisation, harmonic function improvisation and montage thinking improvisation. Piano improvisation is practical in nature, and this skill is often used in real-life performances to fill in the gaps in a song or piece of music, or to fill in and adapt an existing melody. Since improvisation takes place without prior preparation, it requires the player to have the ability to react quickly and compose on the fly (Guo, 2023). In addition, improvisers need to adjust the content and form of their performance at any time according to the scene situation and the performance of other players to adapt to different occasions and needs. It also emphasizes the play of personal style and the display of creativity, so it requires the player to have good knowledge of music theory and keyboard playing ability, as well as strong improvisation and adaptation ability. Piano improvisation also shows a certain degree of collaboration,

although improvisation has a certain degree of independence, but it also needs to collaborate with other players to complete the performance of musical works (Dong, 2022). Piano improvisation has an important position and role in music, and it is an integral part of music performance, creation, teaching and communication. Piano improvisation is an immediate music performance skill, which requires the player to quickly and accurately grasp the melody, harmony, rhythm and other musical elements and combine them into a complete musical work. This skill has an important position in music performance, which can improve the player's musical literacy and expressive ability (McPherson, Lopez-Gonzalez, Rankin, & Limb, 2014). Piano improvisation is also a way of music creation, which requires the performer to have certain knowledge of music theory and creative experience, and to integrate personal emotion, creativity and imagination into the musical work. This way of creation can promote the diversity and innovation of musical works (Shi, 2021). In the musical works, sometimes there are some gaps or deficiencies, then piano improvisation can play its role, through improvisation and performance, to fill these gaps, so that the whole musical work is more complete, rich and layered (Di Mauro, Toffalini, Grassi, & Petrini, 2018). Piano improvisation is also an important part of music teaching. By teaching piano improvisation skills, it can improve students' musical literacy, playing skills and creative ability, as well as promote students' music practice and performance ability. Piano improvisation is also a way of musical communication, which can build a platform of interaction and communication between the performer and the audience, making the performer and the audience closer and more intimate, as well as promoting the development and dissemination of music culture (Zhang, 2023). Piano improvisation training can help players improve their ability in music performance, creation, understanding and feeling, enhance their musical creativity and emotional expression, so as to better show the charm and artistic value of music. Piano improvisation requires immediate creation and performance of music, which requires players to have good musical creativity and imagination (Biasutti & Frezza, 2009). Through training, it can help players enhance their understanding and ability to utilize the elements of music, and improve their freedom and creativity in music performance and creation (Ramon & Chacon-Lopez, 2021). At the same time, this training can also promote the players' mastery of music theory and practical skills, making them more powerful and confident in the field of music (Cui, 2021). The impact on the aspect of emotional expression ability, piano improvisation is a highly emotional form of expression, which

requires the player to express the emotion and mood through musical skills (Lopata, Nowicki, & Joannis, 2017; McPherson, Barrett, Lopez-Gonzalez, Jiradejvong, & Limb, 2016). Through training, it can help players better understand and master the emotional expression skills of music, so that they can convey the emotions of the music to the audience in the performance and bring the audience a profound artistic enjoyment. It can be seen that through training, it can help performers to improve their understanding and feeling of musical works, and better grasp the connotation and emotion of musical works, so as to achieve better results in performance .

2. PIANO IMPROVISATION AND MUSICAL CREATIVITY

2.1 Definition of Musical Creativity and its Importance in Music

Musical creativity is the ability necessary for the human brain to carry out creative musical activities in a specific socio-cultural environment. It includes the comprehension, utilization and creation of musical elements, as well as the appreciation, understanding and interpretation of musical works. Musical creativity plays an important role in the field of music, and it is one of the most important factors in promoting the development of music creation, performance and education (López-González & Limb, 2012). Musical creativity is the foundation of music creation, and creativity can inspire composers to use musical elements and language to create unique musical works. It is not only reflected in the creative process, but also in musical performance. Performers need to express the emotions, stories and connotations of musical works through their own performance skills and styles, which requires them to have strong musical creativity and expressiveness. Musical creativity is also one of the focuses of music education (Du, 2023). By cultivating students' creativity, it can improve their musical literacy, appreciation and performance skills, and promote their deep understanding and love of music. It not only has an important impact on the field of music, but also inspires creativity in other fields. For example, many scientists, artists, writers, etc. have expressed how music has inspired and influenced them.

2.2 The Embodiment and Utilization of Musical Creativity in the Process of Piano Improvisation

The embodiment and application of musical creativity in the process of piano improvisation requires players to master various techniques, creative

thinking, harmonic application, melodic composition, rhythmic processing and other aspects of ability and quality. At the same time, the development of creativity in improvisation can also be achieved through continuous learning and practice, gradually improving and expanding the player's musical creativity and expressiveness. In piano improvisation, players need to use various techniques to express their musical creativity. These techniques include the touch of the keys, the control of the tone, the rhythm, the use of the pedals and so on. Through the skillful use of techniques, players can create unique musical works (Zhang, 2023). Performers need to use reverse thinking, divergent thinking and other ways of thinking to break the routine and create unique musical works. In piano improvisation, the use of harmony is one of the keys to express musical creativity. Players need to master the basic knowledge of harmony, including chord structure, chord progression, chord inversion, etc., and through reasonable harmonic design, they can create music works with rich layers and changes. Melody creation is one of the centers of musical creativity. Performers need to use their own musical sensibility and imagination to create a melody that matches the style of the song and their own playing skills, so as to make the musical work more unique and personalized. Rhythm is an important aspect of musical creativity. Performers can express the emotion and mood of the music through the free treatment of rhythm, making the music more expressive and infectious. Improvisation is another important aspect of musical creativity. Performers can improvise and arrange the songs according to their own musical feelings and understanding, including the melody, harmony, rhythm and other aspects of the arrangement, to create a more personalized musical works.

2.3 Improvisation stimulates and enhances individual musical creativity

Improvisation can stimulate and enhance an individual's musical creativity in a variety of ways. Improvisation encourages players to create and perform music without prior preparation, and this instantaneous creative process can stimulate inspiration and creativity (Du, 2023). By exploring and utilizing different techniques and elements in their compositions and performances, players can constantly discover new musical possibilities (Li, 2021). Improvisation requires players to combine their knowledge of music theory with practical skills. By using the knowledge of harmony, melody and rhythm in improvisation, players can deepen their understanding of music theory and improve their practical skills in music composition and performance (Choi, 2022). Improvisation

emphasizes the expression of emotion and the creation of mood, which requires the performer to deeply understand the connotation and emotion of the musical work, and to convey the emotion and mood to the audience through his/her own performance skills (Cheng, 2023). This process of emotional expression can enhance the player's musical sensibility and expressiveness, and then improve his musical creativity. Through the use of reverse thinking, divergent thinking and other ways of thinking in improvisation, players can develop their innovative thinking ability and flexibility in music creation (Luo, 2021). Improvisation requires collaboration and communication with other players. This collaborative process can stimulate players' creativity and help them better understand and learn from other players' musical ideas and techniques. Through mutual inspiration and feedback, players can continuously improve their own musical creativity. Improvisation helps players to better understand their own musical styles, preferences and strengths. Through self-reflection and learning in improvisation, players can find the direction and method of their own musical creation, and then improve their own musical creativity.

3. PIANO IMPROVISATION AND EMOTIONAL EXPRESSION

3.1 The Role and Function of Music in Emotional Expression

Music plays a very important role in emotional expression, it not only conveys emotions, but also enhances them so that the listener can better understand and express his or her emotional state. The following are some of the functions of music in emotional expression: music can stimulate the listener's emotion, music through melody, rhythm, harmony and other elements, stimulate the listener's emotional response, so that the listener has empathy and emotional connection. For example, some impassioned music can stimulate people's excitement and enthusiasm, while some soft and beautiful music can make people feel calm and relaxed; music can enhance emotion, music can strengthen and enhance the listener's emotion, so that the listener can more deeply feel their inner emotional state. For example, some lyrical music can strengthen people's feelings of sweetness and sadness for love, while some dynamic music can strengthen people's feelings of excitement and enthusiasm; music can help listeners express their emotions, music can be used as a way of emotional catharsis to help listeners express their inner emotions. For example, some people will express their emotions and feelings by writing songs or playing musical

instruments, while some people will seek emotional fulfillment and comfort by listening to music; music can bring positive emotions, music can bring positive emotions to the listener, such as happiness, excitement, thrill and so on. These emotions can improve listeners' mental health and enhance their sense of happiness and fulfillment. In conclusion, music plays a very important role in emotional expression, it can stimulate, enhance, express and transmit emotions, so that listeners can better understand and express their inner emotional state.

3.2 Piano Improvisation Expresses Emotions Through Musical Elements

Piano improvisation can express emotions through various musical elements. Melody is one of the most important musical elements in piano improvisation, and it can express the emotion and theme of the music. By changing the pitch, rhythm and timbre of the melody, different emotional responses can be created. For example, a soprano melody can be upbeat and exciting, while a bass melody can convey sadness and heavy emotions. Harmony is another important musical element in piano improvisation. Different emotional experiences can be created through different combinations of harmonies. For example, a tense harmony can convey feelings of anxiety and uneasiness, while a harmonious harmony can convey feelings of calm and tranquility. Rhythm is another key musical element in piano improvisation. By varying the rhythmic groove and tempo, different emotional responses can be created. For example, a fast tempo can be exciting and thrilling, while a slow tempo can convey feelings of sadness and quietness. Tone is also one of the most important elements in expressing emotion in piano improvisation. By changing the timbre of the piano, different emotional responses can be created. For example, bright and crisp tones can convey cheerful and energetic emotions, while soft and dark tones can convey soft and sad emotions. In conclusion, piano improvisation expresses emotions through various musical elements, which interact and influence each other to create beautiful music. By mastering these musical elements, piano improvisers can better express their emotions and thoughts and resonate with the audience.

3.3 Improvisers Use Technique and Experience to Express Emotions

There are many ways for improvisers to use their playing skills and experience to express their emotions, and here are some of the main strategies: mastering basic skills. Improvisers need to have solid basic skills, including finger dexterity, speed and power control, and tone control.

These basic skills are the foundation for expressing emotion; developing listening and perceptual skills, improvisers need to have very sharp listening and perceptual skills. They need to be able to accurately hear the sounds, tones and rhythms of other instruments, as well as perceive the overall emotional tone of the music, so that they can better cooperate with the orchestra or string orchestra to create a perfect performance; Experimenting with different beats and rhythmic patterns, improvisers need to have a flexible sense of rhythm and tempo. They can try to use different beats and rhythmic patterns, such as triplets, pentatonic, etc., to create unique musical effects and express different emotions; create and mutate themes, improvisers can create their own themes or mutate themes from other musical works. By constantly varying and creating, they can express their own personality and emotions; Enhance dynamics and expressiveness, improvisers need to have strong dynamics and expressiveness to bring out the musical emotions through changes in strength, speed and timbre; Practice working with other instruments, improvisers need to work together with other instrumentalists to create a perfect performance effect. By practicing cooperation with other instrumentalists, improvisers can better understand the sound and emotion of other instruments, so that they can better cooperate with other instrumentalists and create perfect performance effects. In conclusion, improvisers need a variety of qualities and skills to use their playing techniques and experience to express emotions. They need to possess solid basic skills, keen listening and perception, a flexible sense of rhythm and tempo, the ability to create and mutate themes, strong dynamics and expressiveness, and the ability to work with other instrumentalists. Through the application of these qualities and skills, improvisers are able to flexibly express the emotion and mood of the music and create a perfect performance.

4. CASE STUDY

Modest Mussorgsky's "Pictures at an Exhibition" is a unique piano suite by Russian composer Modest Mussorgsky. The work consists of ten separate but interrelated pieces depicting a pictorial exhibition. The repertoire is unique in terms of musical creativity and emotional expression. First of all, from the point of view of musical creativity, this work undoubtedly reflects Mussorgsky's extraordinary talent and unique artistic perspective. He utilizes rich harmonic techniques, compositional

structure and piano weaving to perfectly combine music with the spiritual connotation of the paintings, depicting the unique charm of each painting with music. Secondly, this work is equally far-reaching in its emotional expression. Mussorgsky has integrated his emotions into each piece, from joy to sadness, from excitement to calmness, each emotion is delicately expressed through the music. For example, the sad and melodious melody of "The Old Castle" expresses Mussorgsky's deep nostalgia and feelings for the old days. At the same time, the main theme of "Walking" runs through the whole suite, like a clue that connects all the pieces closely. This melody is based on the composer's imitation of the footsteps of the audience pacing back and forth in front of the paintings at the exhibition, resurrecting the visual image in the form of music and realizing the connection between the two art forms. This main theme keeps appearing in each piece, which not only strengthens the totality of the work, but also allows people to deeply feel Mussorgsky's love for art and unique insights into life during the listening process. Overall, Modest Mussorgsky's "Pictures at an Exhibition" is an outstanding work that demonstrates Mussorgsky's musical creativity and emotional expression. It is not only a work of music, but also a monologue of the artist's mind, which deserves to be appreciated and cherished by all.

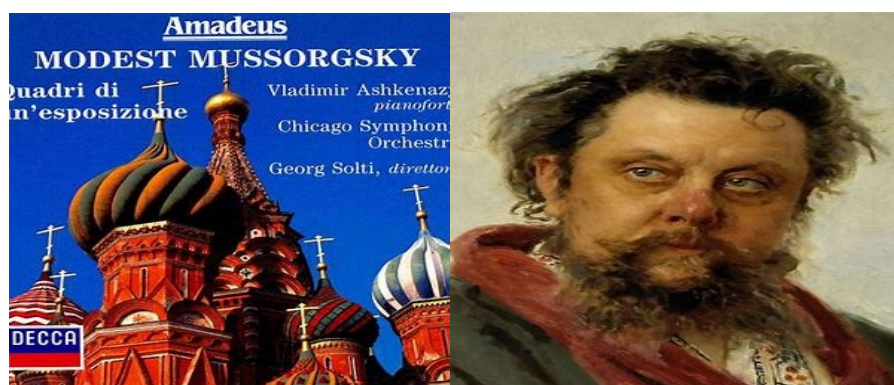


Figure 1: Promotional image of Modest Mussorgsky's "Pictures at an Exhibition" and portrait of Modest Mussorgsky (image from the Internet)

Franz Schubert's "Fantasie in F minor, Op. 102", an improvisation composed by Schubert in 1828, is often referred to as Schubert's eighth piano sonata and the last piano sonata he composed. The sonata is divided into four movements, each with a distinctive style and emotional expression. The first movement is sonata-like, with a dramatic atmosphere and deep emotion; the second movement is a flexuetto, with the clarinet as a background, showing Schubert's innovations in harmony and melody; the third movement is an elegant minuet, showing the composer's unique style; and the fourth movement is a ritornello finale, which brings the whole

work into an ardent and passionate atmosphere. this work shows excellence in musical creativity and emotional The fourth movement is a rondo finale that brings the whole work into a warm and passionate atmosphere. First of all, from the point of view of musical creativity, Schubert demonstrated a novel and unique approach to music creation in this work. The work has a strong Romantic musical style, and Schubert utilizes rich harmonies, complex melodies and varied rhythms to create a unique musical world. For example, in the first movement, Schubert employs strong contrasts, interspersing intense dynamics with quieter atmospheres, bringing a strong emotional impact to the listener. In the second movement, on the other hand, he employs soft clarinets and a heartfelt chorus to create an atmosphere of warmth and serenity, an innovation in the traditional form of the sonata.



Figure 2: Partial score of Franz Schubert's "Fantasie in F minor, Op. 102" and Schubert's portrait (image from the web)

5. SUGGESTIONS ON METHODS AND PRACTICES OF PIANO IMPROVISATION TRAINING

5.1 Systematic Study of Music Theory Knowledge

Piano improvisation requires a certain basic knowledge of music theory, such as harmony, work analysis, composition method and so on. Learning basic music theory, learning notes, rhythms, scales, chords, intonation and other basic knowledge of music theory, mastering the basic principles and laws of piano playing; learning piano skills, learning piano playing skills, including finger exercises, scales and chords inversion, arpeggio exercises, etc., to improve the accuracy and speed of the piano playing; learning work analysis, learning how to analyze the piano works, including the structure of the piece, tonal and harmonic, and weaving changes, etc., to improve the understanding of the musical works and performance level; learning

basic composition theory and methods, including harmony, composition method, etc.; learning basic composition theory and methods, including harmony, harmony, and composition method. To improve the understanding and performance level of musical works; to learn basic compositional theories and methods, including harmony, composition, orchestration, etc., to understand how to compose and arrange tunes, and to lay the foundation for improvisation; to read piano music literature, to understand the characteristics and techniques of different styles and periods of piano performance, and to broaden the understanding of piano music; to participate in piano concerts and performances, and observe the performances of other piano performers. Participate in piano concerts and performances, observe the performances of other piano players, understand the improvisation skills of different interpretive styles; through self-practice and creation, constantly exercise and improve the ability and level of improvisation, and apply the learned theoretical knowledge to practice. In conclusion, the systematic learning of theoretical knowledge requires accumulation and practice, and continuous exploration and study in order to gradually improve the level of improvisation.

5.2 Enhanced Practice of Techniques

Practicing technique is at the heart of improvisation. Practicing finger dexterity, speed and strength, as well as mastering techniques such as common chord progressions and scale transitions, can help to improvise better. In piano improvisation, practicing technique is very important. Learn to play basic chords, master the major chord types such as major and minor chords, seventh chords, etc. and practice using them in different scales and repertoire. Try practicing each chord with different finger sequences and fingerings to improve finger dexterity and independence. Train left and right hand coordination. Piano accompaniment usually requires the left and right hands to function simultaneously, so you need to spend time practicing coordination. You can start with simple exercises and gradually increase the difficulty, such as practicing triplets and quadruplets; learn to follow the rhythm, piano accompaniment needs to closely follow the rhythm of the song, so you need to train your sense of rhythm. You can use a metronome or drums to help you practice. You can slow down the tempo during practice and listen carefully to whether the timing of each note is accurate; learn by listening to songs, learn and practice by listening to familiar songs and imitating the piano accompaniment in the original song. This will help you better understand the structure and emotion of the music and improve your performance.

Diversify your practice by trying to practice different types of music, such as pop songs, classical music, jazz, etc., so that you can flexibly use the skills you have learned in different situations; Seek professional guidance by enlisting the help of an experienced piano teacher to guide you in your practice and provide feedback and suggestions for better improvement of your technique; Learning to play piano accompaniment well takes time and effort. It is important to keep practicing frequently and regularly in order to keep improving your skills.

5.3 Enhancement of Listening Practice

Aural training is crucial in piano improvisation. In the usual practice, we should pay attention to the listening training of scales and chords. Through repeated practice, gradually familiarize yourself with the sound effects of various scales and chords, and strengthen your ability to recognize different pitches and intervals. You can play various scales and chords on the piano, and then listen to them with your heart and mind to exercise your hearing ability. Rhythm and rhythm are the backbone of music, so it is important to pay attention to the rhythm and rhythm of the listening training. You can practice with the help of a metronome, focusing on listening to whether the timing of each note is accurate, and gradually familiarize yourself with different rhythmic patterns and rhythms. In regular practice, pay attention to the music and emotion of the listening training. Through a lot of music appreciation and performance practice, develop your understanding and expression of music, and understand the emotions and moods expressed by different styles of music. Also pay attention to the listening training of harmony and weaving. Through learning the theory of harmony, understanding the sound effect and color changes of various chords, and practicing the connection and progression of various chords on the piano, you will strengthen your ability to recognize harmony and texture.

5.4 Enhancing the Learning of Chord Connections

Chord connections are one of the most important elements of improvisation, and learning chord connections can help to better grasp the rhythm and emotion of music. In order to learn the chord structure, you need to know the structure of the chords. For beginners, you can start with the basic major and minor triads, and gradually master the various chord variations, such as augmented triads, diminished triads, dominant seventh chords, and so on. Practice chord inversions: After mastering the chord

structure, you can start practicing chord inversions. Generally speaking, chord inversions can be practiced from the I, IV, V level, first practicing the connection in the original position, then practicing the connection in the inverted position. By practicing chord inversions, you can improve your familiarity with the keyboard and enhance your finger dexterity. Listening and analyzing classical works, you can understand the use of chord connections by listening to and analyzing classical piano improvisation works. Pay attention to observe how the players use chord connections in their works, and how they choose chord connections according to the melody and emotion of the songs; pay attention to the use of harmony, understand the acoustic effects and color changes of various chords through learning the theory of harmony, and gradually master how to use harmony to enrich the level of piano improvisation in the practice; the ultimate goal of learning chord connections is to be able to flexibly play the chords in piano improvisation. The ultimate goal of learning chord connection is to be able to utilize it flexibly in piano improvisation. Therefore, you should pay attention to training your improvisation ability. Through a lot of improvisation practice, you can cultivate your own musical sense and improvisation ability, and improve and enhance your performance level in the practice.

5.5 Reinforcement of Rhythm and Beat Exercises

Rhythm and beat are the foundation of improvisation, and practicing them can help to better grasp the rhythm and emotion of the music. When practicing, use a metronome to help you develop a steady sense of beat. Start slow, gradually increase the tempo, and listen to the timing of each note for accuracy. You can count the beats in your mind or use your hands and feet to help you get the rhythm right. After acquiring a stable sense of rhythm, you can start practicing various rhythm patterns. You can start with basic rhythms, such as the half note, quarter note, eighth note, etc., and then gradually add more complex rhythms, such as triplets and quadruplets. When practicing, pay attention to the accuracy of the rhythms and don't be too fast or too slow. In improvisation, it is often necessary to master the transition between different beats. You can gradually familiarize yourself with the transition from 4/4 to 3/4 and from 2/4 to 3/8 in your practice. When switching beats, pay attention to the stability of the rhythm and the accuracy of the beat. Cultivate a sense of rhythm: When practicing, focus on developing your sense of rhythm. You can develop your musical sense through a lot of music appreciation and performance practice, and

pay attention to listen to the way other players handle rhythm and beat. Sight-reading exercises can help players grasp the rhythm and beat of a piece quickly and accurately. When practicing, it is important to pay attention to the clef, key sign, note positions, rhythm and variation notation, strength notation, etc., and to strengthen the coordination between the eyes and the hands so that the fingers can accurately play the rhythm and beat of the piece.

5.6 Widely Appreciate and draw on Different Musical Styles and Resources

In piano improvisation, it is very important to appreciate and draw on a wide range of different musical styles and resources. In the usual practice, you can appreciate various musical works of different styles, such as pop, classical, jazz, blues, rock and so on. Through extensive appreciation, one can understand the characteristics and performance techniques of different styles of music and expand one's musical horizons. Studying the history of different styles of music, one can learn about the origin and development process of various kinds of music and deepen one's understanding of music styles. You can learn by reading music history books and watching music history lectures. When enjoying the performances of other piano players, one can learn from their techniques and expressions. By observing their performances, one can understand the improvisation techniques of different interpretive styles and improve one's own playing level. When enjoying classical works, you can try to imitate their techniques and expressions. Through continuous imitation and practice, you can improve your playing ability and gradually develop your own style. Participating in piano concerts and performances, you can observe the performance of other piano players and learn the improvisation techniques of different interpretive styles. At the same time, you can also communicate with and learn from your peers, expanding your musical network and resources. In conclusion, a wide appreciation of different musical styles and resources can help piano improvisers expand their horizons and improve their performance level. Through continuous learning and practice, they can gradually develop their own playing style and inject more creativity and inspiration into their improvisation.

6. CONCLUSION

Piano improvisation training has a profound effect on musical creativity and emotional expression. Through improvisation, players can freely use

their creativity and imagination to integrate their inner emotions and feelings into the music, thus giving the music more profound connotations and expressive power. Piano improvisation training is an important revelation for music education and practice. Through learning and practicing improvisation, players can improve their musical literacy and creativity, and at the same time, it also helps to cultivate their cooperation and communication skills, which can continuously improve their musical creativity and emotional expression, thus giving music more profound connotations and expressive power. At the same time, improvisation can also expand the players' musical cognitive vision and enhance their musical cooperation ability, laying a solid foundation for their better development in their future musical career. Therefore, we should pay attention to the application of piano improvisation training in music education and practice, and actively promote this teaching method. The effect of piano improvisation training on musical creativity and emotional expression is an important research topic, which helps to improve the performance skills and expressiveness of piano performers, and also helps to promote the freedom and innovation of music creation.

References

- Biasutti, M., & Frezza, L. (2009). Dimensions of music improvisation. *Creativity research journal*, 21(2-3), 232-242.
- Cheng, W. C. (2023). Deep integration of musical technique and emotional expression in piano stage performance. *Hundred Flowers*, 06, 43-45.
- Choi, E.-y. (2022). Exploration of using comprehensive music sense teaching method to improve students' musical creativity. *Hwa Hsia Teacher*. 23, 34-36.
- Cui, S. (2021). Does Engagement Data Induce Target User Consumption of Recommended Content Feeds? *Available at SSRN*.
- Di Mauro, M., Toffalini, E., Grassi, M., & Petrini, K. (2018). Effect of long-term music training on emotion perception from drumming improvisation. *Frontiers in psychology*, 9, 404272.
- Dong, L. (2022). The artistic aesthetic value of piano improvisation accompaniment. *Ethnic Music*, 05, 35-37.
- Du, J. N. (2023). Exploration of Emotional Expression in the Art of Piano Playing--A Review of Research on the Art of Piano Playing and Its Diversified Development. *Research on Science and Technology Management* 12, 272-273.
- Guo, Q. (2023). Research on the application of popular music elements in piano improvisation. *Journal of Bengbu College*, 01, 37-41.
- Li, Y. (2021). The reference and utilization of piano works in college piano teaching--A review of Research on Teaching Piano Playing and Improvisation Accompaniment. *Journal of Tropical Crops*, 12, 3730.

- Lopata, J. A., Nowicki, E. A., & Joanisse, M. F. (2017). Creativity as a distinct trainable mental state: an EEG study of musical improvisation. *Neuropsychologia*, 99, 246-258.
- López-González, M., & Limb, C. J. (2012). *Musical creativity and the brain*. Paper presented at the Cerebrum: the dana forum on brain science.
- Luo, W. (2021). Analysis of the role of music listening in the cultivation of piano improvisation accompaniment ability. *Tomorrow's Style*, 19, 35-37.
- McPherson, M. J., Barrett, F. S., Lopez-Gonzalez, M., Jiradejvong, P., & Limb, C. J. (2016). Emotional intent modulates the neural substrates of creativity: An fMRI study of emotionally targeted improvisation in jazz musicians. *Scientific reports*, 6(1), 18460.
- McPherson, M. J., Lopez-Gonzalez, M., Rankin, S. K., & Limb, C. J. (2014). The role of emotion in musical improvisation: an analysis of structural features. *PLoS One*, 9(8), e105144.
- Ramon, L. N., & Chacon-Lopez, H. (2021). The impact of musical improvisation on children's creative thinking. *Thinking Skills and Creativity*, 40, 100839.
- Shi, J. (2021). Music recommendation algorithm based on multidimensional time-series model analysis. *Complexity*, 2021, 1-11.
- Zhang, J. (2023). A practical investigation on the introduction of improvisation accompaniment in piano teaching in general colleges and universities. *Symphony (Journal of Xi'an Conservatory of Music)* 01, 145-148.