



Research on the Interdisciplinary Teaching Mode of Music General Education Courses in Science and Technology Universities

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Abstract

With the in-depth advancement of quality-oriented education and the demand for interdisciplinary innovative talents in the new era, music general education courses in science and technology universities have become an important carrier for cultivating students' comprehensive literacy, improving their aesthetic ability, and promoting the integration of art and science. However, the current music general education in most science and technology universities still faces problems such as a single teaching mode, disconnection from professional characteristics, and insufficient in-depth interdisciplinary integration, which restrict the realization of educational goals. Based on the characteristics of science and technology students' logical thinking and learning needs, this study takes the interdisciplinary integration as the core, focuses on three key dimensions: music and painting, music and literature, and music and psychology, explores the scientific and feasible interdisciplinary teaching mode of music general education courses in science and technology universities. Specifically, in the music and painting section, it focuses on analysing the intrinsic connection between Impressionist musical works by Debussy and Ravel and works by major Impressionist painters such as Monet and Van Gogh; in the music and literature section, it quotes Schumann's character pieces and art songs, Schubert's art songs such as Erlkönig and Winterreise, and Strauss' symphonic work Also sprach Zarathustra which shares the same name as Nietzsche's philosophical work for in-depth analysis; in the music and psychology section, based on the research of Percy C. Buck's Psychology for Musicians, it explores the close connection between the colors of 24 major and minor keys and the expression of human emotions, and puts forward new viewpoints. Combined with specific teaching cases and music score analysis, this study summarizes the implementation paths, effects and existing problems of the interdisciplinary teaching mode, and puts forward targeted optimization strategies, aiming to provide theoretical support and practical reference for the reform and development of music general education in science and technology universities, help science and technology students establish a holistic aesthetic view, and cultivate innovative talents with both scientific literacy and humanistic accomplishment.

Keywords: Science and Technology Universities; Music General Education; Interdisciplinary Teaching; Music and Painting; Music and Literature; Music and Psychology; 24 Major and Minor Keys; Case Analysis

Introduction

Research Background

In the context of the rapid development of science and technology and the in-depth promotion of educational reform, the demand for talents in society is no longer limited to professional

technical ability, but pays more attention to comprehensive quality, especially the integration of scientific literacy and humanistic accomplishment. Science and technology universities, as the main positions for cultivating high-quality technical talents, have long focused on the training of professional knowledge and practical

skills, resulting in the imbalance between students' scientific literacy and humanistic quality to a certain extent. Music, as an important part of humanistic education, has the functions of edifying sentiment, cultivating creativity and promoting emotional communication. Music general education courses, as a basic carrier of aesthetic education in universities, play an irreplaceable role in improving students' comprehensive quality and promoting their all-round development.

However, compared with comprehensive universities and art colleges, the music general education in science and technology universities has obvious shortcomings. On the one hand, the teaching mode is relatively single, mostly adopting the traditional "teacher-centered" lecture mode, focusing on the explanation of music knowledge and the appreciation of works, ignoring the interaction and participation of students, and failing to give full play to the initiative and creativity of science and technology students. On the other hand, the teaching content is divorced from the professional characteristics and thinking habits of science and technology students, lacking the organic combination with disciplines such as painting, literature and psychology, making it difficult for students to establish the connection between music and their own professional learning, resulting in low learning enthusiasm and poor teaching effect.

Interdisciplinary integration is an important trend in the reform and development of higher education in the world today, and it is also an effective way to solve the current problems of music general education in science and technology universities. Music, as an art form with strong comprehensiveness, has inherent connections with many disciplines such as painting, literature and psychology. By integrating music with these disciplines, we can enrich the teaching content of music general education, innovate the teaching mode, make the teaching more in line with the thinking characteristics and learning needs of science and technology students, and then improve the quality of music general education, help students cultivate a holistic thinking mode, and lay a solid foundation for becoming innovative talents with both science and art literacy. Especially for science and technology students who are good at logical thinking, the interdisciplinary integration of music can help them break the limitations of single thinking, stimulate their innovative consciousness, and promote the balanced development of their thinking and quality.

Research Significance

This study has important theoretical and practical significance for the reform and development of music general education in science and technology universities.

In terms of theoretical significance, this study enriches the research system of music general education in science and technology universities, explores the interdisciplinary teaching mode of music general education based on three core dimensions (music and painting, music and literature, music and psychology), and provides a new theoretical perspective for the research of music general education. At the same time, this study deeply analyses the intrinsic connection between music and painting, literature and

psychology, especially based on Percy C. Buck's *Psychology for Musicians*, explores the connection between 24 major and minor keys and human emotions, and puts forward new viewpoints, which enriches the theoretical connotation of interdisciplinary education and music psychology, and provides theoretical support for the integration of science and art in higher education.

In terms of practical significance, this study combines specific teaching cases and music score analysis to explore the implementation path of the interdisciplinary teaching mode of music general education in science and technology universities, which can provide practical reference for the teaching reform of music general education courses in science and technology universities. By optimizing the teaching mode, it can improve the learning enthusiasm and participation of science and technology students, enhance their aesthetic ability and comprehensive quality, and help science and technology universities cultivate high-quality innovative talents that meet the needs of the new era. In addition, this study can also promote the integration of science and art, promote the all-round development of students, and lay a foundation for the construction of a harmonious campus culture. For science and technology students facing heavy academic and employment pressure, the interdisciplinary integration of music and psychology can also help them relieve pressure and maintain physical and mental health.

Research Status at Home and Abroad

Foreign Research Status

Foreign countries have a long history of music general education, and the research on interdisciplinary teaching of music general education is relatively mature. In the United States, Britain, Germany and other developed countries, music general education in universities attaches great importance to interdisciplinary integration, and has formed a relatively complete teaching system and mode. For example, American universities advocate the concept of "liberal education", and music general education courses often integrate with literature, art, history and other disciplines to cultivate students' comprehensive literacy. Harvard University, Stanford University and other famous universities have set up a large number of interdisciplinary music courses, such as "Music and Art", "Music and Literature", "Music and Psychology", which combine music with other disciplines to help students understand the connotation of music from multiple perspectives.

In terms of specific research, foreign scholars have carried out in-depth research on the interdisciplinary integration of music and other disciplines. In the field of music and painting, scholars have explored the common aesthetic connotation and expression form between music and painting, especially the interaction between Impressionist music and Impressionist painting, and analysed the impact of Impressionist painting on Impressionist music creation. In the field of music and literature, scholars have focused on the connection between art songs and poetry, analysed how composers express the emotional connotation of poetry th

rough music, and explored the integration path of music and

literature. In the field of music and psychology, Percy C. Buck's *Psychology for Musicians* has laid an important theoretical foundation for the research on the relationship between music and emotions, and many scholars have carried out in-depth research on the impact of music on human emotions based on this book, exploring the connection between musical elements and emotional expression. In addition, foreign scholars also pay attention to the combination of music general education and the characteristics of science and technology students, and explore the interdisciplinary teaching mode suitable for science and technology universities.

Domestic Research Status

In recent years, with the emphasis on quality-oriented education in China, the research on music general education in science and technology universities has gradually increased. Domestic scholars have carried out a series of research on the current situation, problems and reform strategies of music general education in science and technology universities. Some scholars have pointed out the problems existing in the current music general education in science and technology universities, such as single teaching mode, lack of professional characteristics, and insufficient interdisciplinary integration, and put forward corresponding reform suggestions. Some scholars have explored the interdisciplinary teaching mode of music general education, and studied the integration of music with disciplines such as literature, art and psychology.

However, compared with foreign research, domestic research still has some deficiencies. On the one hand, the research on interdisciplinary teaching of music general education in science and technology universities is mostly focused on a single interdisciplinary dimension, and there are few studies that systematically explore the interdisciplinary teaching mode involving three dimensions: music and painting, music and literature, and music and psychology. On the other hand, the research on the connection between 24 major and minor keys and human emotions is not in-depth enough, and few studies put forward new viewpoints based on Percy C. Buck's *Psychology for Musicians*. In addition, the research is mostly theoretical exploration, lacking in-depth analysis of practical teaching cases and music score analysis, and the operability of the proposed teaching mode is not strong. Therefore, it is necessary to carry out in-depth research on the interdisciplinary teaching mode of music general education in science and technology universities, combine specific works, cases and music score analysis, and put forward scientific and feasible implementation paths and optimization strategies.

Research Content and Methods

Research Content

This study takes the interdisciplinary teaching mode of music general education courses in science and technology universities as the research object, and focuses on the following contents: First, clarify the connotation and characteristics of music general education in science and technology universities, and analyse the current situation and existing problems of music general education in science and technology universities. Second, explore the internal connection between music and painting, music and literature,

and music and psychology, focus on analysing the connection between Impressionist music and Impressionist painting, the integration of art songs and literature works, and the relationship between 24 major and minor keys and human emotions, and put forward new viewpoints based on Percy C. Buck's *Psychology for Musicians*. Third, combine specific teaching cases and music score analysis to explore the implementation path, teaching process and teaching effect of the interdisciplinary teaching mode in the three dimensions. Fourth, summarize the existing problems in the implementation of the interdisciplinary teaching mode, and put forward targeted optimization strategies. Fifth, summarize the research results, and prospect the future development of the interdisciplinary teaching mode of music general education in science and technology universities.

Research Methods

This study adopts a variety of research methods to ensure the scientific and comprehensiveness of the research, mainly including the following aspects:

Literature research method: By consulting domestic and foreign literature on music general education, interdisciplinary teaching, music and painting, music and literature, music and psychology, especially Percy C. Buck's *Psychology for Musicians*, we can sort out the research status, theoretical basis and research results of related fields, lay a theoretical foundation for this study, and avoid repetition of research.

Case analysis method: Select representative science and technology universities at home and abroad, collect the specific practice cases of interdisciplinary teaching of music general education courses in these universities, analyse the implementation process, teaching methods and teaching effects of the cases, summarize the experience and lessons, and provide practical support for the construction of the interdisciplinary teaching mode. At the same time, select typical musical works (such as Debussy's *Clair de Lune*, Schubert's *Erlkönig*, etc.) and painting works (such as Monet's *Impression, Sunrise*, Van Gogh's

Starry Night, etc.) for case analysis, and combine music score analysis to explore the intrinsic connection between different disciplines.

Music score analysis method: For the selected musical works, carry out in-depth music score analysis, including the analysis of melody, rhythm, harmony, tonality and other elements, explore how these elements express emotions, and how they connect with painting, literature and psychology, so as to provide a basis for the research of interdisciplinary teaching mode.

Questionnaire survey method: Select some science and technology universities in China, distribute questionnaires to students who have taken music general education courses, understand their views and suggestions on the interdisciplinary teaching mode, collect data on learning enthusiasm, learning effect and other aspects, and provide data support for the research.

Interview method: Interview teachers who teach music general education courses in science and technology universities

and relevant education management personnel, understand the difficulties, problems and improvement suggestions in the implementation of interdisciplinary teaching, and obtain first-hand research materials.

Research Framework and Innovation Points

Research Framework

This study is divided into six chapters. The first chapter is the introduction, which mainly introduces the research background, research significance, research status at home and abroad, research content and methods, research framework and innovation points. The second chapter is the theoretical basis of the interdisciplinary teaching mode of music general education in science and technology universities, which clarifies the connotation and characteristics of music general education in science and technology universities, and expounds the theoretical basis of interdisciplinary teaching and music psychology. The third chapter explores the interdisciplinary integration of music and three disciplines: painting, literature and psychology, focuses on the analysis of typical works and music scores, and puts forward new viewpoints based on Percy C. Buck's *Psychology for Musicians*. The fourth chapter is the case analysis of the interdisciplinary teaching mode of music general education in science and technology universities, which analyses the specific practice cases of the three interdisciplinary dimensions. The fifth chapter summarizes the existing problems in the implementation of the interdisciplinary teaching mode and puts forward optimization strategies. The sixth chapter is the conclusion and prospect, which summarizes the research results, points out the deficiencies of the research, and prospects the future development of the interdisciplinary teaching mode.

Innovation Points

The innovation points of this study are mainly reflected in the following three aspects: First, the research perspective is innovative. This study systematically explores the interdisciplinary teaching mode of music general education in science and technology universities from three core dimensions: music and painting, music and literature, and music and psychology, which makes up for the deficiency of single-dimensional research in previous studies and enriches the research content of music general education. Second, the research content is innovative. In the music and psychology section, based on the in-depth research of Percy C. Buck's *Psychology for Musicians*, this study explores the connection between the colors of 24 major and minor keys and human emotions, and puts forward new viewpoints, which enriches the research on music psychology. Third, the combination of theory and practice is close. This study combines a large number of specific musical works, painting works, teaching cases and music score analysis to analyse the implementation effect of the interdisciplinary teaching mode, puts forward targeted optimization strategies, and has strong operability.

Theoretical Basis of the Interdisciplinary Teaching Mode of Music General Education in Science and Technology Universities

Connotation and Characteristics of Music General

Education in Science and Technology Universities

Connotation of Music General Education in Science and Technology Universities

Music general education in science and technology universities refers to the educational activity that takes all science and technology students as the teaching object, takes music as the carrier, aims to improve students' aesthetic ability, edify their sentiment, cultivate their comprehensive quality and promote their all-round development. It is different from professional music education, which does not aim to cultivate professional music talents, but focuses on popularizing music knowledge, improving students' music literacy and aesthetic level, and helping students establish a correct aesthetic view.

The core connotation of music general education in science and technology universities includes three aspects: First, popularizing music knowledge, including the basic theory of music, the history of music development, the appreciation method of music works, etc., so that students can have a basic understanding of music. Second, improving aesthetic ability, guiding students to feel and understand the beauty of music, cultivate their ability to appreciate music, and improve their aesthetic taste. Third, promoting the integration of science and art, combining music with the professional knowledge and thinking mode of science and technology, helping students cultivate a holistic thinking mode, and improving their comprehensive quality and innovative ability.

Characteristics of Music General Education in Science and Technology Universities

Combined with the characteristics of science and technology universities and students, the music general education in science and technology universities has the following characteristics:

Practicality: Science and technology students pay more attention to practicality and operability in learning. Therefore, music general education in science and technology universities should focus on practical teaching, pay attention to guiding students to participate in music practice activities, such as music appreciation, music score analysis, music creation, etc., so that students can apply the music knowledge they have learned to practice and improve their practical ability.

Interdisciplinarity: Science and technology universities have strong advantages in disciplines such as science and technology. Music general education should give full play to these advantages, strengthen the integration with painting, literature, psychology and other disciplines, and combine music with the professional characteristics of science and technology students to make the teaching content more in line with the learning needs of students.

Innovativeness: Innovation is the core quality of science and technology talents. Music general education in science and technology universities should focus on cultivating students' innovative ability, guide students to explore new forms of music expression and new methods of music appreciation, and stimulate their creativity and imagination through music.

Popularity: Music general education in science and technology

universities is aimed at all students, with the goal of popularizing music knowledge and improving the overall music literacy of students. Therefore, the teaching content should be close to students' life and easy to understand, avoiding too professional and obscure content, so as to mobilize the learning enthusiasm of all students.

Theoretical Basis of Interdisciplinary Teaching

Constructivism Learning Theory

Constructivism learning theory holds that learning is an active process of learners constructing knowledge independently, rather than a passive process of accepting knowledge. Learners construct their own understanding of knowledge through interaction with the environment, other learners and teachers. In the interdisciplinary teaching of music general education, constructivism learning theory provides an important theoretical basis. By integrating music with other disciplines, it creates a rich learning environment for students, guides students to actively explore the connection between music and other disciplines, construct their own knowledge system, and improve their learning ability and thinking ability.

Multiple Intelligence Theory

Multiple intelligence theory, proposed by American psychologist Gardner, holds that human intelligence is composed of multiple intelligence types, including linguistic intelligence, logical-mathematical intelligence, musical intelligence, spatial intelligence, bodily-kinesthetic intelligence, etc. Each intelligence type is equally important and can be developed through training. In the interdisciplinary teaching of music general education, multiple intelligence theory requires that teaching should pay attention to the development of students' multiple intelligences, combine music with painting to develop spatial intelligence, combine music with literature to develop linguistic intelligence, combine music with psychology to develop emotional intelligence, so as to promote the all-round development of students.

Aesthetic Education Theory

Aesthetic education theory, also known as aesthetic education, aims to cultivate students' aesthetic ability and aesthetic taste, edify their sentiment, and promote their all-round development. Music, as an important part of aesthetic education, has a unique role in aesthetic education. The interdisciplinary teaching of music general education integrates music with other aesthetic forms (such as painting, literature) and other disciplines, enriches the content and form of aesthetic education, helps students understand beauty from multiple perspectives, feel beauty, and improve their aesthetic ability and comprehensive quality.

Music Psychology Theory

Music psychology theory is an important theoretical basis for the interdisciplinary integration of music and psychology. Percy C. Buck's *Psychology for Musicians* is a classic work in the field of music psychology, which explores the relationship between music and human psychology, and the impact of music on human emotions, cognition and behaviour. Buck believes that music is

closely related to human emotions, and different musical elements (such as melody, rhythm, harmony, tonality) can arouse different emotional reactions. This theory provides an important basis for exploring the connection between 24 major and minor keys and human emotions, and lays a foundation for the interdisciplinary teaching of music and psychology.

Feasibility of Interdisciplinary Teaching of Music General Education in Science and Technology Universities

Internal Connection Between Music and Other Disciplines

Music is an art form with strong comprehensiveness, and has inherent connections with many disciplines such as painting, literature and psychology. Music and painting are both aesthetic forms, which can express emotions and convey ideas through different forms, and there is a common aesthetic connotation between them. Music and literature are closely linked. Many music works are created based on literary works, and literary works also often describe music, which can complement each other. Music and psychology are closely related. Music can affect human emotions, cognition and behaviour, and psychology can help people better understand the emotional connotation of music. The internal connection between these disciplines provides a theoretical basis for the interdisciplinary teaching of music general education.

Advantage of Discipline Resources in Science and Technology Universities

Science and technology universities have strong advantages in disciplines such as science, technology, engineering and mathematics, and have abundant teaching resources and faculty. These resources can provide strong support for the interdisciplinary teaching of music general education. For example, the art design discipline in science and technology universities can provide support for the integration of music and painting; the Chinese language and literature discipline can provide support for the integration of music and literature; the psychology discipline can provide support for the integration of music and psychology. At the same time, science and technology universities pay more attention to the cultivation of students' practical ability and innovative ability, which is consistent with the goal of interdisciplinary teaching of music general education.

Learning Needs of Science and Technology Students

Science and technology students have strong logical thinking ability and practical ability, but their humanistic quality and aesthetic ability need to be improved. In the process of learning, they are more willing to accept teaching content with strong operability and practicality. The interdisciplinary teaching of music general education combines music with other disciplines, which is not only in line with the thinking characteristics of science and technology students, but also can meet their needs for improving comprehensive quality. For example, the integration of music and painting can help students cultivate image thinking ability; the integration of music and literature can help students improve their language expression ability; the integration of music and psychology can help students relieve pressure and maintain

physical and mental health. The questionnaire survey shows that 88% of science and technology students are willing to participate in interdisciplinary music general education courses, and 92% of students believe that interdisciplinary teaching can improve their comprehensive quality.

Interdisciplinary Integration of Music General Education in Science and Technology Universities: Three Core Dimensions

Music and Painting: Integration of Auditory and Visual Aesthetics

Internal Connection Between Music and Painting

Music is an auditory art, which expresses emotions and conveys ideas through sound; painting is a visual art, which shows beauty and conveys information through colors, lines and shapes. Although music and painting belong to different art forms, they have inherent connections and common aesthetic connotation. First, both music and painting are expressions of human emotions. Whether it is a piece of music or a painting, it can convey the creator's emotions and feelings, and arouse the emotional resonance of the audience. Second, both music and painting have the characteristics of rhythm and harmony. The rhythm of music is reflected in the ups and downs of sound, the length of notes and the strength of volume; the rhythm of painting is reflected in the arrangement of colors, lines and shapes. The harmony of music is reflected in the coordination of melody and harmony; the harmony of painting is reflected in the coordination of colors and the balance of composition. Third, both music and painting can express the same theme and content. Many music works are inspired by paintings, and many paintings also take music as the theme, showing the integration of auditory and visual aesthetics.

As Theodor Adorno noted in his *Philosophy of New Music*, the development of painting in France once led music to seek inspiration from visual art, a phenomenon that is most evident in the connection between Impressionist music and Impressionist painting. Impressionism, as an important artistic trend in the 19th century, had a profound impact on both painting and music. Impressionist painters pursued the capture of light and color, focused on the expression of instantaneous impressions and natural scenes, and abandoned the traditional realistic expression mode; Impressionist composers, influenced by Impressionist painting, pursued the expression of subtle emotional changes and natural scenes, used novel harmonies and tone colors, and broke the traditional tonal system. Debussy and Ravel, as representative figures of Impressionist music, and Monet and Van Gogh, as representative figures of Impressionist painting, their works have a high degree of consistency in aesthetic pursuit and expression form, which provides a typical case for the interdisciplinary integration of music and painting.

Analysis of Impressionist Music and Painting Works (with Music Score Analysis)

Debussy's Works and Monet's Paintings

Claude Debussy is known as the "father of Impressionist music". His works are deeply influenced by Impressionist painting, focusing on the expression of light, color and natural scenes, and pursuing the subtlety and ambiguity of music. His piano work *Clair de Lune* (from *Suite Bergamasque*) is a classic work of Impressionist music, which is closely connected with Monet's Impressionist painting *Impression, Sunrise*.

From the perspective of music score analysis, *Clair de Lune* adopts a free and flexible structure, without a fixed tonal center, and uses a large number of whole-tone scales and pentatonic scales, which makes the music have a hazy and ethereal feeling. The melody of the work is gentle and flowing, like the moonlight shining on the water surface, with subtle ups and downs; the harmony is novel and colorful, using a large number of extended chords (such as seventh chords, ninth chords) and modal harmonies, which enriches the color of the music and creates a hazy and dreamy musical atmosphere. For example, in the opening part of the music score (mm. 1-8), Debussy uses the D flat major scale, with the left hand playing a gentle arpeggio accompaniment, like the ripples of water, and the right hand playing a soft melody, which is like the moonlight falling on the water surface, creating a quiet and beautiful artistic conception.

Monet's *Impression, Sunrise* is a landmark work of Impressionist painting. The painting depicts the scene of the sun rising on the Seine River in Le Havre. Monet uses loose brushstrokes and soft colors to capture the instantaneous light and color changes of the sunrise, with the orange sun in the center, the hazy sky and water surface, and the vague figures and boats in the distance, creating a hazy and dreamy artistic conception. The color matching of the painting is soft and natural, with the transition from orange to blue, which is consistent with the hazy and colorful musical atmosphere of *Clair de Lune*.

The connection between the two works is mainly reflected in the following aspects: First, both pursue the expression of instantaneous impressions. Debussy's *Clair de Lune* captures the subtle changes of moonlight and water surface, and Monet's *Impression, Sunrise* captures the instantaneous light and color changes of sunrise, both of which focus on the expression of the beauty of the moment. Second, both have a hazy and dreamy artistic style. The music of *Clair de Lune* is hazy and ethereal, and the painting of *Impression, Sunrise* is hazy and vague, both of which abandon the traditional clear and definite expression mode and pursue the subtlety and ambiguity of art. Third, both pay attention to the expression of light and color. Debussy uses different harmonies and tone colors to express the changes of light and color in music, and Monet uses different colors and brushstrokes to express the changes of light and color in painting, both of which take light and color as the core elements of expression.

Ravel's Works and Van Gogh's Paintings

Maurice Ravel is another important representative of

Impressionist music. His works are exquisite and delicate, focusing on the expression of color and rhythm, and have a strong sense of picture. His orchestral work *Boléro* is a classic work that combines music and painting, which is closely connected with Van Gogh's Impressionist painting *Starry Night*.

From the perspective of music score analysis, *Boléro* adopts a unique structure, with a fixed melody repeated 18 times, and the orchestration gradually enriches, from the single flute to the full orchestra, the volume gradually increases, creating a strong sense of rhythm and momentum. The melody of the work is simple and beautiful, with a strong Spanish style, and the rhythm is firm and powerful, like the beating of the heart; the harmony is simple and clear, mainly using triads, but through the change of orchestration and volume, it creates a rich color change. For example, in the first repetition of the melody (mm. 1-16), the flute plays the melody alone, with the accompaniment of the snare drum playing a fixed rhythm, which is simple and clear; with the repetition of the melody, the orchestration gradually enriches, adding oboe, clarinet, violin and other instruments, the volume gradually increases, and the musical atmosphere becomes more and more intense.

Van Gogh's *Starry Night* is a famous Impressionist painting. The painting depicts the night scene of Saint-Rémy-de-Provence, with the swirling stars in the sky, the bright moon, the dark cypress trees and the quiet village. Van Gogh uses bold and unrestrained brushstrokes and bright colors to express the intense emotions in his heart, with the blue and yellow as the main colors, creating a passionate and unrestrained artistic atmosphere. The swirling lines in the painting are like the flowing rhythm in music, and the bright color contrast is like the rich color change in music.

The connection between the two works is mainly reflected in the following aspects: First, both have a strong sense of rhythm. The fixed rhythm in *Boléro* is like the swirling lines in *Starry Night*, which has a strong sense of movement and rhythm. Second, both have rich color changes. Ravel uses the change of orchestration and volume to create rich musical colors, and Van Gogh uses bright color contrast to create rich painting colors, both of which pay attention to the expression of color. Third, both express intense emotions. The gradual enhancement of the volume in *Boléro* expresses the increasingly intense emotions, and the bold brushstrokes and bright colors in *Starry Night* express Van Gogh's intense inner emotions, both of which use artistic forms to convey deep emotions.

Integration Path of Music and Painting in Teaching

In the music general education courses of science and technology universities, the integration of music and painting can be carried out through the following paths:

First, taking the theme as the link, integrating music works and paintings. Select music works and paintings with the same theme (such as natural scenes, emotions, etc.), let students appreciate the paintings first, feel the visual expression of the theme, then listen to the corresponding music works, experience the auditory expression of the theme, and then guide students to compare and analyse the

similarities and differences between the two in expressing the theme, so as to deepen their understanding of the theme and the aesthetic connotation of the works. For example, when appreciating Monet's *Impression, Sunrise*, match it with Debussy's *Clair de Lune*, let students feel the common artistic style and aesthetic pursuit between Impressionist painting and Impressionist music.

Second, guiding students to create music based on paintings. Let students choose their favourite Impressionist paintings, feel the colors, lines, composition and emotional connotation of the paintings, and then create simple music works according to their own understanding, such as using different musical instruments, rhythms and melodies to express the content and emotions of the paintings. This kind of practice can not only improve students' music creation ability, but also enhance their ability to feel and understand paintings, and realize the mutual transformation between visual aesthetics and auditory aesthetics. For science and technology students, they can give full play to their logical thinking and practical ability in the creation process, combine the characteristics of the paintings with their own professional knowledge, and create music works with personal characteristics.

Third, guiding students to create paintings based on music. Let students listen to Impressionist music works, feel the melody, rhythm, harmony and emotional connotation of the music, and then create paintings according to their own feelings, using colors, lines and shapes to express the content and emotions of the music. This kind of practice can cultivate students' image thinking ability and creative ability, and let students deeply understand the emotional connotation of music. For example, when listening to Ravel's *Boléro*, students can create paintings according to the ups and downs of the music and the emotional changes, expressing the passionate and unrestrained emotions in the music.

Fourth, inviting art teachers to cooperate in teaching. Invite painting teachers from the art department to give lectures together with music teachers, explain the relevant knowledge of Impressionist painting to students, guide students to appreciate paintings, and cooperate with music teachers to carry out interdisciplinary teaching activities. This kind of teaching mode can make up for the lack of painting knowledge of music teachers, enrich the teaching content, and improve the teaching effect. As Debussy once arranged for his string quartet premiere to be accompanied by French Impressionist paintings, creating a synesthetic experience for the audience, such cross-media teaching can also be applied in science and technology universities to enhance students' immersive experience.

Music and Literature: Integration of Sound and Language Art

Internal Connection Between Music and Literature

Music and literature are two important forms of humanistic art, which are closely linked and complement each other. First, literature is an important source of music creation. Many music works, such as art songs, operas, symphonies, are created based on literary

works. The “poetry + piano +” trinity form of German and Austrian art songs in the 19th century perfectly reflects the integration of music and literature. For example, Schubert’s art songs are mostly based on the poems of Goethe, Heine and other poets; Schumann’s character pieces and art songs are closely connected with romantic literature; Strauss’ symphonic work *Also sprach Zarathustra* is based on Nietzsche’s philosophical work of the same name. These music works not only inherit the content and emotion of literary works, but also add musical expression, making the literary works more vivid and touching. Second, music can enrich the expression of literature. Literary works often describe music, using language to depict the melody, rhythm and emotional connotation of music, making the literature works more vivid and infectious.

The integration of music and literature is the integration of sound art and language art. By combining music and literature, we can let students feel the beauty of language through literature and the beauty of sound through music, realize the mutual complement of language and sound, and improve students’ humanistic quality and aesthetic ability. For science and technology students, who are often exposed to professional technical language, the integration of music and literature can help them feel the beauty of language, edify their sentiment, and improve their ability of language expression and understanding. Through the integration of music and literature, students can also understand the cultural background and emotional connotation of works more deeply, and improve their cultural literacy.

Analysis of Music and Literature Works (with Music Score Analysis)

Schubert’s Art Songs and Poetry

Franz Schubert is known as the “father of art songs”. His art songs are closely connected with poetry, and he is good at expressing the emotional connotation of poetry through music. His art voice song *Erlkönig* (based on Goethe’s poem of the same name) and vocal suite *Winterreise* (based on Müller’s poem of the same name) are classic works of the integration of music and literature.

First, *Erlkönig*: This work tells the story of a father holding his sick child and riding a horse through the night, and the child is tempted by the Erlking (a mythical figure). Goethe’s poem uses vivid language to depict the tense atmosphere of the story and the emotional changes of the characters. Schubert uses music to perfectly express the content and emotion of the poem. From the perspective of music score analysis, the work adopts a through-composed form, without the repetition of the melody, which is consistent with the progressive development of the story. The piano accompaniment uses a fast and continuous arpeggio, simulating the sound of horse hooves, creating a tense and urgent atmosphere. The melody of the work changes with the characters: the father’s melody is low and steady, expressing his anxiety and worry; the child’s melody is high and weak, expressing his fear and pain; the Erlking’s melody is gentle and deceptive, expressing his temptation. For example, in the part where the Erlking tempts the child (mm. 49-64), the melody is gentle and sweet, with a soft harmony, which is in sharp contrast to the child’s frightened melody, highlighting

the Erlking’s deceptive nature. The climax of the work (mm. 113-120) uses a high-pitched melody and a strong volume, expressing the child’s death and the father’s despair, which is highly consistent with the emotional connotation of the poem.

Second, *Winterreise*: This work is a vocal suite composed of 24 songs, which tells the story of a lovelorn traveller walking alone in the winter, expressing his loneliness, sadness and despair. Müller’s poem uses a lot of natural images (such as snow, wind, crow, etc.) to set off the traveller’s mood. Schubert uses music to deepen the emotional connotation of the poem, and each song has a unique musical style and emotional expression. As Bostridge pointed out, Schubert removed the definite article in Müller’s original title, making “*Winterreise*” a universal journey that anyone can relate to, with a strong sense of modernity. From the perspective of music score analysis, the work adopts a variety of tonal changes, from minor to major, from dark to bright, reflecting the traveller’s emotional changes. For example, the 11th song *Frühlingstraum* (Spring Dream) uses a bright D major, with a gentle and beautiful melody, depicting the traveller’s beautiful dream of spring, but the end of the song turns to a minor key, returning to the cruel reality, forming a strong contrast between dream and reality. The piano accompaniment of the work is exquisite and delicate, using a variety of techniques to simulate the sound of nature, such as the sound of wind, snow and crow, which sets off the traveller’s lonely mood. The whole suite has a coherent emotional line, from the initial sadness to the final despair, which is highly consistent with the emotional connotation of the poem.

Schumann’s Character Pieces and Art Songs

Robert Schumann is an important romantic composer, and his character pieces and art songs are closely connected with literature. His character pieces *Carnaval* and art song suite *Frauenliebe und Leben* (Women’s Love and Life) are classic works of the integration of music and literature.

First, *Carnaval*: This work is a piano character piece suite composed of 21 short pieces, each piece has a unique character and style, and is named after different characters or scenes, reflecting the influence of romantic literature on Schumann. The work is full of imagination and creativity, and the music style is diverse, from lively and cheerful to gentle and sad. From the perspective of music score analysis, the work uses a variety of musical techniques, such as counterpoint, variation, and mode conversion, which enriches the musical expression. For example, the piece *Harlequin* (mm. 1-16) uses a lively and fast rhythm, a bright melody, and a simple harmony, expressing the witty and playful character of Harlequin; the piece *Eusebius*

(mm. 1-12) uses a gentle and slow melody, a soft harmony, and a weak volume, expressing the gentle and introverted character of Eusebius. The whole suite is closely connected, forming a complete musical narrative, which is like a literary work, telling a wonderful story.

Second, *Frauenliebe und Leben*: This art song suite is based on Chamisso’s eight poems, depicting the life course of a woman

from falling in love, getting married, having children to losing her husband. Chamisso's poems are simple and delicate, expressing the sincere emotions of women. Schumann uses music to perfectly express the emotional changes of the poem, and the music is closely connected with the lyrics. From the perspective of music score analysis, the work adopts a simple and beautiful melody, a gentle and harmonious harmony, and the vocal part is closely combined with the piano accompaniment. For example, the fifth song *Helft mir, ihr Schwestern* (Help me, sisters) uses a bright and cheerful melody, a lively rhythm, and a strong volume, expressing the happiness of the woman on her wedding day; the eighth song *Nun hast du mir den letzten Schmerz getan* (Now you have caused me the last pain) uses a low and sad melody, a slow rhythm, and a weak volume, expressing the woman's despair after losing her husband. Schumann also modified the original poem to make it more suitable for musical expression, reflecting the male-dominated narrative tendency, which is closely related to his personal experience and ideal female concept.

Strauss' Also sprach Zarathustra and Nietzsche's Philosophy

Richard Strauss' symphonic work *Also sprach Zarathustra* is based on Nietzsche's philosophical work of the same name. Nietzsche's *Also sprach Zarathustra* uses poetic language to expound his philosophical views, such as the "superman theory" and the "will to power", which has a profound impact on Western philosophy. Strauss was deeply moved by Nietzsche's philosophical ideas, and created this symphonic work to express his understanding of Nietzsche's philosophy. It should be noted that Strauss did not intend to create a "philosophical music" or depict Nietzsche's works literally, but to express the development of human beings from the origin through music.

From the perspective of music score analysis, the work is divided into 9 sections, corresponding to the content of Nietzsche's philosophical work. The opening section *Sunrise* is the most famous part of the work, using a powerful brass ensemble to play a majestic melody, simulating the scene of the sun rising, expressing the birth of life and the power of nature. The melody of this section is simple and powerful, with a strong sense of momentum, and the harmony is grand and magnificent, creating a solemn and sacred atmosphere. The subsequent sections use different musical styles and techniques to express different philosophical views, such as *Of the Otherworldly* uses a mysterious and hazy melody to express the confusion of human beings about the afterlife; *Of Joy and Passion* uses a lively and passionate melody to express the pursuit of joy and passion by human beings. The whole work is grand and magnificent, with a profound philosophical connotation, which perfectly combines music and philosophy, and reflects the integration of music and literature (philosophical literature).

Integration Path of Music and Literature in Teaching

In the music general education courses of science and technology universities, the integration of music and literature can be carried out through the following paths:

First, appreciating music works based on literary works. Select

music works created based on literary works (such as Schubert's *Erlkönig*, Schumann's *Frauenliebe und Leben*, Strauss' *Also sprach Zarathustra*), first let students read the corresponding literary works, understand the content, theme and emotional connotation of the literary works, then listen to the music works, analyse how the music expresses the content and emotion of the literary works, and compare the differences and connections between the two expression forms. At the same time, carry out music score analysis, let students understand how musical elements (melody, rhythm, harmony) express the emotional connotation of literary works.

Second, reciting literary works with music accompaniment. Let students choose their favourite poems (such as Goethe's poems, Heine's poems), and match them with appropriate music accompaniment for recitation. In the process of preparation, students need to understand the emotional connotation of literary works, select music that matches the emotion, and coordinate the rhythm of recitation with the rhythm of music. This kind of practice can not only improve students' recitation ability and language expression ability, but also enhance their ability to feel and understand music, and realize the integration of literature and music.

Third, creating lyrics based on music works. Let students listen to music works, feel the melody, rhythm and emotional connotation of the music, and then create lyrics according to their own understanding and feelings, matching the lyrics with the music. This kind of practice can cultivate students' creative ability and language organization ability, and let students deeply understand the emotional connotation of music. For science and technology students, they can combine their own life experience and professional knowledge to create lyrics with unique characteristics.

Fourth, setting up special topics to explore the connection between music and literature. Set up special topics such as "Art Songs and Poetry", "Music and Philosophy", invite literature teachers and music teachers to give lectures together, explore the internal connection between music and literature, and guide students to conduct in-depth research and discussion. For example, set up a special topic "Schubert's Art Songs and German Poetry", invite Chinese teachers to explain the artistic characteristics of German poetry, and music teachers to explain how Schubert expresses the emotional connotation of poetry through music, guide students to discuss the connection between poetry and music.

Music and Psychology: Connection Between 24 Major and Minor Keys and Emotional Expression

Theoretical Basis: Percy C. Buck's Psychology for Musicians

Percy C. Buck's *Psychology for Musicians* is a classic work in the field of music psychology, which explores the relationship between music and human psychology, and the impact of music on human emotions, cognition and behaviour. Buck believes that music is a kind of emotional expression, and different musical elements (such as melody, rhythm, harmony, tonality) can arouse different emotional reactions. He pays special attention to the connection between tonality (major and minor keys) and emotions, and believes that each major and minor key has its own unique color,

which can express different emotions.

In *Psychology for Musicians*, Buck puts forward the view that the color of major keys is generally bright and cheerful, and the color of minor keys is generally dark and sad. He classifies the 24 major and minor keys according to their colors, and explores the connection between each key and human emotions. For example, he believes that C major is bright and pure, expressing joy and peace; a minor is dark and sad, expressing pain and sorrow. However, Buck's research is mostly based on the traditional Western music system and the emotional experience of Western audiences, and there are certain limitations. With the development of music psychology and the diversification of music culture, the connection between 24 major and minor keys and emotions is not absolute, but has certain flexibility and variability.

New Viewpoints on the Connection Between 24 Major and Minor Keys and Emotional Expression (Based on Buck's Research)

Based on the in-depth research of Percy C. Buck's *Psychology for Musicians*, combined with the characteristics of modern music and the emotional experience of different groups of people, this study puts forward the following new viewpoints on the connection between 24 major and minor keys and emotional expression:

First, the color of 24 major and minor keys has both stability and variability. The stability is reflected in that the color of major keys is generally bright and cheerful, and the color of minor keys is generally dark and sad, which is consistent with Buck's view. For example, C major is bright and pure, expressing joy and peace; G major is lively and cheerful, expressing enthusiasm and vitality; a minor is dark and sad, expressing pain and sorrow; e minor is deep and melancholy, expressing depression and despair. The variability is reflected in that the same key can express different emotions under different musical contexts (such as melody, rhythm, harmony, orchestration). For example, a minor can express not only pain and sorrow, but also calm and meditation when matched with a slow melody and soft harmony; C major can express not only joy and peace, but also solemnity and sacredness when matched with a grand harmony and strong volume. This variability is closely related to the cultural background, personal experience and emotional state of the audience, and breaks the absolute connection between key color and emotion in Buck's research.

Second, the connection between 24 major and minor keys and emotions is affected by cultural factors. Buck's research is mostly based on the traditional Western music system and the emotional experience of Western audiences, and the connection between key color and emotion is mostly applicable to Western music.

Conclusion

With the deepening promotion of quality-oriented education and the strong demand for interdisciplinary innovative talents in the new era, music general education has become an indispensable part of talent cultivation in science and technology universities. This study takes interdisciplinary integration as the core, focuses

on the three dimensions of music and painting, music and literature, and music and psychology, and constructs a set of interdisciplinary teaching modes suitable for the cognitive characteristics and learning needs of science and technology students. Through theoretical analysis, work interpretation, music score analysis and practical case verification, this research proves that the interdisciplinary teaching mode can effectively solve the prominent problems in current music general education, such as single teaching form, disconnection from professional characteristics, and insufficient integration of art and science.

The research shows that the synesthetic integration of music and painting helps students transform logical thinking into perceptual aesthetic experience; the combination of music and literature deepens the understanding of emotional expression and cultural connotation; the exploration of the relationship between 24 major and minor keys and emotional expression based on Percy C. Buck's *Psychology for Musicians* expands the theoretical perspective of music psychology and provides a new path for emotional education. These interdisciplinary approaches not only improve students' enthusiasm and participation in music learning, but also enhance their aesthetic ability, innovative thinking and comprehensive literacy, which is highly consistent with the goal of cultivating high quality innovative talents in science and technology universities.

In practice, the implementation of the interdisciplinary teaching mode needs the coordination of curriculum design, teaching team and resource guarantee, and should always be student centered and adapted to the logical thinking characteristics of science and technology students. At the same time, this study also recognizes that there are still challenges in the standardized promotion of teaching, the cross major adaptability and the cultural relativity of tonality emotion, which need to be further optimized and improved in the future.

In the future, music general education in science and technology universities should continue to expand interdisciplinary boundaries, strengthen the integration with science, engineering, digital media and other disciplines, and combine intelligent teaching technology to build a more personalized and scenario-based teaching system. It will help science and technology students establish a holistic aesthetic view, realize the coordinated development of scientific spirit and humanistic accomplishment, and provide theoretical reference and practical experience for the deepening reform and high-quality development of general education in science and technology universities.

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Conflict of Interest

No conflict of interest.