



Using the Trala application for learning to play the violin: A study of techniques, which affect listeners

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ABSTRACT

Mastering the violin depends on the possibility of achieving a higher dynamic accuracy of sounds, which requires high-quality learning approaches. The purpose of this paper is to explore the possibilities of using the Trala application to develop violin-playing skills, considering the techniques that influence listeners. Using the Trala application in training involved developing some approaches. The Trala application is designed to facilitate violin instruction by integrating innovative approaches. It emphasizes the provision of feedback, includes exercises aimed at developing playing technique, and incorporates elements of gamification to enhance the learning experience. The study determined that the students of Group No. 2 had achieved the highest quality of interpretation of melodies. The group focused on imitation techniques. The students of Group No. 3, who focused more on creating improvisation during their studies, reached the second level in terms of interpretation quality. However, the students of Group No. 3 demonstrated great confidence in their performance due to the diversity in learning. The authors of the paper found that the students of Group No. 2 had performed violin compositions more efficiently, according to the audience (the coefficient of perception (p') is equal to 9.8). The practical significance of the paper lies in the development of violin playing skills by using the functionality of the Trala application. The prospects of the study relate to determining the possibilities of using the Trala application for teaching musicians of different age categories.

1. Introduction

Playing bowed instruments contributes not only to the formation of professional competence but also affects general cognitive activity and personal enrichment. This is due to the sequence of developing the skills of playing an instrument and the embodiment of creative ideas, which contributes to the activation of memory and imagination (Fu'adi et al., 2021). To influence listeners, it is necessary to ensure the use of dynamic techniques and musical embellishments, which manifest themselves in the expressiveness of sounds. Therefore, learning to play the violin should be thoughtful and focused on the positive perception of the audience (D'Amato et al., 2020).

The subtle tonal nuances of violin melodies serve as an effective medium for conveying the distinctive characteristics of Chinese music. The violin enables the integration of both European and Chinese musical traditions within a melody, thereby influencing the expressiveness of performance (Zhang et al., 2022). The use of the violin in the performance of Chinese music allows for the application of various interpretative approaches, contributing to the achievement of a harmoniously

structured musical form. Tunefulness and poetry characterize Chinese music and form an overall aesthetic (Liu et al., 2018). The melodic expressiveness of music, including Chinese performed on the violin, is achieved through the smoothness of sound production and the conveyance of subtle melodic nuances. The development of emotional depth in performance is facilitated by the establishment of appropriate dynamic variations (Xia, 2022). Natural sound and harmony are present in Chinese music, which aims at conveying different emotions and musical images. The popularity of the violin is associated with the possibility of transmitting these sounds, which trigger various emotions (joy, sadness, peace, etc.). The expression of various emotions through the violin is closely linked to the flexibility of dynamic performance, as well as the regulation of tonality and intonation. Pitch adjustment during violin performance contributes to additional depth of sound, thereby enhancing the overall emotional expressiveness of the interpretation. Refining the bowing technique allows for modifications in the character of the music, which are associated with performance intensity and timbral variations. The pressure exerted by the bow influences the volume of the performance and the clarity of individual tones. Rapid bow

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movements affect the brightness of the sound; however, it is also essential to consider the bow's angle, which impacts the precision of execution. Higher sound quality is achieved when the bow approaches the midpoint of the string.

Furthermore, tempo control plays a crucial role in establishing the intended mood of a melody. This is particularly evident in the articulation of nuanced details, which are of significant importance in Chinese music (Zhang et al., 2022). The violin contributes to the creation of a special lyricism of the music and a high level of artistry of performance, which is associated with a special intonation. This intonation is shaped by the specific interaction between the bow, the strings, and the musician's technique, which is largely determined by the performer's level of proficiency. Intonation depends on the precise placement of the musician's fingers on the fingerboard, which facilitates the adjustment of musical intervals. The accuracy of performance is contingent upon the musician's refined technique and control over the bow, contributing to the development of a proper and well-balanced sound. Playing the violin conveys the beauty characteristic of Chinese music, which is associated with musical variations, ornamentation, and rhythm. The variation in intonation, the use of dynamic expression, and the articulation of musical nuances contribute to the aesthetic richness of Chinese music performed on the violin (Zhang & Gao, 2024). It is possible to introduce new sonic interpretations of a composition through musical variations, thereby reflecting the musician's style. The role of ornamentation is closely linked to enhanced expressiveness and the expansion of the emotional range of sound. Additionally, rhythmic variation can enhance musical expressiveness by adapting performance techniques accordingly.

Several factors influence the quality of violin sound, ranging from the instrument's construction to the chosen pedagogical approach. However, selecting an instructional method should be aligned with the student's level of musical proficiency to ensure a gradual and systematic development of their skills. This may be due to the *prima vista* method, which is associated with the visual perception of notes. An imitation technique can also be used, which aims at reproducing melodies and playing techniques of other musicians. Musicians can also use improvisation techniques and compose melodies (Akutsu, 2020). All these training techniques aim to develop rhythmic skills, which influence the quality of performance. Moreover, using digital technologies is a common approach of the modern education system. Their effectiveness is related to educational videos when students play melodies, focusing on sound files and the accuracy of playing by note, etc. (Gulum, 2023; Kesendere, 2022). The integration of digital technologies in violin instruction enables a more precise exploration of musical elements while preserving the distinctive style of Chinese music. Digital tools in the learning process are designed to refine specific components, ensuring the retention of the unique characteristics of the Chinese musical language. The detailed approach to instruction allows for considering various modal modulations, contributing to developing a distinct performance sound. Additionally, digital technologies facilitate the visualization of educational materials and interactive tutors, which support real-time adjustments to playing techniques (Di Stefano et al., 2024; Provenzale et al., 2024).

Trala is one of the innovative violin training applications that promotes the development of practical playing skills (Lo et al., 2023). The effectiveness of the Trala application is related to the processing of audio signals, which allows for feedback not only on the overall quality of playing the violin but also focusing on the accuracy of the pitch and the reproduced rhythm. The application also helps to provide various repertoires, which expands the opportunities for students to develop different skills (Tsugawa, 2023). The Trala application provides training programmes by famous violinists (Joshua Bell, Kiana June Weber, Rassa Mahmudian, etc.), which allows students to focus on a certain playing technique. With the help of the application, it is possible to ensure the development of musical skills by ear, which contributes to a cleaner and more expressive performance. Digital technologies make it possible to

develop basic knowledge about music theory and more sophisticated ones, harmoniously combining musical chords (Akutsu, 2018; Volioti et al., 2023). Built-in training systems ensure control over the quality of performance, which further influences their improvement. The availability of various exercises allows for a better approach to learning, which expands the understanding of the possibilities of musical instruments.

1.1. Literature review

The aesthetic performance of melodies on the violin depends on the chosen method of interpretation, which enables the conveyance of the artistic essence of a specific musical composition (Li, 2023). Playing the violin allows performers to fulfil themselves based on a profound understanding of fundamental knowledge. Knowledge helps violinists develop and polish up their bow skills to convey to listeners the emotional state of a piece of music. To achieve a high quality of teaching the violin, there are various teaching methods, both of the classical type (classroom work – “student-teacher”) and those using artificial intelligence and digital technologies (Li, 2023). Using the Melodyne Studio 4.0 curriculum allows the development of intonation skills in violin students. The curriculum has been successfully tested involving undergraduates studying at the Faculty of Music Education. During the experiment, the researchers considered the success of students according to the following indicators: the correctness of intonation in the home position, the correctness of intonation at variable speed, and the correctness of intonation when reproducing I-III changes. The experimental testing plan demonstrated its effectiveness before and after the program's implementation. It has been experimentally proven that constant exercises allow for the correction of posture disorders when combined with developing violin playing skills and intonations while playing the violin (Kalender & Barış, 2022). Developing and applying academic programmes for students with hearing impairment is an important area in teaching violin playing. Music schools and conservatories use the programmes successfully. Reflective education and the joint, coordinated work of professional violinists and students are the basis of such an inclusive practice. Thus, a dialogue of knowledge takes place, which leads to the understanding that students with hearing disabilities do not need another repertoire (easy and especially developed) or a unique method but adaptation at the methodological and didactic level (Sánchez, 2021).

The use of intelligent technologies is part of the programmes for teaching aesthetics and violin playing in Beijing schools, as well as piano, violin, and percussion instruments. The assessment of the level of knowledge was carried out in three stages before and after the experiment. According to the estimates for the final academic concert, students of the violin class demonstrated the lowest results, which characterized the progress of knowledge. As for skill level, high results were obtained by 39.1 %. It should be noted that using intelligent technologies has a positive effect on student training. However, practice shows that the selection of applications should be careful since they play a significant role in all aspects of learning (Li & Sun, 2023). Used to improve the algorithm for recognizing musical sounds, the combination of machine learning technologies and the audio technology of the Internet of Things allows teachers to avoid using the traditional model of music teaching. The integrated platform interacts with the subsystems of the intelligent music class and gets access to information. Based on the Internet of Things and audio technologies, the layout of smart music classrooms and the software architecture make it possible to teach students effectively to play the violin (Li & Han, 2023). Music education allows you to identify the potential and limitations of mutual learning of students. The combination of violin and viola playing in teaching is a useful strategy for students. It affects their achievement of the goal because the asymmetric relationship and the developing structure of relationships between students allows them to improve intonation. As a result of this interaction of students (working in pairs), the intonation of string students is steadily

improving (Fernández-Barros et al., 2023).

The myVibrato app runs on iPhones and allows violinists to analyse and refine their vibrato technique. The application's features are that it allows users to make technical adjustments, classify problems in vibrato performance, and provide students with data to comprehend and structure the technique of teaching violin playing (Ho et al., 2017).

Musical and pressure sensors can be utilized as technologies for music education, enabling students to enhance their focus on performance accuracy, the interpretation of musical contexts, and the refinement of key learning parameters (Volta & Di Stefano, 2024).

Learning to play the violin aims at obtaining fundamental musical knowledge based on the improvement of playing skills and the aesthetics of melody reproduction. It is possible to optimize the learning process with the help of digital technologies, which allows you to focus on the versatility and diversity of educational applications (Yifeng & Haris, 2023).

Applications and technologies that introduce violin playing into the educational process are essential tools for improving the quality of music education. However, scientific articles have not considered using the Trala application in teaching violin playing.

1.2. Problem statement

Playing the violin is characterized by a high level of artistry and lyricism of sound. The distinctive timbre of the violin enables a high-quality performance of Chinese music. This is achieved through the refinement of sound subtleties and the exploration of its unique characteristics. It is possible to expand the possibilities of music education with the help of interactive technologies. Using the Trala application, one of the most popular for learning to play the violin, contributes to the formation of a high level of skills in playing a musical instrument. The variety of composition genres in the application helps expand the possibilities of playing a musical instrument. The purpose of the article is to explore the possibilities of using the Trala application in teaching violin playing, considering the techniques of influencing listeners.

The objectives of the study included:

- development of educational approaches using the Trala application;
- determination of the level of confidence and quality of students' performance of violin melodies after training, using the Pearson coefficient to compare the results between three groups of students;
- comparison of the level of listeners' perception of the melodies played on the violin by the students of Group No. 1 (prima vista), Group No. 2 (imitation techniques), and Group No. 3 (improvisation skills).

2. Methodology

2.1. Research design

The first stage of the research was to develop a violin training programme. At the same time, the training involved interactive technologies, which made it possible to use the Trala application (Fig. 1). The choice was made on this application because it has the highest user ratings and promotes the development of violin playing skills for different age groups. As part of the study, the Trala application was adapted to the possibility of using certain educational approaches. The educational approaches are aimed at developing practical and artistic violin playing skills and focusing on expanding opportunities through improvisation. The researchers divided the students into three groups during the training process. The training involved going through all four stages. However, the students of Group No. 1 focused on prima vista, which was associated with performing Trala exercises and individual melodies, focusing on prima vista.

Furthermore, the students of Group No. 1 initially focused on changing the musical notes and then on playing melodies on the violin during improvisation. The students of Group No. 2 used the principle of imitating other performers. The students were looking for additional versions of musical compositions during the improvisation. These compositions were used as improvisational ones. The students of Group No. 3 focused on improvising melodies at each stage of their studies.

Overall, the learning process using the Trala application was centered on receiving real-time feedback, enabling students to adjust their playing accurately. The performance quality assessment was facilitated through a microphone or camera, ensuring precise feedback. This allowed for the provision of accurate recommendations for improving playing technique. The application is accessible to students as it can be used on various devices, including tablets, personal computers, and mobile phones. Additionally, Trala incorporates elements of gamification, allowing students to progress through different learning levels.

The second stage of the study included determining the confidence and quality of the interpretation of violin melodies by the students of the groups. Initially, five teachers determined the students' levels of playing the musical instrument. They associated the quality of interpretation with compliance with the technical aspects of performance, the smoothness of execution, and artistry. In assessing performance confidence, consideration was given to students' application of free musical variation approaches, which promoted a tension-free violin playing technique and facilitated ease of execution. Additionally, performance confidence was associated with the reduction of performance anxiety, which could otherwise impact the retention of musical information, notation, and the overall mood of the musical piece. At the same time, the students could perform both the mandatory and their compositions.

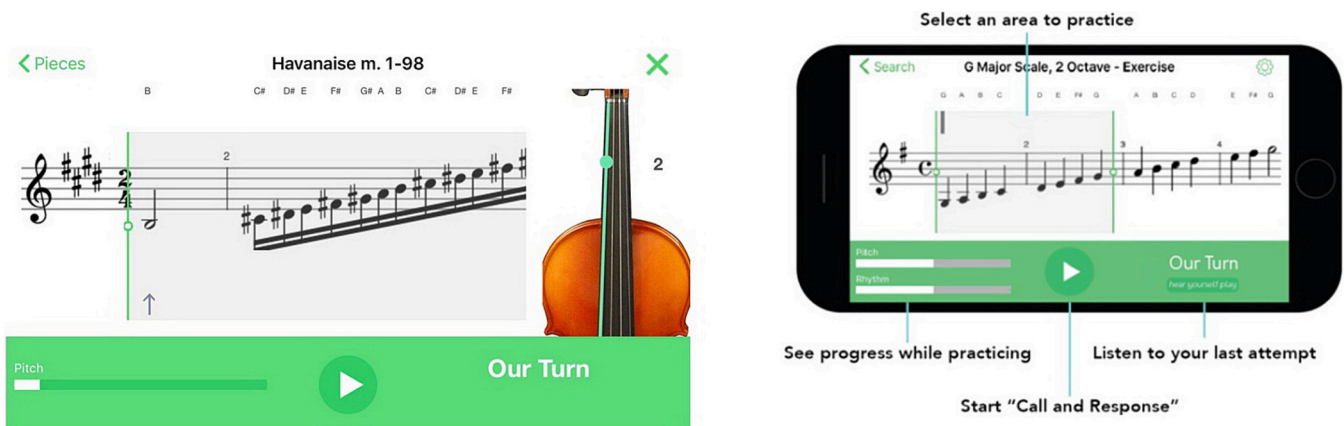


Fig. 1. The functionality of the Trala application used for training.

The researchers processed the obtained results, focusing on the use of the Pearson correlation coefficient (Blanco & Ramirez, 2019). This approach made it possible to provide a statistical comparison between two similar categories of data. The categories of confidence and quality of interpretation of melodies on the violin were similar since they were formed within the framework of the performance of the same melodies, showing the general level of formed violin playing skills.

The third stage of the study involved determining the audience's perception of the quality of the performance of melodies on the violin. The researchers subjected the audience to a survey that considered the following:

- melodiousness of compositions;
- the technical accuracy of sound production;
- the harmonic coherence of compositions.

The melodiousness of a composition was understood as the precise articulation of musical elements that convey its overall mood. The technical accuracy of sound production was based on the correct execution of violin melodies, encompassing the maintenance of appropriate intonation and dynamics, the precision of transitions, and adherence to intervals, all of which depend on proper coordination. The harmonic coherence of compositions referred to the alignment of all musical components, ensuring the preservation of the intended tonality and the balanced distribution of musical accents. The authors of the paper evaluated the level of perception of the compositions by the audience separately in the three groups of students, which had implied research on different techniques of influencing listeners. The level of students' perception of performance quality was assessed following their use of the Trala application. Since the audience members were not professional musicians, their perception of the melodies was primarily based on the emotional expressiveness of the sound. The evaluation focused on determining the level of expressiveness, which contributed to conveying the mood of the music, as well as assessing the interaction between musicians and the audience. This approach aimed to ensure objectivity in the perception of performances. Collecting data from the listeners involved filling out a text document indicating the level of the highest and lowest quality performance. The respondents' written answers made it possible to eliminate the ambiguity of the survey since each listener had presented specific results. The survey made it possible to calculate the perception coefficient using Formula 1.

$$\dot{p} = \frac{h + t + m}{n}, \quad (1)$$

h is the overall harmony of performance;

t is the compliance with some technical aspects while playing the violin;

m is the overall melodiousness of the sounds of the compositions;

n is the number of benchmarks.

The highest value of a single criterion was 10, which was determined according to the opinion of the listeners.

2.2. Sample

The study involved 183 students who studied the violin. Second-year students represented the respondents from [BLINDED] and the [BLINDED]. The age of the respondents ranged from 18 to 20 years. This limitation related to ensuring the development of approaches to learning to play the violin, where the development of basic skills of playing a musical instrument was excluded. The researchers excluded first-year students from the study since the training programme randomly placed the students into groups. This implies using the VerifyShare application to assign each student a separate number. They chose the application randomly due to its ease of use. Group No. 1 included 63 students, Group No. 2–61 students, and Group No. 3–59 students. A total of 98 women and 85 men participated in the study, resulting in a gender ratio of 60 % to 40 % in each group, respectively. In addition, the researchers involved 315 listeners in the study who attended concerts of

the students. The listeners participated exclusively in the third stage of the study. The researchers selected the based on VerifyShare and the applications submitted through the Kuaishou social network. The listeners had to have musical knowledge, which involved answering some musical questions during the sampling.

2.3. Statistical processing

The researchers used the LibreOffice Calc application for their calculations, which allowed them to edit existing formulas in accordance with the current study. Their convenience and ease of use contributed to creating tables and figures based on the data obtained.

2.4. Ethical issues

The researchers paid particular attention to the ethical issues since they aimed to comply with international publication requirements. The authors of the paper were also the subject of the ethical standards, which excluded possible conflicts of interest (Committee on Publication Ethics, 2021).

3. Results

Within the framework of the presented training system, using the Trala application is assumed to provide specific educational approaches. The chaotic use of the application influences the training and does not allow for the development of violin-playing skills (Fig. 2).

Since the training involved using the Trala application, the researchers focused on the functionality of the application during the selection of the repertoire and practical tasks. The development of practical skills initially assumed training the instrument and focusing on the initial capabilities of the musicians. The researchers obtained the results using the Trala application. The use of the application is primarily aimed at developing the musical and performing abilities of students. This involved the development of fingerings important for the formation of sophisticated approaches to playing the violin. The development of fingering is important because its change contributes to the transformation of the timbre and strength of sounds. The repetition of movements through verbalization and visualization aimed at developing precise violin playing skills. The performers also planned to work with their fingers since their incorrect stretching affects the change in the meaning of musical compositions. The training emphasized repeating one melodic phrase since this allowed various melodies to be played on the violin.

The second instructional approach aimed to integrate artistic and technical violin techniques, facilitating higher emotional expressiveness in performance. The combination of artistic and technical skills suggested a greater emotionality. Based on the imitation technique, the researchers used videos and appropriate exercises from the Trala application. Watching videos about the performance of different compositions allows for the accumulation of musical experience, which manifests in the development of imaginative thinking and memory. It also manifests itself in understanding the specifics of creating emotionality in performance, using different timbres. This training approach is aimed at forming the individuality of students using individual musical intervals and intonation. The training approach also assumed replacing musical pauses with additional noises, which influenced the melodiousness of sounds. The aesthetics of sounds assumes developing the skills of changes between certain pitches, observing the timbre dynamics and the presented fingerings.

The formation of intonation approaches and work on vibration was of great importance during the training since these indicators formed the manner of performance and contributed to the artistic sound of the violin. When playing the violin, the musical intonation results from a combination of the chosen tempo and natural overtones. The researchers used equalizing exercises and combinations of different notes to develop

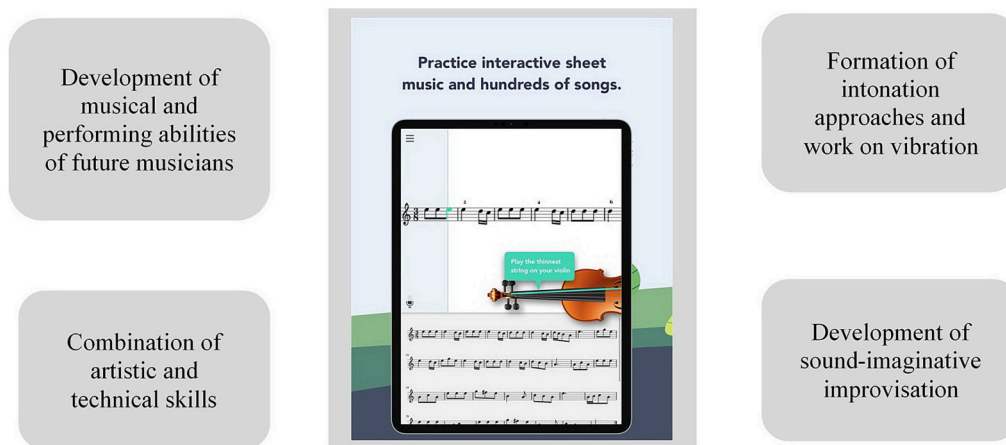


Fig. 2. Author's approaches to learning to play the violin using the Trala application.

correct intonation and work on sound vibration by focusing on the Trala application. The development of these skills resulted from the changes in the speed and rhythm of musical movements. Changing the ways of performing a particular phrase involved determining the most expressive sounds of a composition by multiplying the musical effect. Using the Trala application allowed the researchers to study a single piece of music.

The development of sound-imaginative improvisation rested on the formed technical skills of playing the violin. The development of improvisation skills involved the use of various techniques aimed at the harmony of performance. Improvisation was associated with composing their musical fragments or changing existing ones. Improvisation involves changing the speed of performance and the pressing force applied with the bow to the strings. The training also involved artistic embellishments, focusing on specialized applications from Trala. Moreover, improvisation called for a change in violin strokes, associated with the hardness of sounds, pauses, and changes in intonation and rhythm.

The researchers used the Trala application to evaluate the students while learning to play the violin (Table 1). The results indicated the confidence of performance and the quality of violin playing of the students who:

- used *prima vista* (Group No. 1);
- focused on imitation techniques (Group No. 2);
- focused on the development of improvisation (Group No. 3).

Based on the data obtained, the researchers concluded that musical skills are high in terms of quality and masterfulness of interpretation. A more profound analysis demonstrated the highest level of masterfulness in the students of Group No. 3. The level resulted from the emphasis on developing improvisation skills, which contributed to improving the quality of performance because of searching for the most appropriate expressive elements. The students of Group No. 2 demonstrated the most confident performance of melodies on the violin. This was due to the development of practical skills because of focusing on training videos from the Trala application. During the performance of musical compositions, the students also achieved a high level of expressiveness and imperceptible key changes. During the musical interpretation, they also

achieved the expressiveness of certain sounds and their minute difference. Some dynamic contrasts also influenced the quality of the melodies. The obtained statistical calculations confirm the absence of significant differences among the three student groups. The statistical validation of the results is supported by the obtained numerical indicators, which reflect the consistency and quality of interpretation among students in the same group, practically at the same level (0.622; 0.651; 0.518). This is attributed to the adoption of identical approaches to the interpretation of violin compositions, which facilitated the achievement of confidence and interpretative quality.

The study also involved determining the students' violin playing quality, which impressed listeners. The study involved determining the high or low levels of perception, which were interrelated with harmony, sound technique, and general melodic sounds (Fig. 3, Table 2).

The study strongly suggested that the students of Group No. 2's performance of violin melodies triggered a more diverse range of emotions. The students' imitation of other performers impressed the audience. This imitation rested on the performers' style, allowing them to achieve artistic performance and demonstrate technical aspects. The violin playing of the students of Group No. 2 demonstrated some virtuoso elements, which resulted from the use of artistic musical embellishments. Performing the violin compositions also suggested a variation in intonation, contributing to better sound reproduction.

The students of Group No. 3, who used improvisation in the learning process, were also able to achieve high results in playing melodies for the violin, which was evaluated as a result of the perception of performed musical works by listeners. This was due to the clarity of lessons using the Trala application.

The students of Group No. 1 made mistakes in the sound quality during the application of open string approaches. They used the open strings to convey the traditional musical colour, manifested in the openness and brightness of sounds. However, this technique is usually associated with developing more professional violin playing skills. Therefore, additional training is required to develop improvisation skills.

The statistical comparison of all indicators of audience perception of musical composition quality demonstrated consistency across all measures. This was attributed to the identification of a positive linear correlation among the indicators across the three groups. The obtained statistical results demonstrate a positive correlation among students from the three groups (since the values fall within the range of 0 to 1), despite minor differences in the level of perception of musical works by the audience. The results were associated with the use of the Trala app, which allowed for the adjustment of students' violin playing techniques. The statistical dependence of the results is linked to the timely correction of specific aspects of violin playing, which influences the potential for high-quality performance.

Table 1

The level of masterfulness and the quality of interpretation of musical compositions by students of Groups No. 1, No. 2 and No. 3.

Group number	Masterfulness of interpretation		Quality of interpretation		Pearson coefficient	p
	M	SD	M	SD		
Group No. 1	3.4	0.95	2.9	1.07	0.622	0.00
Group No. 2	2.7	1.03	3.8	0.75	0.651	0.00
Group No. 3	3.6	0.81	3.2	0.94	0.518	0.00

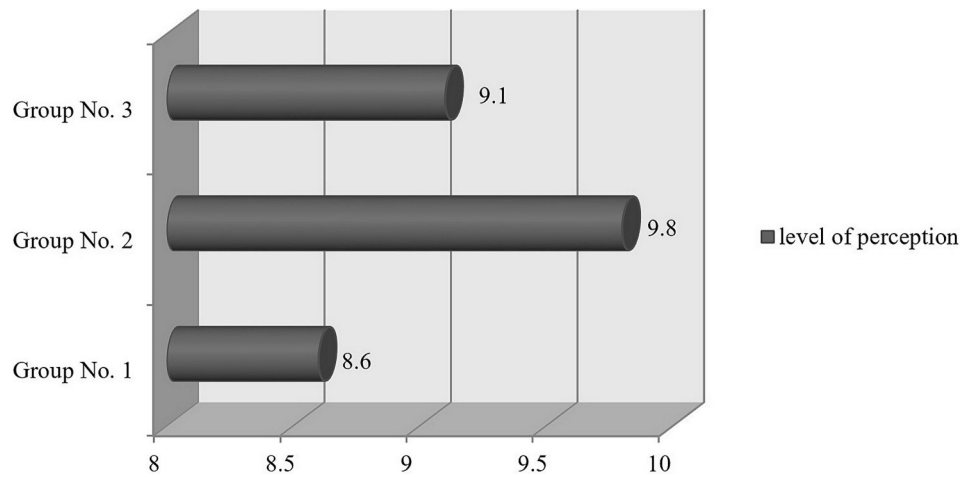


Fig. 3. The level of listeners' perception of the quality of musical compositions in different groups of the students.

Table 2

Statistical distribution of audience perception of musical composition quality using Pearson's coefficient.

Group number	M	SD	Pearson coefficient			p
			Group 1	Group 2	Group 3	
Group 1	3.4	0.85	–	0.783	0.732	0.00
Group 2	3.8	0.80	0.783	–	0.751	0.00
Group 3	3.0	0.92	0.732	0.751	–	0.00

4. Discussion

The innovative educational project “Oidos a Pares” has presented the advantages of students' simultaneous musical education. The main objective of the project was to improve the intonation and auditory skills of students learning to play the violin and viola. The project's authors developed some didactic materials and a strategy for interaction between students and teachers. Teaching students to play the violin and viola in pairs was an important project component. The students who participated in the project collaborated with those with an asymmetric level of skills, knowledge, and abilities to teach each other based on a common goal. Thus, communication and the common goal allowed the students to accelerate the development of the necessary skills to play musical instruments (Fernández-Barros et al., 2020). To learn to play the violin, students need to set learning goals and constantly check, control, and motivate themselves, as well as develop the emotional component. The main task of Plectrus is to teach and evaluate instrumental intonation in real time. Using the software allows researchers to study the constructions of self-regulation during the learning process. The authors of this study used audiovisual recordings to carry out the analysis. The students demonstrated various behaviours that allowed them to independently regulate their knowledge, motivation, behaviour, and emotions. According to the results of the experiment, the researchers found that the students with more pronounced self-regulation processes had better results in mastering instrumental intonation (López-Calatayud & Tejada, 2024). The use of the Plectrus application in violin instruction facilitates the exploration of various pedagogical approaches. The results indicate that this application offers a more limited range of functionalities compared to the Trala application. Using smartphones or tablets allowed the students to analyse quickly the phenomenon of acoustic beats (a combination of two tones with some difference in frequency), which influenced the auditory sensation. As with any stringed instrument, the violin is tuned using an acoustic rhythm. There is a reference tone to tune a string. If a string is untuned, then a beating occurs. If the frequencies match, there is no beating, indicating that the

string is tuned correctly. Using the Oscilloscope application, it became possible to match acoustic signals and determine the beat frequency (Kuhn et al., 2022). In their paper, the researchers did not consider the peculiarities of the acoustic phenomenon and the strategies of interaction between students. However, they studied the possibilities of the Trala application to teach the students of these three different groups using *prima vista*, imitation, and improvisation.

Using intelligent learning, diversified classes are the most important component in the field of education informatization in China. Online education is well integrated into learning to play the violin in the context of the intelligent Internet of Things. Suppose teachers and parents of violin students do not have the opportunity to control independent work. In that case, neural networks come to the rescue, aimed at solving the problems of learning to play the violin. The analysis of the characteristics of the time and frequency domain of various audio signals and speech and music signals helps to separate the model of sound sources based on a deep neural network. This allows teachers and parents to evaluate the homework of violin students (Zhang, 2022). The use of intelligent robots is one of the latest innovations in the field of music. The violin embodies the soprano voice, and there are many musical pieces for this instrument. The ViolinTalk system has proven itself as an XY-type robot violin control system and an Internet of Things (IoT) device. This system allows students to control the bow's speed and change the volume and tone. This includes analysing errors in the speed of performance, improving the effects of performance, and analysing and correcting errors in the speed of performance. Several robots can form a string orchestra – two violins, one viola, and a cello (Huang & Lin, 2023). This paper did not consider using robots to develop emotional violin playing skills. In the presented studies, their use was primarily associated with the development of specific violin-playing skills. However, the paper studied some peculiarities of listeners' perception of melodies played on the violin, based on the results of the students from the three studied groups.

Dynamic Auxiliary Support (DAS) allows for the evaluation of the adaptation of motor skills and musical abilities of violinists. According to statistics, 93 % of instrumentalists, especially violinists, suffer from injuries of the musculoskeletal system. DAS was used to minimize muscle activation and limit fatigue accumulation. DAS helps to change the configuration of the upper limbs of violinists while preserving the peculiarities of musical performance (Ziane et al., 2023). Learning to play the violin should involve the development of expressiveness, precision, and coordination of movements. Violinists can achieve this by focusing on imitation techniques. Some researchers proposed using joint interpretation in training. It contributes to developing pitch and forecasting approaches for the harmonious reproduction of musical compositions by different musicians (Klein et al., 2022).

The analysed papers made it possible to determine that information technologies were a common technique for learning to play the violin. However, their specification is quite limited. This article emphasized the capabilities of the Trala application used for learning to play the violin. This research also aimed to determine the possibility of using the Trala application in learning by focusing on diverse approaches (prima vista, imitation, and improvisation techniques). Based on this gradation, the researchers determined the effectiveness of the Trala application and the sound quality of violin compositions by the students of the three different groups.

5. Conclusions

The research aimed to determine the peculiarities of learning to play the violin by focusing on an innovative approach and using the Trala application. The Trala application facilitated the acquisition of visualization materials and the use of a specific repertoire for playing melodies and allowed performing exercises of varying complexity during the training. The developed training approaches included developing the musical and performing skills of students. They allowed combining artistic and technical skills, intonation approaches, work on vibration, and sound-imaginative improvisation. The development of practical skills involved technically correct violin playing, the formation of timbre and strength of sound, allowing the students to perform various melodies. The development of artistic and technical skills presupposed the formation of individuality in performance, considering the specifics of intervals, intonation, and general emotionality. The development of intonation and vibration approaches resulted from sound equalization applications and sound-imaging improvisations by changing musical fragments.

During the training, the Trala application helped the students develop their interpretation quality and masterfulness. The students of Group No. 3 were very masterful in their interpretation ($M = 3.6$; $SD = 0.81$) because they were not afraid to combine musical elements of different complexities. The focus on improvisation in teaching allowed using some experimental approaches when performing melodies associated with a constant search. The students of Group No. 2 demonstrated a higher quality of musical interpretation ($M = 3.8$; $SD = 0.75$). They achieved such results by imitating other musicians, which allowed for the accuracy of the melodies.

Based on listening to the melodies for the violin, the audience presented their conclusions regarding the performance quality. The students of Group No. 2 achieved a higher level of performance artistry. The students of Group No. 1, who used prima vista in their training, achieved lower results due to the inaccuracy of using open strings.

The limitations of the study relate to the involvement of respondents of the same age category. This allowed the researchers to determine the effectiveness of using the Trala application in teaching violin playing. In their further research, the authors plan to explore the possibility of using the Trala application for respondents of different age categories while learning to play the violin in more detail.

The practical significance of this paper lies in the study of ways to use the Trala application for learning to play the violin, based on the prima vista, imitation, and improvisation methods. The study will determine the effectiveness of the Trala and Violin Academy applications for learning to play the violin.

CRediT authorship contribution statement

Wei Liu: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Consent to participate

Informed consent was signed by participants.

Ethics approval

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. The study was approved at the meeting of the Ethics Committee of Shenyang Conservatory of Music (Protocol no. 421 dated from 18.04.2023).

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

All data generated or analysed during this study are included in this published article.

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