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Effectiveness of the Teaching Program Prepared to Improve Intonation Skills in Violin Education *

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Abstract

In this study, the effect of the curriculum prepared for the elimination of posture-grip disorders in students and the development of the right-and left-hand skills on the intonation skills of students was examined. For this purpose, the curriculum prepared by targeting the 1 and 2 grade levels of the Music Teaching Undergraduate Program was applied to 6 students studying at Bolu Abant İzzet Baysal University Music Education Department in the 2018–2019 academic year. In the study, the explanatory sequential mixed method was used, a single group pretest–posttest experimental design was applied in the quantitative dimension, and a structured interview technique was used in the qualitative dimension. Thirteen weeks worth of the prepared curriculum was applied to the experimental group, one hour per week. The effectiveness of the programme was examined based on three tasks: intonation accuracy in the first position, intonation accuracy according to the speed variable, and intonation accuracy in I–III position–transition playback. The studies and exercises determined for this purpose were performed by the students in the studio environment before and after the application, and the intonation errors in the files recorded in the computer environment were converted into numerical data with the Melodyn Studio 4.0 package program. To calculate the level of significance between the pretest–posttest results, 8772 notes records were analysed, and the Wilcoxon Marked Rows test was applied using the SPSS program. The descriptive analysis method was used in the analysis of qualitative data. According to the analysis, significant improvement was detected in the intonations of the students in all three tasks. It was seen that the qualitative student opinions supported these results, and the students stated that there was an improvement in their intonation and violin playing skills after the application. As a result, it can be said that regular technical exercises by eliminating posture-holding disorders and improving violin playing skills are effective in the development of intonation in the violin.

Keywords

Violin training
Violin playing technique
Intonation
Individual instrument curriculum
Intonation development

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Introduction

Intonation, arguably the most challenging part of violin education, is defined as a musician's ability to accurately produce the right sounds within a melody (Chen, Woollacott, Pologe, & Moore, 2008). The ability to play with the right intonation depends on many variables, especially in fretless instruments such as the violin. First, one needs a developed sense of hearing that can detect and identify the accuracy of the sound. Also, an advanced sense of touch and touch control is required in order to judge the distance between the sounds on the touch and make the appropriate correction accordingly. Studies investigating how to develop all these skills revealed that intonation has auditory, visual, and kinesthetic dimensions (Nunez, 2002).

Studies on musicians' intonation skills and perceptions of correct intonation have a history of approximately100 years. Such studies focused on the development of hearing skills and concluded that musicians' sound matching and auditory discrimination skills could be improved through regular exercises (Dalby, 1992; Geringer, 1983; Geringer, MacLeod & Ellis, 2014; Heller, 1969; Lundin, 1963; Platt & Racine, 1985; Porter, 1977; Smith, 1995; Yarbrough, Karrick, & Morrison, 1995; Yarbrough, Morrison, & Karrick, 1997). Although the perception of intonation accuracy and decision-making mechanism is basically linked to hearing skills, intonation accuracy in violin requires more than that. Indeed, although it is important to have very good hearing and to be able to perceive the precise distance between sounds, advanced instrument command and technical skills are required to reflect these differences on the touch correctly. Accordingly, pedagogues, artists, and researchers of violin education deem the following necessary to have good intonation:

1. Ability to instantly correct faulty notes/an enhanced sense of touch (Flesch, 1939; Galamian, 1962; Markov, 1984)
2. Regular exercise (Winn, 1905), regular technical exercise (Balkan, 2020)
3. Correct left-hand technique
    a. Correct left-hand positioning (Galamian, 1962; Winn, 1905)
    b. Not lifting the fingers unnecessarily, finger holding during string switch (Aytekin, 2012; Büyükaksoy, 1997; Bytovetzski, 1917; Courvoisier, 1908; Flesch, 1939; Galamian, 1962)
    c. Not raising the fingers too high (Bytovetzski, 1917; Dalton, 2003; Flesch, 1939; Galamian, 1962; Gün Duru, 2016; Memedaliyev, 2003)
    d. Not wrapping the thumb to the neck (Winn, 1905), keeping the thumb is flexible and comfortable (Menuhin, 1981), reducing the tension in the left hand (Flesch, 1939; Galamian, 1962; Markov, 1984)
    e. Pressing against the strings with the tip of the fingers flexibly and freely, keeping the fingers relaxed (Flesch, 1939; Markov, 1984; Menuhin, 1981; Okay & Kurtaslan, 2013; Wilhelmj & Brown, 1898)
    f. Keeping the fingers, especially the third and fourth fingers, on the touch/according to the sound to be created (Auer, 1926; Aytekin, 2012; Büyükaksoy, 1997; Dalton, 2003; Geminiani, 1751; Gün Duru, 2016; Günay, 2006; Memedaliyev, 2003; Memedaliyev & Sarıkaya, 2007; Menuhin, 1981; Okay & Kurtaslan, 2013; Romeo, 1986; Wilhelmj & Brown, 1898)

All of the abovementioned skills and behaviours are related to the technical aspect of violin playing. Experts agree that exercising with the right technique will both improve all aspects of the violin performance and help to achieve better intonation. Playing with the wrong left-hand technique leads from one error to another. It is known that the wrong technique leads to wrong violin hold, which leads to stiffness and tension in the hands, and this tension leads to many problems related to tempo, positioning, and intonation. It was observed that such problems can become chronic when left unresolved, causing students to feel like they have 'limited talent' or are inadequate over time, and consequently, alienating them from the instrument. Indeed, in cases where intonation problems could not be resolved, students were reluctant to play their instruments, they got alienated and even quit over time, which is a prevalent problem encountered frequently by experts (Kanno, 2003).

There are numerous studies in the literature on the development of musicians' intonation skills, and there are studies at various levels and scopes, especially focusing on the development of students' hearing skills. However, no studies were found focusing on the instrumental technique dimension of intonation. Accordingly, this study aims to develop based on violin pedagogy literature a training programme for the development of students' right and left-hand skills and investigate its impact on students' intonation skills. The study aims to answer the research question 'How effective is the training program designed to develop intonation in violin education?'

The sub-questions of the study are as follows:

1. Is there a significant difference between the participants' intonation accuracy in the first position pretest and posttest scores?
2. Is there a significant difference between the participants' intonation accuracy at fast tempos pretest and posttest scores?
3. Is there a significant difference between the participants' intonation accuracy while switching between the first and third positions pretest and posttest scores?
4. What are the participants' opinions on the implementation phase of the study?

Limitations of the Study

The limitations of the study are given below:

1. This study was carried out with six first- and second-year undergraduate students at Bolu Abant Izzet Baysal University, Faculty of Education, Department of Fine Arts Education, Department of Music Education, who took the individual instrument course, in the 2018–2019 academic year.
2. In this study, intonation accuracy in the first position, by speed, and while switching between the first and the third positions were measured.
3. The technical materials, instrumental techniques, and educational resources used in the development of the training programme also present a limitation.
4. Finally, Studio One 3 was used in the analysis of the sound recordings taken for the pretest and posttest, Melodyn Editor was used in identifying intonation errors, and the equal temperament was taken as a reference point for intonation accuracy.

Purpose of the Study

This study aims to examine the impact of technical exercises that aim to teach students the correct posture-hold skills and technical habits to improve their intonation skills.

Significance of the Study

Nunez (2002) claims that intonation development has three dimensions, namely visual, auditory, and kinesthetic. It was found after a literature review that studies on intonation development mainly focus on students' auditory or auditory-visual skills. However, the number of studies focusing on the kinesthetic dimension was found to be extremely few and an evident lack of studies on the development of instrumental technique and technical exercises were observed. It is thought that this study, which focuses on the kinesthetic dimension of intonation, will fill a gap in the literature.

Method

This study investigated the impact of the training programme developed for music teaching students who took the individual violin class on their intonation skills. Developed based on the resources written by renowned pedagogues (Auer, 1921, 1926; Flesch, 1939; Galamian, 1962), the training programme aims to develop right and left-hand skills through various exercises to teach the correct posture-holding behaviours, and in this study, development in participants' intonation skills was observed based on three different variables.

The exploratory sequential mixed methods design was used in the study. With this approach, data are collected quantitatively in the first stage of the study, and the interviews held in the second stage (qualitative stage) are thought to be helpful in elucidating the quantitatively obtained data (Creswell, 2014/2016). The mixed method was utilized in the study in order to receive the detailed opinions of the participants regarding the training programme and to make use of participants' convictions in the interpretation of the quantitative data and the evaluation of the programme.

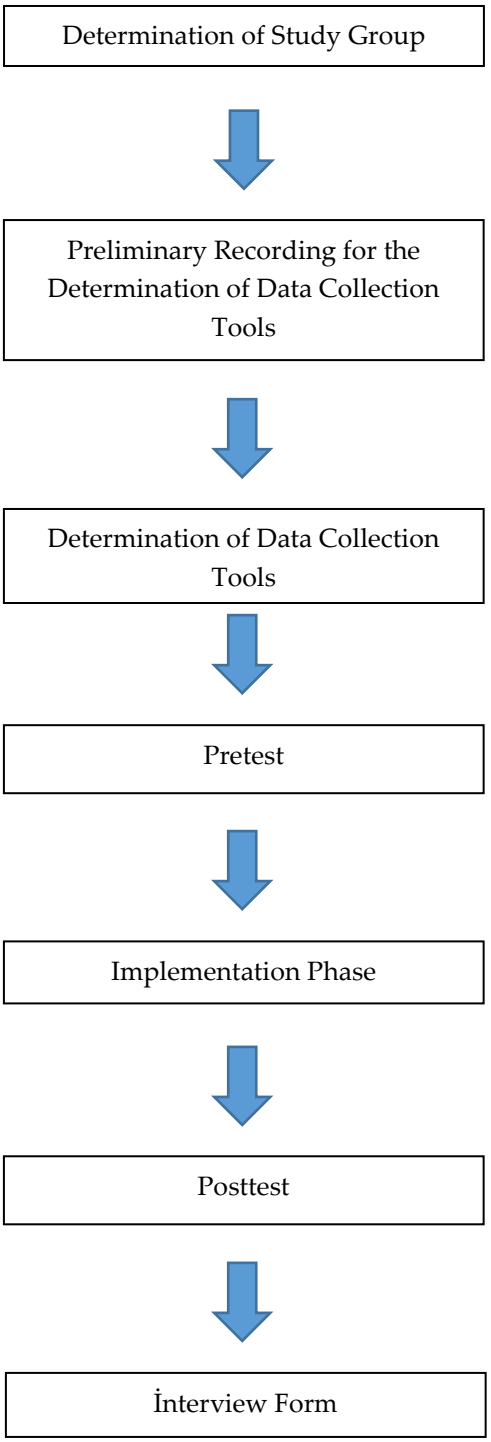

Figure 1. Process steps

One-group pretest–posttest design was adopted in the quantitative stage of the study. With this method, the impact of the experimental procedure is measured over a single group (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2020), by comparing the results of the pretest performed before the implementation phase and the posttest made after the implementation phase. As evident from its title, individual instrument classes are carried out individually; thus, instead of comparing the performance of the participants with that of other participants in a control group, the performance of each student before and after the implementation phase was compared. In the second stage of the study, structured interviews, a qualitative research method, were utilized.

Study Group

The study group of consisted of six (n=6), two males and four females, first-year and second-year undergraduate students at Bolu Abant Izzet Baysal University, Faculty of Education, Department of Fine Arts Education. The participants were selected through the purposive sampling method. Purposive sampling method is preferred in certain special cases that meet certain criteria or have certain characteristics (Büyüköztürk et al., 2020). In order to prevent students from having problems in adapting to the activities carried out in the implementation phase, third-year and fourth-year students were excluded from the study group.

Before the implementation phase, 10 candidate students who had posture-holding and intonation problems were identified by interviewing lecturers. Interviews were held with these students, and they were informed about the implementation phase of the study. After the interviews, two first-year students and four second-year undergraduate students volunteered to participate in the study. The information with the students participating in the research is shared in Table 1.

Table 1. Personal information of the students participating in the research

	Student I	**Student II**	**Student III**	**Student IV**	**Student V**	**Student VI**
Age	19	19	19	18	18	19
Gender	Male	Female	Female	Female	Male	Female
Class level	2	2	2	1	1	2
Type of High School Graduated	Fine Arts High School	Anatolian High School	Fine Arts High School	Fine Arts High School	Fine Arts High School	Fine Arts High School
Ownership of Own Instrument	Yes	Yes	Yes	Yes	Yes	Yes

Of the six students who participated in the study, five graduated from a fine arts high school and one graduated from an Anatolian high school. Student II, who is the only Anatolian high school graduate, received violin training for three years before starting the undergraduate degree; the skill levels of the students who took part in the implementation phase are similar.

Data Collection Tools

The impact of the training programme carried out in the quantitative stage of the study on participants' intonation accuracy was measured with three tasks. The said tasks measured the following:

1. Intonation accuracy in the first position
2. Intonation accuracy at fast tempos
3. Intonation accuracy while switching between the first and the third positions.

Preliminary recordings were taken in order to select the measurement tools to be used, to determine the speed based on the performance of the students, and to enable the students to experience the environment in which the recordings will be taken. Participants were assigned with Wohlfahrt op.45 no.3 etude three days before the recording and were asked whether they performed it before. After the analysis of the data obtained from the preliminary recording, three different measurement tools were determined for each task by taking into account the difficulty levels of the technical tasks, and for content validity, two violin and one viola instructors who have a Ph.D. in music education were consulted. Accordingly,

1. For the measurement of intonation accuracy in the first position, Exercises 7, 9, 10, and 11 in Henry Schradieck's School of Violin Technics (SVoT)Vol. no. 1 no. 6 were performed at a pace of 50 bpm.
2. For the measurement of intonation accuracy at fast tempos, Exercises 7, 9, 10, and 11 in Henry Schradieck's SVoT Vol. 1, no. 6 were performed at a pace of 100 bpm.
3. For the measurement of intonation accuracy while switching between the first and the third positions, Franz Wohlfahrt Op.45 Étude no. 36 was performed at a tempo of 55 bpm.

A structured interview form was prepared in order to receive participants' opinions about the implementation phase in the qualitative stage of the study. This form included questions about the intonation problems experienced by the participants before the training programme, as well as the implementation phase. The designed questions were related to the intonation and technical problems participants had experienced before taking part in the study, the change experienced in the instrumental technique, the individual gains from the implementation phase, and criticisms regarding the implementation phase. Three faculty members, two from the field of music education and one expert in assessment and evaluation, were consulted to ensure content and construct validity. The interview form finalized in line with the received feedback was applied after the posttest.

Data Collection

The study took place in the spring term of the 2018-2019 academic year. The pretest was conducted on February 20, 2019, and the implementation phase was initiated on February 21, 2019. The study, which continued for 13 weeks, ended on May 17, 2019. The preliminary recordings were taken before the quantitative stage of the study, and all subsequent recordings were taken in a professional sound studio located in the city centre of Bolu. In the recordings, Rode NT 1A microphone, RME Pro sound card, and American Audio HP 700 headphones were used; intonation errors in the recordings taken with the Studio One 3 software were identified with the Celemony Melodyn Editor package program. A total of 8772 notes were recorded, 731 notes per student in each recording. Quantitative data collection tools were given out to the participants two days before the pretest and posttest and were taken back after the recordings. The students stated that they had never performed the etudes and exercises used in the implementation phase and that they did not know the composers of the said works or the books they were featured in.

One week after the posttest conducted at the end of the implementation phase, between 24 and 31 May 2019, the structured interview form was used to collect data. The prepared form was sent to the participants via e-mail and answers were collected with the same method.

Data Analysis

The data were collected quantitatively, by recording the etudes and exercises performed in the studio environment. Equal temperament was taken as the basis for determining intonation accuracy; the intonation errors in audio files recorded using the Studio One 3 software were identified using Celemony Melodyn Editor. The software errors encountered during the analysis of the recordings were detected and noted, and they were removed from the excel files where the pretest and posttest data were kept, ensuring that the intonation errors in the same notes were examined in the statistical analysis. The software errors encountered in the recordings were as follows:

1. Detection of various tunes instead of the played note by the software and the display of this tune in the Melodyn Editor program (displaying a sound one octave higher or lower, etc.): this caused different notes from the played one to appear, so it could not be included in the analysis.
2. Note loss occurred when two conjoined notes were picked up as a single note, so the relevant note could not be included in the analysis.

For the analysis of the data obtained in the quantitative stage of the study, SPSS Statistics 20, Kolmogorov-Smirnov, and Shapiro-Wilk normality tests revealed that the dataset did not show a normal distribution. Accordingly, the Wilcoxon Signed-Rank Test was performed in order to measure whether there was a significant difference between the participants' pretest and posttest scores. This test is performed to measure whether there is a significant difference between two measurements in cases where the data belonging to the same group do not show a normal distribution (Kilmen, 2015).

The descriptive analysis method was performed in the analysis of the obtained qualitative data. With this method, the collected data is summarised and interpreted vis-a-vis predetermined themes. Direct quotations are frequently utilised to present the views of the participants of the study in a striking manner (Yıldırım & Şimşek, 2018). The collected data were explicated in accordance with the themes of technical problems experienced by the participants before the implementation phase, changes in the instrumental technique, individual achievements, and criticisms. During the analysis of the obtained data, the quotes were presented directly and impartially; then, the cause-effect relationship between the data and the quotes was interpreted and various inferences were made.

Development Stage of the Training Programme

Table 2. Units and learning outcomes table of the training programme

Preparation Stage of the Training Programme		
Unit	**Unit**	**Unit**
Intonation, Posture and Holding the Instrument	Violin Intonation	Knows the situations that affect intonation. Knows the effect of holding the violin on intonation.
	Posture and Holding the Instrument	Explain the importance of a correct and proper posture in violin playing. Follows violin holding rules. Follows bow-holding rules. Understands the importance of the left/right hand being comfortable while playing the violin.
Basic Elements of Playing the Violin	Right-Left Hand Skills in Violin Playing	Aware that left-hand finger pressure is a factor affecting sound quality. Holds the left palm of the left hand parallel to the fingerboard. Uses the whole bow while playing the violin. Positions the fingers of the left hand on the fingerboard and close to the strings. Presses the tip of the fingers, flexibly and softly against the strings. Knows how to adjust the pressure correctly in each part of the bow. Adjusts the bow angle correctly while playing double-stops technique. Adjusts the angle of the arm according to the height of the strings. In string shifts, does the transition by bringing the bow closer to the string. Aware of the importance of finger holding during shifting. Practice double-stops in all strings.
	Speed Skill in Playing the Violin	Knows how to adjust the location and length of the bow according to the speed. Keeps fingers close to the strings and makes smaller movements according to the speed.
Positions in Playing the Violin	III. Position in Violin	Knows the principles to be considered while shifting between positions (I-III). Is able to perform exercises in which there is a shift between the first and the third positions.

The Unit and Learning Outcomes Chart of the curriculum prepared within the scope of the research is shared in Table 2. In the training programme, sources of famous violin pedagogues such as Carl Flesch (1939), Ivan Galamian (1962), Leopold Auer (1921,1926), Pavel Bytovetzski (1917), and Yehudi Menuhin (1981) on the violin playing technique and posture-holding were utilised. In addition, the views of notable pedagogues and educators such as Ruggiero Ricci (Ricci & Zayia, 2007), Auguste Wilhelmj (Wilhelmj & Brown, 1898), William Primrose (Dalton, 2003), Edith Lynwood Winn (1905), Muhammedjan Turdiev (personal communications) and Ali Uçan (Özer, 2006) were also taken into consideration. In the selection of the etudes and exercises used in the training programme, as well as the determination of the strategies to be adopted in the study, violin pedagogue Dr. Muhammedjan Turdiev was consulted. In the programme design stage, five experts with a Ph.D., two of whom are specialised in training programmes and three in music education, were consulted. The lesson plans were prepared in line with Gagne's Model of Instructional Design.

Implementation Phase

The study took place in the spring term of the 2018-2019 academic year. The implementation phase lasted 13, and no developments undermining the study occurred. Before the implementation phase, individual lesson programmes were prepared for each student, and lessons were held for one hour each week.

In the first week of the implementation phase, the participants were informed about the factors and variables affecting intonation; afterward, the dimensions of violin intonation were discussed. It was stated that for good intonation, first and foremost, correct posture-holding is required, and for this, the whole body should be relaxed and upright, and the left arm and right arm should be extremely relaxed and free from tension. In addition, it is necessary to keep the left palm parallel to the touch and the fingers on the strings close to the touch; the left wrist should be free, the fingers of the left hand should press the strings with their natural weight, and therefore, the natural weight of the fingers should be discovered. After discussing violin pedagogues' opinions about the posture-holding and right- and left-hand techniques necessary for achieving good intonation, exercise no.1 from the Schradieck SVoT 1 was performed. The participants were asked to perform the work at a slow tempo, with the whole bow, and in octaves. The exercise done in order to reinforce the information explained in the first week was given as homework for the second week, when the whole Schradieck SVoT 1 no.1 exercise was performed.

In the third and fourth weeks, double-stop exercises started. The Schradieck SVoT no. 1 exercise was studied E string drone accompaniment.

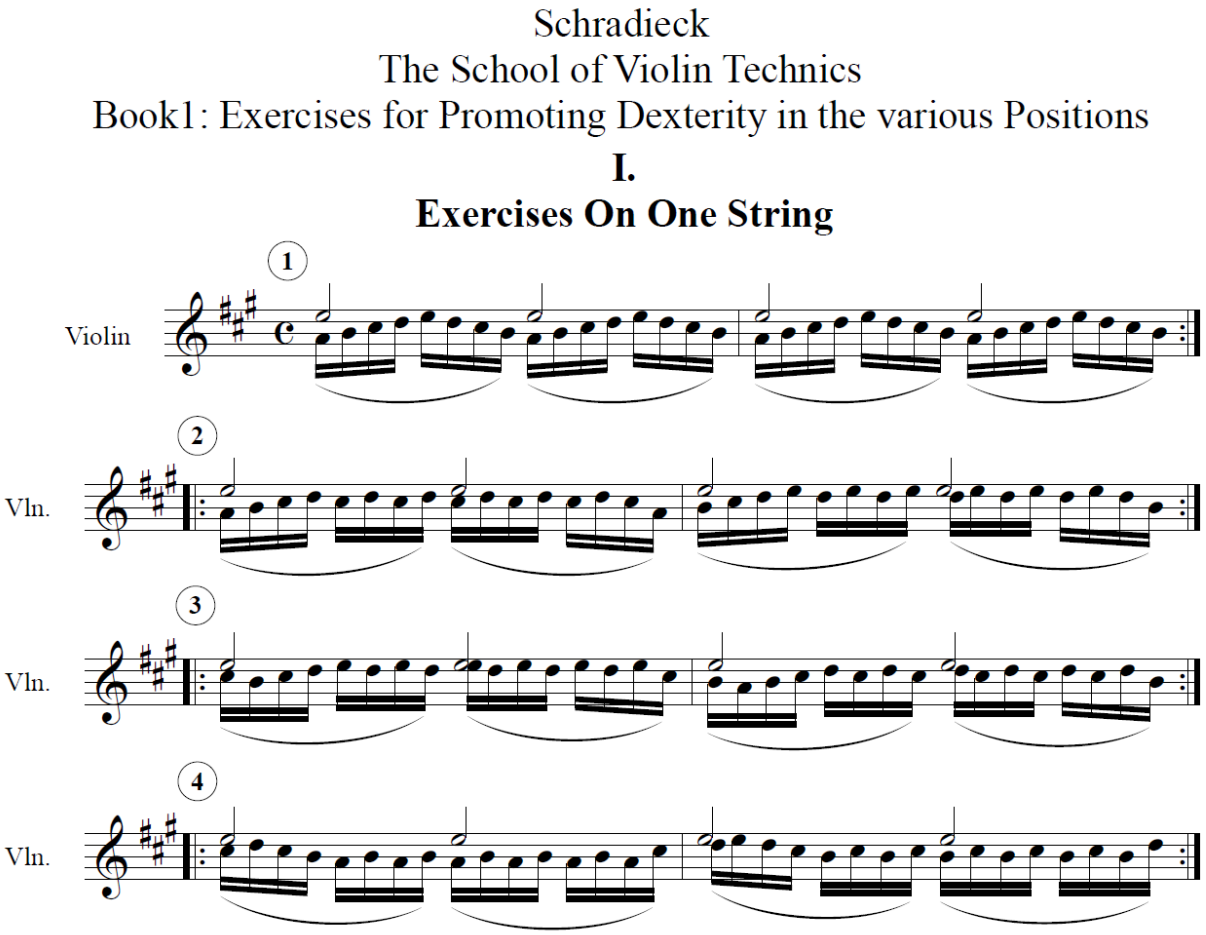

Figure 1. Schradieck SVoT 1 no.1 E-string drone accompaniment exercise

By emphasizing the importance of non-tension in any part of either arm, the participants were asked to press the strings vertically and with the natural weight of their fingers. When needed, the participants were reminded to set the bow angle correctly and use the entire bow. In weeks five and six, H. E. Kayser op.20 no.2 etudé and Schradieck SVoT no.2 were performed. During these weeks, attention was paid to the use of the entire bow, asymmetric use of the bow, keeping the fingers on the touch, correct adjustment of the angle of the arm in string shifts, finger extension, flexibility, comfort in the left hand, and intonation accuracy. Double-stop exercises also continued.

In weeks seven and eight, Schradieck SVoT no.1 was performed in each string with the open string drone accompaniment. These exercises were carried out to teach the participants to adjust the bow angle on all strings, foster intonation development through double-stop practices on all strings, and help participants adjust the finger pressure according to varying string thicknesses. Schradieck SVoT no.3 was performed in order to develop participants' skills of finger holding and bringing the bow close to the string during string switches, and Kayser Op.20 no.1 was performed in order to teach participants how to adjust the location and length of the bow in line with the tempo. In the ninth and tenth weeks, exercises began to be carried out for the development of speed skills. First, behaviours and mistakes that may prevent fast-playing were mentioned by making use of pedagogical resources and expert statements. Kayser Op.20 no.4 etude was deciphered and performed at a slow tempo in semiquavers and with detaché bowing. The participants were informed about what to do with their right and left hands at different speeds. The first six exercises from the Schradieck SVoT no.6 were performed in order to work on scales in all strings and develop the skills of finger holding and touch control during string shifts. Double-stop exercises continued in all string combinations.

In weeks eleven, twelve, and thirteen, the subject of playing the violin in the third position was covered. The participants were informed about types of shifting and points to consider during shifting, and afterward, Schradieck SVoT no. 10 was performed. Attention was paid to the necessity that the thumb is relaxed during shifting, that the hand should move as a whole, and that skipping or caesuras should be avoided during shifting. The Kayser Op.20 no.4 was continued to be performed to ensure participants' development in terms of speed, and a tempo range of 100-140 bpm was targeted, changing in line with the progress level of each student.

Results

Findings Obtained from the Comparison of Participants' Intonation Accuracy in the First Position Pretest-Posttest Scores

The results of the Wilcoxon Signed-Rank Test performed to answer the first sub-question of the study, 'Is there a significant difference between the participants' intonation accuracy in the first position pretest and posttest scores?', are given in Table 3.1.

Tablo 3.1. Wilcoxon Signed Rank Test Results for the solution of the first sub-problem

		N*	Mean Rank	Sum of Ranks	Z	p
Student I	**Negative Ranks**	125	113,33	14166,00		
Pretest-Posttest	**Positive Ranks**	87	96,69	8412,00	-3,220	,001
	Ties	11				
Student II	**Negative Ranks**	117	96,00	11232,50		
Pretest-Posttest	**Positive Ranks**	82	105,70	8667,50	-1,577	,115
	Ties	25				
Student III	**Negative Ranks**	134	107,90	14459,00		
Pretest-Posttest	**Positive Ranks**	71	93,75	6656,00	-4,590	,000
	Ties	18				
Student IV	**Negative Ranks**	99	109,94	10884,50		
Pretest-Posttest	**Positive Ranks**	103	93,38	9618,50	-,762	,446
	Ties	20				
Student V	**Negative Ranks**	119	105,65	12572,50		
Pretest-Posttest	**Positive Ranks**	81	92,93	7527,50	-3,081	,002
	Ties	24				
Student VI	**Negative Ranks**	114	108,68	12389,00		
Pretest-Posttest	**Positive Ranks**	91	95,89	8726,00	-2,156	,031
	Ties	18				

The analysis revealed a significant difference in favour of the intonation accuracy in the first position posttest scores of four out of six participants (Student I: $z= -3.220$; $p<0.05$, Student III: $z=-4.590$; $p<0.05$, Student V:$z=-3.081$; $p<0.05$, Student VI:$z=-2.156$; $p<0.05$).

Findings Obtained from the Comparison of Participants' Intonation Accuracy at Fast Tempos Position Pretest-Posttest Scores

The results of the Wilcoxon Signed-Rank Test performed to answer the second sub-question of the study, 'Is there a significant difference between the participants' intonation accuracy at fast tempos pretest and posttest scores?', are given in Table 3.2.

Tablo 3.2. Wilcoxon Signed Rank Test Results for the solution of the second sub-problem

		N*	Mean Rank	Sum of Ranks	Z	p
Student I	**Negative Ranks**	123	108,99	13405,50		
Pretest-Posttest	**Positive Ranks**	82	94,02	7709,50	-3,350	,001
	Ties	10				
Student II	**Negative Ranks**	131	104,73	13720,00		
Pretest-Posttest	**Positive Ranks**	83	111,87	9285,00	-2,447	,014
	Ties	8				
Student III	**Negative Ranks**	136	108,53	14760,50		
Pretest-Posttest	**Positive Ranks**	67	88,74	5945,50	-5,261	,000
	Ties	15				
Student IV	**Negative Ranks**	107	105,50	11288,50		
Pretest-Posttest	**Positive Ranks**	89	90,08	8017,50	-2,058	,040
	Ties	17				
Student V	**Negative Ranks**	131	111,74	14638,50		
Pretest-Posttest	**Positive Ranks**	82	99,42	8152,50	-3,603	,000
	Ties	9				
Student VI	**Negative Ranks**	94	108,22	10172,50		
Pretest-Posttest	**Positive Ranks**	110	97,61	10737,50	-,335	,738
	Ties	13				

The analysis revealed a significant difference in favour of the intonation accuracy at fast tempos posttest scores of five out of six students in the experimental group (Student I: $z=-3.350$; $p<0.05$; Student II: $z=-2.447$; $p<0.05$; Student III: $z=-5.261$; $p<0.05$; Student IV: $z=-2.058$; $p<0.05$ and Student V: $z=-3.603$; $p<0.05$); in other words, a significant decrease was observed in intonation errors of five out of six students in the study group. An increase was observed in the number of intonation errors made by Student VI, and no significant difference was found in favour of its posttest score.

Findings Obtained fromthe Comparison of Participants' Intonation Accuracy while Switching between the First and the Third Positions Pretest-Posttest Scores

The results of the Wilcoxon Signed-Rank Test performed to answer the third sub-question of the study, 'Is there a significant difference between the participants' intonation accuracy while switching between the first and the third positions pretest and posttest scores?', are given in Table 3.3.

Tablo 3.3. Wilcoxon Signed Rank Test Results for the solution of the third sub-problem

		N*	Mean Rank	Sum of Ranks	Z	p
Student I	**Negative Ranks**	161	136,74	22014,50		
Pretest-Posttest	**Positive Ranks**	99	120,36	11915,50	-4,162	,000
	Ties	17				
Student II	**Negative Ranks**	173	139,55	24142,50		
Pretest-Posttest	**Positive Ranks**	92	120,68	11102,50	-5,222	,000
	Ties	16				
Student III	**Negative Ranks**	154	143,38	22080,50		
Pretest-Posttest	**Positive Ranks**	105	110,38	11589,50	-4,349	,000
	Ties	23				
Student IV	**Negative Ranks**	143	134,08	19173,00		
Pretest-Posttest	**Positive Ranks**	113	121,44	13723,00	-2,300	,021
	Ties	22				
Student V	**Negative Ranks**	150	145,87	21881,00		
Pretest-Posttest	**Positive Ranks**	109	108,16	11789,00	-4,185	,000
	Ties	20				
Student VI	**Negative Ranks**	149	137,11	20430,00		
Pretest-Posttest	**Positive Ranks**	107	116,50	12466,00	-3,359	,001
	Ties	23				

The analysis revealed a significant difference in favour of the intonation accuracy while switching between the first and the third positions posttest (Student I: $z= -4.162$; $p<0.05$; Student II: $z= -5.222$; $p<0.05$; Student III: $z= -4.349$; $p<0.05$; Student IV: $z= -2,300$; $p<0.05$, Student V: $z= -4.185$, $p<0.05$, Student VI: $z= -3.359$; $p<0.05$).

Findings on Participants' Opinions Regarding the Training Programme

The qualitative data collected to answer the fourth sub-question of the study were analysed by the descriptive analysis method and analysed and interpreted in line with the identified themes.

1. Participants' opinions regarding the intonation problems and technical problem they had experienced before the training programme are given below:

   Student I: *'Before the study, I thought that I had serious violin intonation problems and many lecturers also emphasized this shortcoming of mine. I think one of the main reasons for my intonation problem was the hold; I would overpressure the violin touch and have difficulty in producing the same sound due to wrong finger placement. The other most important factor was spring control and spring pressure, I was exerting too much pressure on the bow and I was having trouble with the steady goings of the bow on the violin.'*

   Student II: *'Before participating in the study, I had experienced intonation problems in some cases and I believe it was because of wrong finger placement on the touch and certain technical errors.'*

Student III: *'Before participating in the study, I had had serious intonation problems due to lack of sufficient and regular exercises, as well as my indifference to my instrument.'*

Student IV: '*I had an intonation problem. I think it was because I would place my hand far from the touch and pull back my fingers from the touch right after I press the note. That's why I forgot where I placed my fingers and pressed different parts of the string each time.'*

Above are the opinions of four participants regarding the intonation problems they experienced before taking part in the study. The data obtained from the interview form showed that other students made similar remarks as well. All participants stated that they had intonation problems before participating in the study and that these problems were mainly due to technical and posture-hold problems.

2. The participants' views on the change in instrumental technique are shared below:

Student II: *'I learned how to hold the violin as if I am a beginner, and I changed my posture, which helped me avoid making similar errors. I had serious problems regarding finger placement on the touch and pressure, and these errors were the most important factors affecting my intonation... Another factor was the bow. The pressure I applied on the strings was inconsistent and I had difficulty in bowing straight.'*

Student III: *'At the beginning, the implementation phase was very challenging for me, because I found out that what I had thought was right was actually wrong.* I realized that my bowing was wrong and I would not keep my fingers close to the strings, which restricted my hand movements.'

Student IV: *'I was very challenged at the beginning, because I had to change the technique I had been using for 4 years and I had difficulty adjusting to the new right-hand-arm and left-hand-arm placement.'*

Student VI: *'Due to my old habits, the implementation phase where we went over posture and hold was fairly challenging.'*

The participants stated that posture-hold exercises at the beginning of the implementation phase were challenging for them. It was expected that the participants would have difficulties due to the changes in the technical habits to which they had been accustomed.

3. The participants' views on their individual achievements in the implementation phase are as below:

Student I: *'The implementation phase was as educative as it was fun. In this phase, I became aware of all the errors that I could or could not observe. The training contributed to me in various ways. Thanks to the exercises we performed, I started overcoming the problems I had related to finger positioning and pressure. The exercises and practices to a slow metronome helped me to start overcoming the problems I had related to pressure and straight bowing as well. I learned a lot of new information about the violin of which I can make use. I, as a prospective teacher, gained crucial experience about how to progress on a subject and what methods to follow.'*

Student II: *'When my bow hold and fingers' position on the touch changed, my intonation improved.'*

Student III: *'These studies greatly contributed to me. I began to realize that the sounds I produced were clearer, that my hands moved more freely, and that I did not get tired like I used to. With this realization, my desire to exercise increased and I was very eager to practice throughout the implementation phase. I was no longer tired of contracting my body, I could produce the sounds I wanted, and able to play my instrument correctly.'*

Student IV: *'The implementation phase contributed to me in terms of achieving tones, producing clearer sounds, playing softly in the G string, contracting myself less, getting tired less easily, the consistent usage of the bow and avoiding bow bounce while playing slowly, playing faster, avoiding finger contraction while playing fast, play trills for a long time without interruption and not contracting the right arm while doing so, extending my fingers easily, performing sounds and intervals correctly in the third position, better performing the work at hand as I do not focus on producing clear sounds, and the freedom to find original solutions to the problems I encounter.'*

Student V: *'Most of the intonation problems I had in the past were related to the fourth finger sounds, which very negatively affected how I performed a work or an etudé. I have realized that back then, when I had problems related to posture and hold, the sound I produced with the violin was closely related to how I played the instrument and I had to work very hard to fix my errors. The exercises and etudes we performed throughout the implementation phase allowed me to improve myself greatly in aspects I had problems with and to play the violin better.'*

Student VI: *'The implementation phase was challenging at the beginning as we went over our old habits regarding posture and hold. However, it got easier over time and I started to improve, especially in achieving clear sound. Playing the violin started to come easier to me every day. I learned to apply equal pressure on the bow while bowing.'*

The participants stated that the training programme had many contributions (such as improvement in left hand/finger posture, decrease in the hand/wrist tension and finger pressure, adjusting bow pressure and better bow command, gaining the habit of regular practice, etc.) in terms of violin playing technique and that these achievements improved to their competencies in many aspects such as intonation, command of the instrument, and right and left-hand techniques.

4. The criticisms of the participants regarding the implementation phase are as below:

Student III: *'I think one semester is not enough for such a study. It would have been much better if the study continued for two semesters.'*

Student V: *'The only point of criticism on my part was the under-utilization of participants'' capacities. For example, performing an etude in octaves instead of semiquavers. Apart from that, it can be said that the study duration was very short. In my opinion, I would benefit way more if the study had continued for two semesters (nine months).'*

The participants stated that they did not have any negative experiences during the implementation phase. Two participants stated that the programme would be more beneficial for them had it continued for two semesters.

Conclusion and Discussion

Discussion and Conclusion on Participants' Intonation Accuracy in the First Position

Factors that may lead to violin intonation problems can be grouped under the following:

1. Problems with posture-hold / incorrect positioning of the fingers of the left hand/incorrect right- and left-hand technique (Angı, Albuz, & Birer,2013; Auer, 1926; Balkan, 2020; Bytovetzski, 1917; Flesch, 1939; Galamian, 1962; Günay, 2006; Ha, 2015; Memedaliyev, 2003; Memedaliyev & Sarıkaya, 2007; Tamer, 2002; Winn, 1905)
2. Insufficient technical exercise (Balkan, 2020; Flesch, 1939; Galamian, 1962; Winn, 1905)
3. Hearing-related problems and weaknesses in the knowledge of harmony (Özer, 2006; Dalby, 1992; Flesch, 1939; Galamian, 1962; Günay, 2006; Miran, 2019; Ricci & Zayia, 2007; Tarkum, 2006; Özer, 2006)

It can be argued that the training programme carried out as a part of the study addresses the abovementioned aspects. At the beginning of the implementation phase, a lecture was given on violin posture-hold to help participants learn the correct instrument technique, and then, right- and left-hand technique exercises were done. The achievements of the training programme for the development of intonation skills are as follows:

1. Aware of the effect of violin hold on intonation
2. Understands the importance of the left/right hand being comfortable while playing the violin
3. Aware that left-hand finger pressure is a factor affecting sound quality
4. Holds the left palm of the left hand parallel to the touch
5. Positions the fingers of the left hand on the touch and close to the strings
6. Presses the tip of the fingers flexibly and softly against the strings
7. In string shifts, does the transition by bringing the bow closer to the string
8. Aware of the importance of finger holding during shifting
9. Knows how to adjust the pressure correctly in each part of the bow

The abovementioned achievements were found to be featured in the works of pedagogues and violin education researchers as technical habits affecting intonation accuracy, to which special attention should be paid. (Auer, 1926; Flesch, 1939; Galamian, 1962; Günay, 2006; Ha, 2015; Memedaliyev, 2003; Memedaliyev & Sarıkaya, 2007). After working on basic violin posture-hold skills at the beginning of the implementation phase, the subject of each session was selected in line with the achievement goals; then, exercises aimed at reinforcing participants' relevant technical habits or skills were performed. Both instructors and artists agree on the importance of doing regular technical exercises, as well as on the fact that the Schradieck exercises and Kayser etudes used in the training programme are helpful in developing technical skills, in addition to being extremely useful in the development of intonation (Auer, 1921; Arney, 2006; Aydın, 2019; Chang, 2014; Koptyova, 2014; Lehmann, 1901; Milstein & Volkov, 1990; Mitchell, 1994; Seitz, 2008; Winn, 1905,1913, 1916; Witter, 2015).

Also, many experts emphasize that regular double-stop exercises improve both right-hand and left-hand skills and that drone exercises contribute to improving hearing skills (Bytovetzski, 1917; Özer, 2006; Kurtaslan, Ergan, & Kutluk, 2012; Ricci & Zayia, 2007, Stowell, 1985; Özer, 2006).

The measurement tools (etudes and exercises) chosen to determine intonation errors were performed from easy to difficult. Accordingly, the easiest technical task was ‘accuracy of intonation in the first position,’ the subject of the first sub-question of the study. The second sub-question of the study is related to playing the violin at a fast tempo, and the third is related to position shifting. Upon examining the findings related to the second and third sub-questions of the study, a significant difference was found between the pretest and posttest scores of Students II and IV in favour of the latter, despite the increase in task difficulty, which suggests that these students are affected by uncontrollable variables (distraction, excitement, stress, and anxiety of success/failure). Considering that a violin player who cannot overcome intonation problems in the first position will be unsuccessful in playing the violin at a fast tempo or by shifting between positions, it is held that the said students (Students II and IV) have room for improvement. Consequently, it was found that the training programme carried out as a part of the study greatly contributed to the development of students' intonation skills. Both statistical analysis results and participants’ opinions about the implementation phase support this finding.

Discussion and Conclusion on Participants' Intonation Accuracy at Fast Tempos

It is scientifically proven that tempo is one of the factors affecting the accuracy of intonation (Fyk, 1995, as cited in Repp, 1997). The factors specified in the literature needed to play the violin comfortably at a fast tempo are as follows:

1. The comfort of the left hand (Auer, 1926; Bytovetzski, 1917; Courvoisier, 1908; Flesch, 1939; Galamian, 1962; Günay, 2006; Kapçak, 2008)
2. Keeping the fingers close to the touch and not lifting them unnecessarily (Auer, 1921; Büyükaksoy, 1997; Bytovetzski, 1917; Courvoisier, 1908; Dalton, 2003; Flesch, 1939; Galamian, 1962; Gün Duru, 2017; Günay, 2006; Menuhin, 1981)
3. Command of notes (Kapçak, 2008)
4. Correctly adjusting the location, height, and speed of the bow (ArkanSümer, 2016; Galamian, 1962; Kalender, Alpagut, & Yandı, 2016).

During the training programme, firstly, exercises were performed to teach the participants to keep their hands relaxed in order for them to have complete command of the violin while playing at a fast tempo. With these exercises, the correct posture-hold technique was taught, and it was aimed that the participants reduce to the best extent possible the tension in their hands and press the touch with the natural weight of the fingers. It can be said that the performance of the first exercise in Schradieck SVoT 1 with the double-stop technique was beneficial both for learning the correct left-hand posture and how to use the left hand freely. After covering how to relieve the tension in the left hand and keep the fingers close to the strings/touch, exercises were carried out to adjust the place and length of the bow according to the tempo. Kayser no. 1 and Kayser no. 4 etudes were used to this end. Other points taken into consideration in these exercises were finger holding during string shifts and preparing beforehand for the sound to be produced. The opinions of Carl Courvoisier (1908, p. 36), a notable violin pedagogue of his time, that *'Exaggerated and unnecessary finger movements should be avoided. In order to rapidly improve intonation accuracy and gain freedom of movement, no finger should be separated from the strings unless necessary, and the finger should be kept ready on the touch before the bow touches the string, wherever and whenever it is*.' and Bytovetzski's (1917, pp. 33-37) opinions that*'All unnecessary finger movements should be avoided; lifting the finger instead of holding it down causes a waste of both time and energy. The higher a student who has trouble playing at a fast tempo raises their fingers, the slower they will complete the movement. The closer the fingers are held against the strings, the faster the movement will be.'* showcase the importance of this aspect.

Analysis revealed that there is one participant whose pretest and posttest scores did not differ significantly. The reason why no significant decrease was observed in the intonation errors of Student VI is thought to be related to uncontrollable variables (excitement, stress, distraction) or that it was observed during the recording that Student VI could not sufficiently internalize the abovementioned technical habits. The participants' success in this study, which encompasses exercises aimed at helping participants learn the correct instrumental technique and improve their violin playing skills, is dependent on their devotion. Indeed, students did regular technical exercises throughout the implementation phase and worked to gain and later reinforce the relevant technical habits and skills. The significant decrease observed in the errors made by five out of six participants in intonation accuracy while playing at fast tempos and the positive feedback of the participants regarding the implementation phase suggest that the training programme was helpful in reducing participants' said errors. Taking into account the participants' varying levels of interest and disposition, as well as, exercise habits, it can be said that Student VI needs to practice more to reduce intonation errors at fast tempos.

Findings Obtained from Participants' Intonation Accuracy while Switching between the First and the Third Positions

According to experts, reasons for experiencing intonation problems while switching between positions can be listed as follows:

1. Problems with left-hand technique: Thumb clinging to the handle, thumb not being flexible and relaxed, tension in left hand, incorrect left-hand technique (Alan, 2014; Balkan, 2020; Flesch, 1939; Galamian, 1962; Gün Duru, 2017; Taş, 2019)
2. Problems related to insufficient technical exercise: Not recognizing the touch, not calculating the distance between the current and next sounds, and using a jumping motion instead of sliding (Auer, 1921; Galamian, 1962; Gün Duru, 2017; Ihas, 2015; Alan, 2014)
3. Timing errors (Galamian, 1962; Taş, 2019; Alan, 2014).

One of the fundamental aspects of shifting is that the left hand and thumb should be comfortable and not cling to the handle, and the shift should take place in a natural flow but without unnecessarily releasing the hand and breaking away from the handle. It is important to follow this pattern while shifting to prevent a contraction in the hand that will hinder the completion of the movement, or vice versa, from keeping the instrument too loose and becoming unable to maintain the command of the instrument. The second issue related to position switching is not knowing the position to which to be switched well enough and performing the switch without producing a glissando. This is related to students' lack of knowledge about shifting positions and insufficient exercise. In position switch exercises, the aim is to ensure the continuity of the music and prevent the production of unintended sounds. A tense hand and moving fingers around without knowing the next position will lead to the production of incorrect sounds and intonation errors, causing unintended timbres. Although there are varying opinions on glissando, all instructors and musicians agree that it is important to avoid any interruptions during switching positions and that (depending on the genre and period, usually) the glissando should be unnoticeable. It is thought that the opinion of some experts that 'the shift should be completed without sliding and the next sound should be produced directly' is based on this principle. Indeed, considering that music differs greatly by genre and period, it would be correct to avoid exact judgements and make grand generalizations. Finally, another problem related to position switch is considered to be related to timing errors. To avoid making such errors, it is recommended to familiarize with the work both in terms of notes and duration and overcome such problems by exercising with the help of a metronome.

In order to prevent technical problems that may cause intonation problems while switching positions and to prevent possible intonation errors, the training programme carried out as a part of the study was developed by taking into consideration expert suggestions. Accordingly, at the beginning of the programme, participants were informed on how to reduce tension in the left hand and to discover the natural weight of the hand; then, the exercises selected from Schradieck SoVT I were performed to reinforce the newly-gained knowledge. The participants were asked to maintain the relaxedness in the left hand and thumb gained with exercises performed in the first position during position switching exercises as well. Considering that the position switch cannot be performed and the violin cannot be played at a fast tempo with a tense hand, it can be argued that doing exercises at high tempos will increase the awareness of the students and indirectly help the hand to relax. Therefore, it is thought that the exercises aimed at improving the skill mentioned in the second sub-question of the study were beneficial for the participants.

The principles of position switch were explained based on examples from Galamian's (1962) book *Principles of the Violin & Teaching*; then, exercise 10 from Schradieck SoVT 1 was performed in order to reinforce the newly-gained information on position switch movements and get accustomed to playing the violin in the third position. It is thought that the said exercise is a beneficial one, encompassing finger extension in the third position, almost all sounds, and different rhythmic combinations and helping increase command of the touch and improve the skill of distinguishing sounds in the third position.

In conclusion, the training programme carried out as a part of the study was determined to cover the aspects of position switch mentioned in the literature that may lead to intonation errors, and it was found as a result of the analysis of the data collected throughout the study, all students showed improvement from pretest to posttest in terms of intonation accuracy while playing the violin while switching between the first and the third positions. The qualitative findings obtained from the interviews held at the end of the implementation phase also support this finding. Accordingly, it can be held that the training programme carried out as a part of this study was beneficial in reducing students' intonation errors while switching between the first and the third positions.

Discussion and Conclusion on Participants' Opinions on the Implementation Phase of the Study

All participants stated that before participating in the study, they had been experiencing posture-hold problems that caused intonation errors. They also stated that they overcame their posture-hold-related problems owing to the exercises performed during the implementation phase and that there was a decrease in the intonation errors they made. Learning how to play the violin is a taxing process. The prominent challenges faced during violin education are related to intonation and posture-hold. It is extremely important to overcome these problems in the education of the violin, which is a difficult instrument as it is fretless. Indeed, it is observed that students who do not have sufficient command over the violin and cannot play it as they desire, get alienated from the instrument over time. There are three dimensions of violin education. The first and the most important dimension is the willingness of the student (Topoğlu, 2010), the second is a good teaching programme, and the third is an attentive instructor who identifies problems and offers solutions (Çelikoğlu, 2019). All participants exhibited devotion to the programme; they regularly attended the sessions and completed all the assignments given throughout the implementation phase. In this respect, it can be said that the participants largely did their part. In the training programme carried out as a part of the study, the students were informed about the solutions to the problems they experienced through lectures, which were followed by posture-hold, violin playing, and intonation exercises to reinforce the theoretical information and enable the students to improve their skills. Finally, the challenges faced by the participants were carefully observed, and with regular exercises, participants were able to achieve success.

In conclusion, it can be said that the results of the quantitative stage of the study are consistent with the participants' opinions regarding the study and that the programme positively contributed to participants' intonation accuracy while playing the violin in the first position, at fast tempos, and switching between the first and the third positions.

Suggestions

1. Students with technical and intonation problems should first be instructed on the correct instrumental technique, and the problems faced by the students should be overcome through regular practice. The study has proven that with the right technique and regular practice, improvement can be achieved in many right-hand and left-hand skills, especially intonation.
2. The study can be carried out with an extended sample consisting of students from different Music Education Departments, Fine Arts High Schools, and Fine Arts Faculties.
3. The subject of intonation development is an overlooked area in Turkey, and there seem to be few experimental studies on the topic. In addition, the main focus of studies on intonation is observed to be the development of hearing skills. It is believed that there is a need for studies addressing the elimination of the technical deficiencies of students who experience problems related to the instrumental technique and that such studies will contribute to both domestic and international literature.

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