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Musical problem-solving skills of music education students: An evaluation on performance

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Abstract

This research was conducted to examine the musical problem-solving skills of music education students during the process of studying a new piece of music. The correlational survey model was used to determine the musical problem-solving level of the students and the relationship between problem definition and resolution levels. The criterion sampling method was used to determine the participants of the study (i.e., 14 flute students from the department of music education). To collect the data, an observation form consisting of definition, synthesis and analysis steps, selected by the researchers for the basic musical problems of musical instruments education, consisting of tonality, articulation, nuance, tempo, interval and rhythmic patterns content, was used by using the 'Bridge Model' developed by Adair. Observation took place in three steps. Problem identification was the first step in solving a musical problem, which was to detect the existence of the problem, and students identified all other problems except for the nuance. In the synthesis step, we determined which of the options the students used to solve the problem she or he defined. Instead of using specific solutions to the problems, the students mostly preferred the option of playing the piece from beginning to end. In the analysis step of the musical problem, while the students were playing the musical piece from beginning to end, the results of the problems studied for the solution were evaluated. It was determined that the students did not have any problems with the tonality and rhythm of the work, but had difficulties in the analysis of articulation, interval and nuance. In addition, it was determined that there was a positive significant relationship between the students' levels of defining and solving musical problems. According to the general results, students are able to define the problem, but cannot apply different approaches to how to solve the problem in the synthesis and solution stages. This research is limited to determine the situation of that based on individual practice performance on a single instrument. For this reason, future research can provide a detailed perspective on the cause of the problem by considering different instrument performances supported by student and teacher opinions.

Keywords: Instrument training, musical problem-solving, study process, problem-solving skills.

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1. Introduction

1.1. Conceptual and theoretical framework

It is seen that the concept of 'problem' is based on problem-solving skills, which is emphasised in all areas of education, and it is expressed in a consistent manner in the relevant literature. These definitions are the obstacles that a person faces in reaching the desired goal (Bingham, 1971, p. 7); a problem that is thrown in front of the individual and prevents the individual (Adair, 2000, p. 33); all real or abstract situations that need improvement (Stevens, 1998, p. 11); the difficulty faced by the individual (Çalık, 2003, p. 128); the difficulties that cause uncertainty that confuses the human mind and disturb the individual and needs to be solved (Duman, 2007, p. 384); and the situations that the organism cannot solve with the current reactions (Açıkgöz, 2016, p. 316). Although the problem is expressed with similar definitions, the problem-solving process may require some analysis steps specific to the nature of different disciplines (Yüksel, 2020, p. 164). According to Woolfolk (1993, as cited in Korkut, 2002, pp. 177–178), while some psychologists argue that effective problem-solving methods are specific to certain problem areas, another group argues that there are some general problem-solving skills that can be applied to many problem areas.

In musical instruments training, the preparation of the technical and musical behaviours that are expected to be reflected in the performance requires analysis first because an etude or piece is a complex musical problem that needs to be solved for the student. At this point, if students can acquire the habit of musical problem-solving, it may be possible to talk about musical behaviours that develop in integrity in the continuation of the process, and musicians who can manage time well for an effective performance. Researching self-regulated learning strategies in musical instruments studies, Nielsen (2001) recommends that students be taught the purpose of problem-solving activity and how strategy choices affect and limit behaviours. According to Sternberg and Kibelsbeck (2021), it is one thing to realise something is wrong and another to define what is wrong. At this point, students need to be self-directed learners who can recognise the problems they encounter in learning, then solve them, which also enables them to be serious problem finders (Csikszentmihalyi, 2013) and problem solvers (Sternberg & Funke, 2019 as cited in Sternberg and Kibelsbeck, 2021). Roesler (2017), in his research to determine the roles of teachers in the solution of musical and technical problems and to define the roles of students in the problem-solving process, determined that as the role of the teacher changes, the problem-solving components of the students also change. Roesler (2016) mentions five components defined as problem-solving behaviours in his research in which experts, who are famous music artists and also educators, observed problem solutions with video recordings: setting goals, evaluating goals, contemplating and considering options, applying principles and making decisions and taking action.

1.2. Related research

All Recently, research has shown that (making and learning music) performance and musical learning in music is an important creative process that includes multidimensional cognitive processes (Jonassen, 2000; Kennell, 2021; Roesler, 2016). According to Roesler (2016), research on problem-solving, which is an important skill in music, has rarely been directly addressed in music education and it is important to examine it systematically. When the current studies are examined, it is seen that the definition of musical problem-solving steps (Byo, 2004; Roesler, 2016; Sternberg & Kibelsbeck, 2021; Whitaker, 1996), the use of problem-solving skills in the process of composition (Berkley, 2004) and the cooperation of musical instruments groups, such as orchestra/chamber music, examine the ways of solving problems audibly (Slette, 2019), i.e., problem-solving theories of experienced artist

musicians (Lisboa et al., 2011), and examine the solution for musical problems with a constructivist approach (Broomhead, 2005; Scott, 2006), i.e., problem-solving strategies in composing music. Musical problem-solving skills are discussed in study areas such as the study of problem-solving in musical instruments study (McAdams, 2004), the examination of problem-solving and self-regulated learning strategies in musical instruments study (Nielsen, 2001) and the development of problem-solving skills in melodic improvisation (Abdullah et al., 2021). In addition, the problem-solving skills of music students are low (Güven, 2017; Küçük, 2012); problem-solving skills in music education do not differ according to gender (Çevik, 2011; Otacıoğlu, 2008); and the problem-solving skills of music students affect self-confidence and musical instruments success (Otacıoğlu, 2008); it has been investigated in various studies that there is no significant relationship between academic achievement in piano lessons and problem-solving skills (Güven, 2017) and that there is a high level of positive relationship between communication skills and problem-solving skills' sub-dimensions of music students (Küçük, 2012).

This study focuses on musical problems and musical problem-solving methods specific to the field of music because we can think of an effective musical performance as the solution of many musical problems that have come together. There are many studies that support this point of view. According to Roesler (2016, p. 39), problem-solving is a complex cognitive activity, and both musical performance and teaching involve the application of extremely complex skills that have become habits over years of practice. Playing a piece of music involves performing multiple difficult skills at the same time faster than the mind can consciously process. According to Sternberg and Kibelsbeck (2021, p. 10), the best learning in music is also a form of problem-solving. Learning to make/play music is an active and constructive process, not passive and rote-based. The fact that musical learning is also musical problem-solving and adopting a problem-solving approach will help to reveal not only good musicians, but also versatile problem solvers in all areas of life. Byo (2004, p. 37) emphasised that a successful educator should devote an important lecture or rehearsal time to teach students problem-solving and develop an assessment programme to improve teaching. These practices will encourage students to see priorities in both problem-solving and problem-solving processes. According to Lisboa et al. (2011, p. 517), although there are many different interpretations of technique in music, the practice is shaped by a general musical understanding from the first stages of learning. For this reason, the problem-solving theories of experienced artist musicians can be shaped differently. According to Slette (2019, p. 35), musicians of instrumental ensembles such as orchestras/chambers are constantly trying to improve their musical performance, they naturally focus on problem-solving.

1.3. Purpose of the study

Section This research is based on the idea that musical problem-solving skills are the basis of an effective instrument study process. The aim of vocational instrument education is to teach the student how to use his instrument skilfully. During their education, students try to perform much technical and musical behaviour together. The reflection of these behaviours on performance as a whole is possible with years of regular practice. In the nature of the working process of the students, it is decisive that they realise the musical problems they encounter and that they can use the working options suitable for the problem to solve it, i.e., they do exercises by focusing on their own musical problems. In other words, it may be possible to talk about an efficient study process for students who get down to the basis of musical problems and practice the right solution options.

To observe the musical problem-solving skills of the students during musical instruments studies and to reach objective results, it is necessary to make the musical problem-solving skills measurable. In this way, students can be directed to problem-solving-oriented work according to their deficiencies

and it will be possible to evaluate the change in students' musical problem-solving behaviours. This research presents an observation model in which students' musical problem-solving skills are evaluated during individual studies. For this reason, our research can contribute to the literature not only with the results of the research on musical problem-solving skills of students, but also on how musical problem-solving skills can be handled and observed in accordance with the theoretical steps in musical instruments education. While working on the instrument, students become self-learning individuals by defining their own musical problems and determining appropriate solution options. At this point, the guidance of the educators is required. The educator can create awareness for the solution of musical problems. For this, the teacher can determine which problems the students experience during the instrument study process and how they try to solve them and direct them to different solution options.

The general problem of the research is to examine the level of students' use of musical problem-solving skills in the musical instruments study process: 'What is the level of students' use of musical problem-solving skills in the musical instruments study process?'. An answer to this general problem was sought with the following research questions:

1-What is the level of students' identification of musical problems in the musical instruments study process?

2-Which solution options do the students use for musical problems during the musical instruments study process?

3-What is the level of students' solving musical problems in the musical instruments study process?

4-Is there a significant relationship between the students' levels of defining and solving musical problems in the musical instruments study process?

2. Method

2.1. Research model

Footnotes In the research, the relational survey model was used to determine the level of using problem-solving skills of the students of music education department and to determine the relationship between the levels of defining and solving the problem. Data collection methods such as questionnaires, observations and interviews are used in surveys conducted in survey models, in which opinions, behaviours and attitudes about phenomena and events are discussed (Karakaya, 2014, pp. 59–60).

2.2. Participants

The criterion sampling method was used to determine the participants in the study. In criterion sampling (Yıldırım & Şimşek, 2021, p. 120), which is based on studying cases that meet a set of predetermined criteria, criteria can be created by the researcher. The first criterion in determining the participants is to have a background of at least 4 years of musical instruments education in order to observe the musical problem-solving skills of the students within the framework of the musical problems determined in the research. With this criterion, it has been tried to ensure that students have previously acquired musical knowledge and skills at a level where they can reflect their musical problem-solving skills. Another criterion is that the students must be flutists, since the etudes that the participants will study during the musical instruments study process are selected from the flute education repertoire. Participants were formed with the voluntary participation of 14 flute students who were studying at Necmettin Erbakan University Music Teaching Programme in Turkey and who

met the determined criteria. Considering the educational level and musical background of the participants, the musical problems expected to be solved in the research were limited to musical problems related to tonality, tempo, rhythmic patterns, interval, nuance and articulation.

2.3. Data collection

To collect data in the research, firstly, an observation form was needed to observe the ability to solve musical problems in musical instruments education. Models for problem-solving skills were examined and it was decided to use the 'Bridge Model' which was prepared by Adair (2000) among the problem-solving models by utilising a problem-solving-based conceptual musical instruments teaching activity (Yüksel, 2020) in which the 'bridge model' steps were used in the relevant literature. The observation form consists of three steps: definition, synthesis (utilising appropriate solution options for the problem) and analysis, as in the bridge model. The musical problems that were expected to be defined, synthesised and solved during the musical instruments study were chosen by the researchers from among the basic musical problems of musical instruments education: tonality, articulation, nuance, tempo, interval and rhythmic patterns. For the synthesis step of the observation form, the solution options that could solve each musical problem were listed, and the opinions of the experts who worked as musical instruments trainers in the department where the students were present were taken for possible suggestions apart from the solution options determined by the researchers. Thus, content validity was provided for the observation form. The musical problem-solving steps in the observation form, which was finalised with corrections and additions, are shown in Figure 1.

Defining Musical Problems	**Synthesis (Using Appropriate Solution Options) Example for Tonality Problem**	**Solving Musical Problems**
• Defining tonality • Defining articulations • Defining nuance terms • Defining the tempo • Defining intervals • Defining rhythmic patterns	• Trying to analyse by repetition of passages on the etude. • Trying to analyse by studying the scale or arpeggio related to the etude. • Analysis by playing nearest notes in the tone of the etude. • Trying to analyse the etude by playing it from beginning to end.	• Resolving tonality • Analysing articulations • Analysing nuance terms • Analysing the tempo • Analysing intervals • Analysing rhythmic patterns

Figure 1
Observation Steps of Musical Problem-Solving

In Figure 1, the observation steps of the musical problem-solving skill of the research are highlighted in dark colours. The steps of defining and analysing information are listed in the light-coloured sections. The synthesis step shows possible solution options. Since the space is limited in the figure, only the solution options for tonality are given as an example in the synthesis step. Solution options for other problems are reported in detail in the findings section. One of the researchers is also the musical instruments teacher, who determines the etudes that the participants will practice for the first time during the observation, in accordance with their level. While the students were working on the determined etudes (1 hour), their permission was taken and an observation recording was made without intervention. Each musical problem handled by watching the recordings was evaluated by two field experts, one of whom was the instructor of the course, on a 5-point Likert-type scale (never, a little, partially, mostly and completely). In general, the measures taken for the validity and reliability of the research are to define the measurement tool in detail, to consult expert opinions, to measure the

observation steps by more than one researcher, to explain the stages of the research clearly, to present the findings in tabular form and to calculate the reliability coefficient.

2.4. Data analysis

In the analysis of the data obtained by using the observation form in the research, it was first checked whether the data showed a normal distribution (Table 1), and the level of agreement between the two observers was calculated using Kendall's coefficient of fit (W) (Table 2). The criteria in the definition, synthesis and analysis steps for problem-solving were tabulated with percentage and frequency distributions using descriptive statistics, and the relationship between the definition and analysis phases was examined. Cronbach's alpha coefficient obtained from the observation form was found to be 0.74 overall, 0.70 for the dimensions, 0.71 for the synthesis step and 0.76 for the analysis step.

Table 1

Normality Test for Problem-Solving

	n	*x*	ss	Kolmogorov–Smirnov *Z*
Defining	14	3.7024	0.59261	0.679
Analysis	14	3.2024	0.79308	0.997

$p < 0.05$.

Pearson’s correlation analysis was used to measure the relationship between these steps, as the distribution was normal in the definition and resolution steps for problem-solving.

Table 2

Interobserver Kendall’s W Coefficient of Agreement

Defining	Expert 1	14	3.7024	0.59261
	Expert 2	14	3.5714	0.59387
	Kendall’s *W* = 0.832		*p* = 0.000	
Analysis	Expert 1	14	3.2024	0.79308
	Expert 2	14	3.1696	0.73806
	Kendall *W* = 0.911		*p* = 0.000	

$p < 0.01$.

Since it was determined that there was a high level of agreement in the definition and analysis steps ($p < 0.01$) of reliability among the observers, the analysis was performed by calculating the data of one researcher from the observers.

3. Results

3.1. Students' level of defining musical problems in the musical instruments study process

Table 3

Distribution of Students' Level of Definition of Musical Problems

Identified musical problems	Never	A little	Partially	Mostly	Completely	Total

	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Tonality	-	-	-	-	-	-	-	-	**14**	**100**	14	100
Articulation	-	-	1	7.1	1	7.1	**8**	**57.1**	4	28.6	14	100
Nuance	**13**	**92.9**	-	-	-	1	7.1	-	-	-	14	100
Tempo	-	-	5	35.7	1	7.1	1	7.1	**7**	**50.0**	14	100
Interval	1	7.1	2	14.3	1	7.1	3	21.4	**7**	**50.0**	14	100
Rhythmic pattern	-	-	2	14.3	1	7.1	1	7.1	**10**	**71.4**	14	100

When the level of definition of musical problems was examined, it was determined that all of the students defined the problem of tonality of the piece. The majority (71.4%) defined rhythmic pattern problems and half of the students (50.0%) completely defined the problems related to intervals and tempo of the piece. It was revealed that 57.1% of the students mostly and 28.6% completely defined the problems related to articulation. It was determined that the students were not sufficient in defining the problem about nuance. In line with this result, it can be said that at the level of defining the problem, the students did not have any problem with tonality, and more than half of the students did not have any difficulty with rhythmic pattern, interval and tempo. On the other hand, it can be said that the students could not define the problem at all in terms of nuance.

Table 4
Distribution of Students' Use of Different Problem-Solving Options

Musical problems	Problem solution options	Never		A little		Partially		Mostly		Completely	
		f	%	*f*	%	*f*	%	*f*	%	*f*	%
Tonality	Trying to analyse by repeating passages on the etude.	3	21.4	5	35.7	2	14.3	3	21.4	1	7.1
	Trying to analyse by studying the scale or arpeggio related to the etude.	**9**	**64.3**	2	14.3	1	7.1	2	14.3	-	-
	Analysis by playing nearest notes in the tone of the etude.	**12**	**85.7**	-	-	1	7.1	1	7.1	-	-
	Trying to analyse by playing the etude from beginning to end.	1	7.1	-	-	3	21.4	2	14.3	**8**	**57.1**
Articulation	Trying to analyse by repeating passages on the etude.	3	21.4	**6**	**42.9**	3	21.4	1	7.1	1	7.1
	Trying to resolve by repeating them on the scale or arpeggio.	**11**	**78.6**	2	14.3	1	7.1	-	-	-	-
	Trying to analyse by playing the etude from beginning to end.	1	7.1	2	14.3	-	-	2	14.3	**9**	**64.3**
Nuance	Trying to analyse by repeating passages that have nuances in the etude.	**12**	**85.7**	1	7.1	-	-	1	7.1	-	-

	Trying to analyse the nuances in the etude by repeating them on the independent scales or arpeggios.	**14**	**100**	-	-	-	-	-	-	-	-
	Trying to analyse the nuances in the etude by studying on long notes.	**14**	**100**	-	-	-	-	-	-	-	-
	Trying to analyse by playing the etude from beginning to end.	**9**	**64.3**	2	14.3	3	21.4	-	-	-	-
Tempo	Trying to analyse the problem by repeating passages with a metronome.	**8**	**57.1**	2	14.3	2	14.3	1	7.1	1	7.1
	Trying to analyse the problem by speeding up through altering articulations.	**14**	**100**	-	-	-	-	-	-	-	-
	Trying to analyse by playing the etude from beginning to end.	-	-	2	14.3	1	7.1	3	21.4	**8**	**57.1**
Interval	Trying to analyse the problem by repeating passages that have wide intervals.	4	28.6	4	28.6	3	21.4	3	21.4	-	-
	Trying to analyse the problem by repeating wide intervals in the etude.	**12**	**85.7**	1	7.1	1	7.1	-	-	-	-
	Trying to analyse the problem by playing the etude from beginning to end.	-	-	1	7.1	1	7.1	1	7.1	**11**	**78.6**
Rhythmic pattern	Trying to analyse the problem by reading note rhythms without their pitch (Bona).	**7**	**50.0**	4	28.6	2	14.3	1	7.1	-	-
	Trying to analyse the problem by repeating passages.	1	7.1	**7**	**50.0**	1	7.1	5	35.7	-	-
	Trying to analyse the problem by playing the etude from beginning to end.	1	7.1	1	7.1	-	-	3	21.4	**9**	**64.3**

When the level of using different problem-solving options of the students was examined, it was determined that the students preferred to use the option of trying to solve the etude by playing it from the beginning to the end (57.1%) completely in the tonality problem. However, it was determined that the distribution of the students was dispersed in using the option of trying to analyse the etude by repetition of the passage, and they did not prefer to use the options of analysing the etude by studying nearest notes in the tone (85.7%) and solving by studying the scale or arpeggios related to the etude (64.3%).

Considering the use of problem-solving options for articulation, it was determined that students mostly used the option of trying to solve the etude by playing it from beginning to end (64.3%), while they did not prefer to use the option of solving the study by repeating the passage on the etude and solving the articulations by repeating it on the scale or arpeggio (78.6%).

In the nuance-oriented problems, it was determined that students did not prefer to use to analyse the passages in which the nuances occur on the etude by repetition (85.7%), analyse the nuances in the etude by repeating them on independent scales or arpeggios (100%), analyse the nuances in the etude by working on long notes (100%) and analyse the etude from beginning to end by playing (64.3%). The results show that students cannot use nuance-oriented problem-solving options.

When the problem-solving options for tempo were examined, it was found that all of the students (100%) never used the option of solving faster by altering the articulation, and 57.1% of them mostly did not use the option of solving the problem by repeating the passage with a metronome. It was revealed that 57.1% of the students mostly preferred the solution problem-solving option by playing the etude from beginning to end.

According to the problem-solving options on interval, it was determined that the majority of students (78.6%) used the option of trying to solve the etude by playing it from beginning to end, while the majority of the students (85.7%) did not use the option of solving by repeating the wide intervals in the etude. On the other hand, it was determined that 28% of the students never used the option of trying to solve the problem by repeating the passages with intervals, 28% used it very little, 21% partially and 21% mostly. It can be said that the problem-solving option used by the students about interval is mostly playing the piece from beginning to end.

When the problem-solving options for rhythmic patterns are examined, it is seen that half of the students (50%) never used the solution of rhythmic patterns by reading note rhythms without their pitch, while the other half used it very little and partially. It was determined that half of the students used the option of trying to solve the rhythmic patterns by passage repetition very little. It was determined that the majority of students (64%) preferred the option of trying to solve the rhythmic patterns problems by playing the study from beginning to end.

In general, when the level of students' use of musical problem-solving options in the synthesis step for problem-solving is evaluated, it can be said that the option of solving musical problems by playing the etude from beginning to end is often preferred in many problems. The students repeated the same solution option for almost all musical problems and did not turn to other solution options that vary according to the musical problem.

3.2. Students' level of solving musical problems in the musical instruments study process

Table 5

Distribution of Students' Level of Solving Musical Problems

Musical problems solved	Never		A little		Partially		Mostly		Completely		Total	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Tonality	-	-	-	-	3	21.4	-	-	**11**	**78.6**	14	100
Articulation	-	-	3	21.4	**5**	**35.7**	4	28.6	2	14.3	14	100
Nuance	**13**	**92.9**	-	-	-	-	-	-	1	7.1	14	100
Tempo	3	21.4	4	28.6	3	21.4	1	7.1	3	21.4	14	100
Interval	-	-	4	28.6	3	21.4	4	28.6	3	21.4	14	100
Rhythmic patterns	-	-	4	28.6	2	14.3	1	7.1	**7**	**50.0**	14	100

When the level of resolution of musical problems was examined, it was found that 78.6% of the students completely solved the problems related to tonality in the etude, half (50%) of the students solved the problems completely and the other half did very little and partially. In addition, it was revealed that the majority of students could not analyse the nuances in the etude. On the other hand, 21.4% of the students could solve the problems related to articulation very little, 35.7% partially, 28.6% mostly and 14.3% completely. 21.4% of the students could not solve the tempo-related problems at all, 28.6% very little, 21.4% partially and 21.4% completely. According to the general

result, it can be said that during the problem-solving phase, the students did not have any problems with tonality and rhythmic patterns, and more than half of them could solve partially or above in articulation and interval. On the other hand, it can be said that students have more difficulties in solving problems in tempo and they cannot solve problems in nuance.

3.3. Students' level of solving musical problems in the musical instruments study process

Table 6
Relationship Between the Levels of Students Defining and Solving the Problem in the Musical Instrument Study Process

		Defining the problem
Solving the problem	Pearson's correlation	0.706*
	Sig. (2-tailed)	0.005
	n	14

* Correlation is significant at the 0.01 level (2-tailed).

When the relationship between the level of problem identification and resolution of the students in the musical instruments study process was examined, it was found that there was a significant positive relationship. In this direction, it can be said that as the level of the problem definition of the students increases, the level of analysis will also increase.

4. Conclusion

In this study, the problem-solving skills of the students while playing a piece on their instruments were examined in terms of definition, synthesis and analysis. In addition, the relationship between the steps of defining the problem and solving it was also investigated. It was observed that the students were able to define their problems related to tonality, articulation, rhythm, interval and tempo. For example, a student who accidentally plays the natural note instead of F sharp in the key G major or a student who cannot play dotted notes can describe his/her own problem. The students could not only describe their problems related to nuance in the piece. Considering that the step of defining the problem is the first step in solving a musical problem, which is to detect the existence of the problem, it becomes important for students to be able to define the problems. In this direction, it is a pleasing result that the students' problem definition levels are good.

In the synthesis step of the musical problem, the options the students used to solve the defined problem were determined. At this stage, students were expected to study immature musical passages in sections. While studying these parts, the musical problems that we determined before could be studied in integrity in each repetition they would do. For example, they could try to optimise it by repeating the four measures that should be played crescendo with the F sharp dotted note in the key G major. This was also the shortest and guaranteed option, but they did not prefer the solution by studying nearest notes in the tone of the etude and the analysis by studying the scale or arpeggio related to the etude. It was revealed that most of the students in articulation used the option of trying to analyse the etude by playing it from the beginning to the end, but they did not prefer the options of analysing the articulation by repeating the passage on the etude and analysing the related articulations by repeating them on the scale or the arpeggio. It was determined that in the problems related to nuance, all of the students did not prefer to analyse the nuances in the etude by repeating them on independent scales or arpeggios and to analyse the nuances in the etude by working on long notes. This result shows that students could not use any of the nuance-oriented problem-solving options.

It has been revealed that the majority of the students use the option of analysing the etude by playing it from beginning to end. On the other hand, it was determined that all of the students did not prefer to use the option of solving the problem by speeding up by altering the articulation, and more than half of the students did not prefer to use the option of solving the problem by repeating the passage with a metronome. It was determined that the majority of the students for the interval topic used the option of trying to analyse the etude by playing it from beginning to end, but never used the option of resolving the wide intervals in the etude. It is seen that the problem-solving option used by the students about interval is mostly playing the piece from beginning to end. In solving the problems related to rhythmic patterns, it was determined that the majority of the students used the option of trying to solve the study by playing it from beginning to end, whereas half of the students did not use the options of solving the rhythmic patterns by reading bona and solving the rhythmic patterns by repeating the passages, or they used it very little. The results obtained in the synthesis step showed that students prefer to use other options less to solve musical problems.

In the analysis step of the musical problem, the results of the problems that were defined and tried to be solved by synthesis were evaluated. It was determined that the majority of students solved the problems related to tonality completely, half of them solved the problems completely and the other half solved the problems very little and partially. It has been revealed that the majority of the students have never been able to analyse the nuances in the study in nuance-related problems. It can be said that at the stage of solving the musical problem, the students did not have any problems with tonality and rhythmic patterns, and more than half of them were able to solve partially or above the articulation and interval. On the other hand, it is seen that the students have more difficulties in solving problems in tempo, and students cannot solve problems in nuance. In general, in using the problem-solving steps, the students did not have any problems in the definition step, but when the level of using musical problem-solving options in the synthesis step for problem-solving was evaluated, it was seen that they had problems in nuance, tempo, articulation and arpeggio, and in solving musical problems, the option of solving the etude by playing the etude from beginning to end was often preferred in many problems.

When the relationship between the students' levels of defining and solving musical problems in the musical instruments study process was examined, it was found that there was a significant positive relationship. In this direction, it can be said that the higher the problem definition level of the students, the higher the level of analysis. When the definition and analysis steps are examined, it is seen that the majority of the students for tonality can define and solve, they are at a slightly lower level in solving musical problems related to rhythmic patterns, interval, tempo and articulation, but they have difficulties in both defining and solving musical problems for nuance. In line with this result, it can be said that the musical problems defined by the students by using different solution options will contribute positively to the analysis step of their studies.

5. Discussion

In this study, which was carried out to determine the level of students' use of musical problem-solving skills in musical instruments education and to determine the relationship between problem definition and resolution levels, problem-solving skills were examined in terms of problem definition, synthesis and analysis. It is thought that the steps of defining the problem, synthesis and analysis in the students' performance study process will help them in understanding problem-solving skills. When the existing studies on the definition of musical problem-solving steps (Byo, 2004; Roesler, 2016; Sternberg & Kibelsbeck, 2021; Whitaker, 1996) are examined, it is seen that although the dimensions are various, they have a similar structure. For example, in the field of music, Whitaker (1996) defined a

theoretical model of musical problem-solving and decision-making by performers, arrangers, conductors and composers; Sternberg and Kibelsbeck (2021) analysed the steps of problem-solving in music by structuring them. These steps are defining the problem, allocating resources to solving the problem, mentally representing the problem, creating a strategy for solving the problem, monitoring the problem-solving and evaluating the solution after a solution has been made. Roesler (2016), on the other hand, mentions five components defined as problem-solving behaviours: setting goals, evaluating goals, designing and considering options, applying principles, and making decisions and taking action. It is seen that the model definitions for musical problem-solving skills are in parallel with the musical definition, synthesis and analysis steps of this research. In all of these models, the definition of the problem suitable for the general structure of problem-solving, the examination and evaluation of the problem and the solution steps formed the general framework.

In line with the general results, it was observed that the students were able to define the problem while playing a piece on their instruments, but it was difficult to think of musical problems with different solution options during the synthesis stage. This has been a difficulty in solving the problem they encountered in the nuance, tempo, articulation and arpeggio studies in the analysis step. Because the students focused on the option of playing the piece from beginning to end during the synthesis stage and because they did not use different problem-solving options, they lost time and could not solve the musical problem they encountered. Similarly, Güven (2017) stated that the problem-solving skills of music students are low; the most common problems students encounter are technical problems and problems related to tempo. He also stated that he had no problem in defining the problem, but had difficulties in solving it, by expressing the problems they encountered during the piano practice. Again, Yazıcı (2014) stated that instructors cannot use problem-solving skills in defining and solving problems faced by students in beginner piano teaching. In parallel with similar research results, it is considered important for students not only to define the problem, but also to think and analyse the solution steps, to determine suitable solution strategies and to apply the solution steps for the healthy functioning of the process in musical instruments education.

Although the general literature defines the steps of musical problem-solving, no research has been found on application in instrument performance. The closest research examining problem-solving skills in music was made by Roosler (2016, p. 28). The researcher recorded the music lessons with six famous artist teachers and observed their problem-solving behaviours. As a result, it revealed identifiable teacher behaviours that precede students' problem-solving: In particular, teachers demonstrated feedback and directions by asking questions, setting principles, showing contrasting options and deliberately avoiding answering questions.

The students repeated the same solution option for almost all musical problems and did not turn to other solution options that vary according to the musical problem. At this point, considering that problem-solving skills are a whole, it cannot be said that they can fully use their problem-solving skills. However, studies such as using different strategies in solving musical problems, for example, studying the problematic passage with different articulations, slowing down the tempo and solving only the passage that is difficult, working with different rhythmic patterns of the passage, taking transitions to different nuances or special works in the passages of the work and taking special studies with different tonality and arpeggio exercises will help prevent time loss in the process of working from start to finish. According to Scott (2006, p. 19), problem-solving with a deep approach encourages students to consider multiple solutions and alternative approaches and also lets students know when to seek help. In this way, the student can integrate the features of melody, rhythm, harmony and expression while

analysing a piece of music. The solution options in the problem synthesis step used in this research and their use were evaluated for the flute instrument, which is within the research limitation.

The results of the research found a significant relationship between the definition and analysis steps of problem-solving skills. In this direction, it can be said that the higher the problem definition level of the students, the higher the level of analysis. In parallel, Nielsen (1999, p. 275) stated that musicians focusing on different and individual ways of working by separating the components of the work they are working on while practicing can contribute to our understanding of how musicians learn. Roesler (2016) proposes that teachers and students can become more successful problem solvers through components of a whole model in which musical problem-solving ways can be explored, analysed and evaluated. According to Scott (2006, p. 19), students need the freedom to define and develop their own musical problems to decide which musical qualities they will need and which methods to apply in their search for musical meaning to solve their problems. Since problem-solving skills will enable students to become self-directed learners who can recognise the problems they encounter in learning, and then solve them (Sternberg & Kibelsbeck, 2021), it is considered important that students gain problem-solving skills.

6. Recommendations

This research was carried out by observing students' individual study performances with the flute instrument within certain musical elements. The general literature has given a more comprehensive definition of musical behaviours, but it has been observed that research on the results of instrument performance or self-study practice is limited. Since the performance behaviours observed in the research are not supported by students and teachers' opinions on the reason for these choices, it is not possible to make an in-depth interpretation of the cause-and-effect relationship. As such, the results of the research remain undetermined. However, musical criteria such as tonality, rhythmic patterns, articulation, tempo, interval and nuance in the content of this research were limited considering the students' levels. Considering the limitations of this research, it is recommended that future researchers consider and compare different variables in future studies. It is possible that different analysis strategies will emerge in different instruments in the stages of definition, synthesis and analysis, which are the steps of musical problem-solving. For this reason, it is recommended for the future research to develop special study strategies according to student levels by considering both the diversification of musical variables and the problem-solving options specific to different instruments.

Examining constructivism, which is a problem-solving approach to effectively shape performance in music, Broomhead (2005) argued that students need regular and continuous problem-solving opportunities and responsibility to understand musical concepts correctly. Educators have a great responsibility to gain musical problem-solving skills. In this direction, educators are an important guide for students to gain the skills to think, analyse these approaches, to make inferences about the solution of the problem by applying them to their musical instruments in practice and to present alternative approaches.

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