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Piyano eğitiminde haptik eldivenin etkililiği

The effectiveness of the haptic glove for piano education

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ÖZ

Eğitim teknolojisi öğrenme süreçlerinde önemli bir rol oynamakta bilişsel, duyuşsal, psikomotor alanlar için öğretmenlerin ihtiyaç duydukları ortam, uygulama ve materyalleri sağlamaktadır. Haptik teknolojiler, özellikle psikomotor öğrenme alanında önemli olanaklar sunmaktadır. Bu araştırmayla, piyano çalmayı yeni öğrenenler için günlük etkinlikler sırasında pasif haptik öğrenme yoluyla dokunsal arayüz entegre edilmiş bir eldivenin piyano eğitimi için etkililiğinin sınanması amaçlanmıştır. Bu amaç doğrultusunda sağ elde kullanılan ve öğrenene birim zamanda tek nota tuşlanacak şekilde titreşimler yollayan bir eldiven kullanılmıştır. Araştırma kapsamında nitel ve nicel yöntemlerin bir arada kullanıldığı zenginleştirilmiş desen kullanılmıştır. Öğrencilerin notaları ve nota sürelerini doğru çalabilme ve doğru parmaklarla çalabilme gibi becerilerini karşılaştırmak amacıyla eşit – zaman örneklemli model kullanılmıştır. Bununla birlikte nitel yöntemde ise öğrenciler ile sürece yönelik görüşmeler yapılmıştır. Görüşmeler ve uygulama süreci video kayıtları ile gerçekleştirilmiştir. Çalışmaya Bilgisayar ve Öğretim Teknolojileri Eğitimi (BÖTE) ve Müzik Eğitimi bölümünden öğrenciler gönüllü olarak katılmıştır. Çalışmanın sonucunda katılımcıların notaları doğru çalabilme ve doğru parmaklarla çalabilme gibi ölçütlerine göre haptik eldiven veya piyano ile uygulama arasında bir farklılık bulunamamıştır. Ancak, eldivenin piyano çalmadan önce parmakları açmada iyi bir alıştırma aracı ve parmak açıcı olabileceği ve parmak numaralarının daha iyi kavranmasında yardımcı olabileceği ve görüşlere göre eldivenin öğrenmeyi kolaylaştırma, zamandan tasarruf etme, çalışmalara yardımcı olma ve verilen süreden daha kısa sürede şarkıyı çözme gibi etkilerinin olduğu belirlenmiştir.

*Anahtar Sözcükler***:** insan bilgisayar etkileşimi, haptik öğrenme, haptik eldiven, piyano eğitimi

ABSTRACT

Educational technology plays an important role in learning processes; provides the environment, practice and materials that teachers need for cognitive, affective, and psychomotor areas. Haptic technologies offer significant opportunities especially in the field of psychomotor learning. With this research, it is aimed to explore the effectiveness of a haptic glove for piano education. A haptic glove was used in the right hand and vibrations were sent to the learner. Within the scope of the study, an enriched pattern was used which combined both qualitative and quantitative methods. In order to compare the skills of the students such as playing the notes correctly and with correct fingers, an equal-time sample model was used. In the qualitative method, however, process focused interviews were conducted with the students. The interviews and the implementation process were carried out with video recordings. Students from the Department of Computer Education and Instructional Technology and Music Education participated in the study voluntarily. According to the results of the study, there was no difference between the implementation of haptic glove or piano with respect to the criteria such as playing the notes correctly and playing with the correct fingers. However, it was determined that the glove could be a good exercise tool and finger opener for opening the fingers before the piano playing and could help to better understand the finger numbers and according to opinions haptic glove had effects such as facilitating learning, saving time, assisting with studies and solving the song in less than the given time.

*Keywords***:** human-computer interface, haptic learning, haptic gloves, piano education

INTRODUCTION

Today, where student-centered learning environments gain importance, the main task of the teacher is to prepare the learning environment depending on the learning objectives, to plan the activities and to guide the students in this process. Learning objectives are examined in three classes: cognitive domain, affective domain and psychomotor domain. While cognitive domain includes the mental activities of the student; affective domain includes characteristics such as feelings and attitudes. Psychomotor domain includes processes related to physical learning. Educational technology plays an important role in this process, providing the environment, practice and materials that teachers need for mental, affective, and psychomotor domains. One of the most recent examples of these applications, haptics, offers significant opportunities, especially in the field of psychomotor learning.

Learning a new motor skill requires a gradual learning process and practice is involved at its centre. The student repeats the skill through trial and error; the repetition process continues until they perform the behaviour without help and automatically. At this point, haptic technologies come into play. Haptic technologies enable the student to continuously make repetitions and to put forth muscle memory. Thus, it facilitates the learning process. Rodríguez et al. (2019) stated that tactile technologies have played an important role in human-computer interaction in the last 20 years. They found that kinaesthetic sensations such as the forces and movements perceived by the muscles, tendons and joints of tactile interaction empower and enhance the user.

Researches show that the vast majority of people perform learning as kinaesthetic or tactile and that this way they understand and remember better (Ashimori & Igarashi, 2017; Ashimori & Igarashi, 2018a; Ashimori & Igarashi, 2018b; Grindlay, 2008; Huang et al., 2010; Rodríguez et al.,2019; Zhang, Li, Chin & Xia, 2019). Haptic technologies open the door to a different learning method for people who learn in this way. One of them is instrument training. For example, new learners of piano can accelerate their learning processes through passive haptic learning and through tactile interface integrated gloves. Grindlay (2008) and Zhang et al. (2019) have observed that tactile technologies improve musical motor learning, beneficial to motor learning, and that tactile technologies are promising with applied prototypes.

According to El Saddik, Orozco, Eid and Cha (2011), haptic or haptic technology allows physical interaction in real or virtual environments through touch. Haptic interfaces (devices) can be used effectively by providing vibrotactile feedback in learning a skill or task that requires hand-eye coordination. In this way, the perception of touch is added to the learning environment and more perception is mobilized and the learning level is expected to increase.

Haptic learning offers two learning opportunities as active and passive. Individuals effectively participate in the learning process in active haptic learning and they are provided with instant feedback through their senses, and receive stimuli in the during the learning process. In passive haptic learning, while individuals learn a psychomotor skill with touch, they are allowed to do a completely different job such as reading books, watching television, and so on (Huang, Do, & Starner, 2008). Passive haptic learning can be used to train motor skills using repetitive tactile stimuli, even if individuals are distracted by other tasks (Aveni, Seim, & Starner, 2019). Passive haptic learning is used to develop students' motor skills without focusing on learning with the help of tactile interface stimuli (Seim, Estes, & Starner, 2015; Seim et al., 2014).

Related Works

Studies have shown that tactile technologies are used in areas such as sculpture, geographical systems, anthropology, physics and concept learning, and have an important and positive effect on students' success as well as motivation, courage, autonomy and learning quality (Civelek, Uçar, Üstünel, &, Aydın, 2014). In addition, it has shown that it provides tactile feedback to the user (Barfield, 2010) by increasing the reality of the simulations.

Passive haptic learning has been used in many domains in educational studies such as text entry (Seim, Reynolds-Haertle, Srinivas, & Starner, 2016), skin-reading (Luzhnica, Veas, & Seim, 2018), braille input (Nicolau, Guerreiro, Guerreiro, & Carriço, 2013; Seim et al., 2014), morse code (Pescara, Polly, Schankin, & Beigl, 2019; Seim et al., 2016). The results show that passive haptic applications are effective in learning morse code more effectively (Seim, Reynolds-Haertle, Srinivas, & Starner, 2016), presenting them as an alternative to active learning on skin reading (Luzhnica, Veas, & Seim, 2018), and recognizing the Braille alphabet. It is seen that haptics also take place in the field of music education, helping students to learn instruments such as piano, and allowing them to practice (Hsiao, Li, Yan, & Do, 2015; Huang et al., 2008; Huang et al., 2010; Jain, 2011; Kohlsdorf & Starner, 2010; Meneses, 2014; Seim et al., 2015).

Learning an instrument is often a complex, difficult and time-consuming process. In order to specialize in a musical work, it must be memorized by repeating it regularly. This process requires numerous application times (Takegawa, Terada, & Tsukamoto, 2012; Xia, Jacobsen, Chen, Yang, & Dannenberg, 2018). According to Huanhuan (2009), in many studies, it was found that students spend a lot of time and effort while practicing their works. Tactile (haptic) interfaces are very effective and useful technology for an individual to learn the instrument. Practicing individuals can learn the movements in the work clearly and directly, not from partitions or sounds. Therefore, learning performance movements directly can help them adapt and play faster, especially for beginners without prior knowledge of music (Zhang et al., 2019).

In the light of this information, haptic technologies especially passive haptic learning technologies open a different learning method for people learning this way. One of them is piano education. For example; new learners of piano playing can accelerate their learning processes through passive haptic learning, through tactile interface integrated gloves (Seim et al., 2015).

Learning to play an instrument is a long and challenging process for beginners. Hallam (1997) recommends regular repetition of the new instrument in order to automate the development of students' cognitive, auditory and technical skills. Similarly, many researchers argue that the passages in the work should be repeated until the dominance is gained for the learning of the passages (Akkuş, 2000; Ercan, 2006; Jain, 2011; Meneses, 2014). In fact, some researchers have determined that musicians use their strategies in the first place during the instrument practices (Aydıner Uygun & Kılınçer, 2018; Bircan, 2018; Kılınçer, 2013; Kılınçer & Aydıner Uygun, 2017). However, in Huang et al. (2008), the repetition process is not limited to the first stage of learning; it also states that it should continue on for the maintenance of the gained information. This situation is time consuming for students. However, practicing is perceived as boring for the student (Akkuş, 2000) and unconscious repetitions along with irregular exercises bring students face to face with certain problems (Kılınçer, 2013). In addition, it can be said that the students' sitting on the piano for a long time during the process causes the exhaustion of muscles of hands and arms and the many hours spent in the study room affects the learning negatively. In this case, Huang et al. (2008) draw attention to passive haptic learning, indicating that individuals who are exposed to passive information in rich learning environments learn more.

In addition, Hsiao et al. (2015) emphasized that students' imitation of the teacher in the process of piano learning is effective in visual and auditory perceptions but that there is no improvement in the perceptions of touch. The researchers used a fingerless glove in their application to detect students' finger strokes. With the vibrations placed on the glove, the teacher's keystrokes were tried to be transferred. As a result of a short application, the students on the accuracy level achieved positive results over 90% with one finger and 85% with double fingers. According to Meneses (2014), a student who uses haptic technologies in piano learning will be able to recognize basic skills such as correct finger usage, the duration of the notes and the ability to play the notes correctly in the work he/she will study. By repeating the work, it can provide a certain ease of play. Repeating the notes of the work visually in mind without touching the instrument can lead to practice through passive haptic learning. Similarly, Baumann and Grinstein (2008) found that the use of haptic technology when playing the piano has positive effects such as playing according to the number of measurements, playing with the correct

sounds, playing according to the rhythmic structure, playing according to finger numbers, playing according to the tempo, and following the technical requirements of the work. Grindlay (2007) also benefited from the haptic system in piano education and determined that the system could be effective in teaching motor skills.

Table 1
Related Studies About Haptics

Authors	Application field
Seim et al., (2016)	A rhythmbased text entry system, can be learned through Passive Haptic Learning using the bone conduction transducer on Google Glass
Luzhnica et al., (2018)	The skill of comprehending text from vibrotactile patterns
Nicolau et al., (2013)	A vibrotactile reading device that leverages the users' Braille knowledge to read textual information
Seim et al. (2016)	A system for Passive Haptic Learning of typing skills
Pescara et al., (2019)	Passive Haptic Learning for teaching Morse code without active attention.
Hsiao et al., (2015)	An instrumented fingerless glove called Tactile Teacher to detect finger taps on hard surfaces.
Huang et al. (2008)	PianoTouch, a wearable, wireless haptic piano instruction system
Huang et al. (2010)	Mobile Music Touch (MMT), to play piano melodies while performing other tasks.
Jain (2011)	Mobile Music Touch (MMT), a lightweight, wireless, haptic music instruction system consisting of fingerless gloves and a bluetooth-enabled mobile computing device.
Kohlsdorf and Starner (2010)	Mobile Music Touch (MMT), the finger corresponding to the appropriate piano key is stimulated.
Seim et al. (2015)	Teaching piano pieces on both hands simultaneously
Xia et al., (2018)	The correct fingering sequence after learning a piece of music haptically with synchronized audio playback.
Huanhuan (2009)	Violin education with tactile feedback
Zhang et al. (2019)	An adaptive haptic interface based on the haptic flüte
Baumann and Grinstein (2008)	Piano education with haptic system
Grindlay (2007)	Piano education with haptic system

As can be seen in the literature (Table 1), studying and learning instrumental music is a tedious, demanding and time-consuming process. In case of not working systematically and consciously, it causes physical problems as well as the process to become boring for the students. In addition, the process results in failure as no sufficient results of the study are achieved. In view of these problems, this study aims to explore the effectiveness of a haptic glove for piano education. In response to this general objective, the following questions were sought:

1. What are the levels of prospective teachers who practice on a piano of being able to play the notes correctly, to play the notes durations correctly and to play with the correct fingers?
2. What are the levels of prospective teachers who practice with haptic gloves of being able to play the notes durations correctly, to play the note periods correctly and to play with the correct fingers?
3. Is there a significant difference between the prospective teachers who practice on a piano and those who practice with haptic gloves in the levels of playing the notes correctly, playing the note durations correctly and playing with the correct fingers?
4. What are the opinions of prospective teachers practicing with haptic gloves on the overall process?

MATERIALS AND METHODS

Research Model

Within the scope of the study, an enriched pattern was used which combined both qualitative and quantitative methods. In this design, researchers use both quantitative and qualitative data simultaneously (Büyüköztürk et al., 2011). In order to compare the skills of the students such as playing the notes correctly and with correct fingers, an equal-time sample model was used. In this model, we work with only one random group. The same group is used as experiment and control group in an order determined by equal time intervals and neutral selection (Karasar, 2007). In the qualitative method, however, process focused interviews were conducted with the students. The interviews and the implementation process were carried out with video recordings.

Participants

Equal-time sampling model was used in the study and therefore a single group application was performed. The same participants were included in the experimental and control groups at a time determined by equal time intervals and neutral selection. Students from the Department of Computer Education and Instructional Technology (CEIT) and Music Education participated in the study voluntarily.

Table 2
Distribution of Prospective Teachers by Demographic Characteristics

Participant No	High School of Graduation	Department	Class	Sex	Knowledge of Notes	Instrument Experience
1	Anatolian	CEIT	1	Male	Yes	No
2	General	CEIT	1	Male	No	No
3	Technical	CEIT	3	Female	No	No
4	Technical	CEIT	3	Female	No	No
5	Anatolian	Music Education	1	Female	Yes (10 months)	No
6	Anatolian	Music Education	1	Male	Yes (6 years)	Piano
7	Fine Arts	Music Education	1	Female	Yes (4 years)	Oud
8	Anatolian	Music Education	1	Female	Yes (10months)	Piano
9	General	Music Education	1	Male	No	No
10	Fine Arts	Music Education	1	Female	Yes (4 years)	Violin
11	Anatolian	Music Education	1	Male	Yes	Oud
12	General	Music Education	1	Male	No	No
13	Fine Arts	Music Education	1	Male	Yes (2 years)	Side-Blown Flute

Table 2 shows the demographic information of the participants; five participants from Anatolian High School, three participants from the General High School and three participants from Fine Arts High School, two participants are seen to have graduated from the Technical High School. The participants' departments are composed of CEIT and Music Education; 11 participants are in their first year and two are in the third year. Seven of the participants were male and six were female. When their previous knowledge on notes is examined, it is seen that eight participants have knowledge about the subject and two participants have piano experience. All of the participants are right-handed.

Data Collection Tools

The participants in the experimental group used haptic gloves during the application process where as the participants in the control group performed piano applications for the song. At the end of the process, face to face interviews were held with the students. In order to increase the reliability of both the application and the interviews and to re-analyse by different researchers, the process has been recorded in the video. Then the video recordings were transferred onto the text.

This research was conducted to measure the effect of haptic glove use on the right hand in learning to play songs on the piano. For this reason, only piano songs that require the use of the right hand were chosen in the study. In these selected songs, both the rhythmic structure of the song, the ease of playing, and the melodic structure that sounds easier and more understandable to the ear were considered appropriate. In addition, while determining the songs, attention was paid to a note range (C-D-E-F-G) that includes the active use of the five fingers of the right hand. Thus, it was thought that the continuous and active use of each finger would be beneficial in terms of demonstrating the effectiveness of the haptic glove and bringing the learner to a better level.

The haptic glove

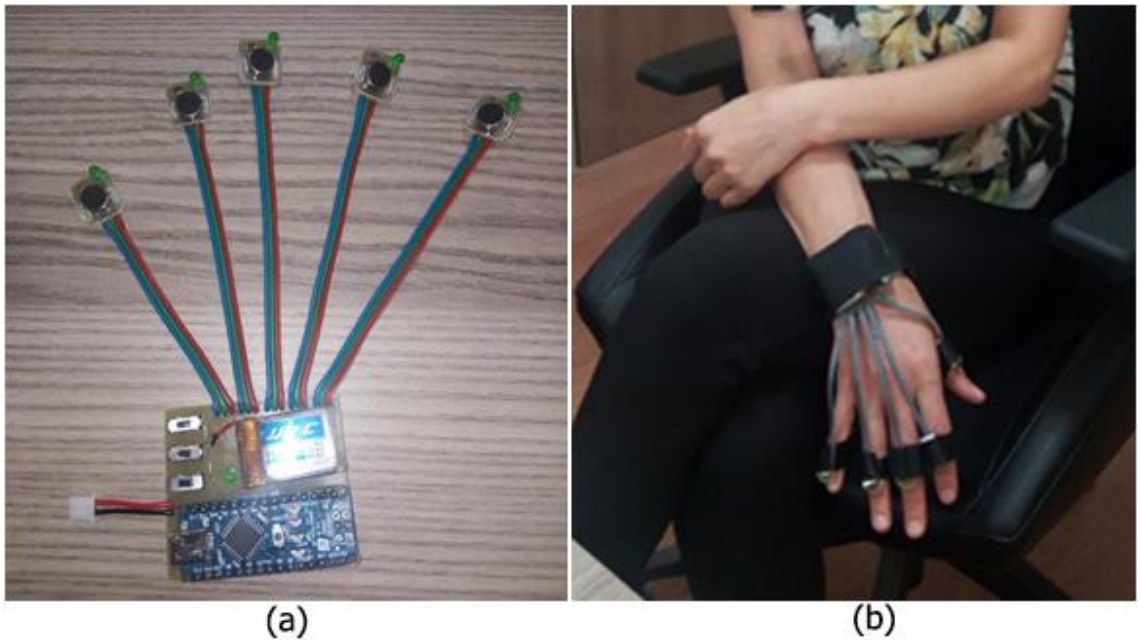
It is aimed to make the piano learning process easier with the haptic glove and to practice without the need for a piano during routine activities. In this respect, a haptic glove was developed by using the ADDIE design model, inspired by the study of Mobile Music Touch (Huang et al., 2010). The following paragraphs describe the development stages of the haptic glove, and the differences and improvements of the glove developed according to the glove that developed by Huang et al. (2010).

In the first phase of the development process, vibration motors, an Arduino Uno card and a power unit were added to each finger of the right hand in the haptic glove. Vibration motors are programmed on Arduino Uno circuit board with the help of Arduino IDE software. Fitness (sports) gloves were used in order to keep the fingers moving freely. 9V battery is installed on the glove as an electronic circuit and power supply.

After the development of the product, an evaluation geared towards the design was done with the participation of students from the department of music and other departments. According to Nielsen (2012), five users are sufficient even in cases where there are many users of a product, many features, and different user types. In the first evaluation of the study, the opinion of 22 people, 12 of which were in the twelfth evaluation process, were included. Arrangements were made in line with the opinions obtained from the first evaluation, and then the glove was finalized by making evaluations and arrangements with the second group. Using the Arduino Nano circuit board instead of the Arduino Uno circuit board can be given as an example to the studies of increasing the power of the vibration motors and the use of LED (Light Emitting Diode) indicators (Figure 1). Unlike other studies (Huang et al., 2008; Luzhnica et al., 2018; Nicolau et al., 2013), vibration motors are not connected to the third knuckle of the fingers but to the first knuckle. Because it was reported that vibrations felt better in the first knuckle, according to the participants' opinions. The process for developing the glove is detailed in a different study (Pala & Mıhcı Türker, 2019).

As can be seen in Figure 1 (a), the haptic glove is built using the Arduino Nano circuit board and works with a vibration motor mounted on the circuit for each finger by getting its energy from an integrated power source. In Figure 1 (b), the main part of the haptic glove coded with the Arduino IDE software is fixed on the right wrist, and the vibration motors are fixed on the corresponding fingers. The notes of each piano songs are applied by activating the vibration motors fixed on the relevant finger according to the length, durations and order of the notes

Figure 1
a) Haptic Glove Circuit, b) The imlemantation of haptic glove



Data Analysis

Participants have worked on the following songs: "Küçük Ayşe, Küçük Asker (22 notes)", "Süt İçtim (29 notes)" and "Maçka Yolları (29 notes)". At the end of the study, participants from both groups were asked to play the songs on the piano and the process was recorded on video. The video recordings were followed by the researcher working in the Department of Music and Performing Arts and their ratios of being able to play the notes correctly, to play the notes durations correctly and to play with the correct fingers were analysed. In order to compare the differences among the groups on their abilities to play the notes correctly, play the note durations correctly and to play with the correct fingers, the Wilcoxon Signed Ranks Test was used.

The data obtained from the interviews with the participants were analysed in a similar way by using the video records and descriptive analysis was used from the qualitative analysis methods. The data obtained were coded by two researchers and the agreement between the experts was calculated using the formula: Consensus / (Consensus + Disagreement) x 100 proposed by Huberman and Miles (1994). In all analyses, it was determined that the reliability levels of experts were above 70% (Yıldırım & Şimşek, 2006).

The Implementation Process

As in the study there was a single piano, participants were randomly divided into two groups before starting to practice. In the first week, the first group was the experimental group, the second group was the control group, and in the second week the first group was the control group and the second group was the experimental group. Songs consist of the following: "Küçük Ayşe, Küçük Asker" (22 notes), "Süt İçtim" (29 notes) and "Maçka Yolları" (29 notes). Different songs were given to the participants in glove application and piano applications, so that the song learned in one application did not affect the other application. The songs were selected by the faculty member of the Department of Music and Performing Arts with similar difficulty. The participants in the experimental group worked with the help of haptic glove and the control group with piano application. The notes of the music were applied to the participants' fingers for 45 to 60 minutes with the help of vibrations during the time of the experiment group's use of haptic gloves. In this process, participants were asked to deal with routine activities.

Participants were asked every 10 minutes if they had any discomfort in hands. Afterwards, the participants were asked to play the piece on the piano with the help of a haptic glove.

In the control group, one of the three songs was chosen randomly and they were asked to repeat the piano application. They were then asked to play the repeating songs on the piano. After the application, the experimental group's opinions on the haptic glove were asked and a discussion was held on this subject. Each participant's performances were recorded on video. Data analysis of these recorded videos was described in data analysis section. How the implementation process of the study was executed is given in Table 3.

Table 3
The Implementation Process of the Study

	Week 1		Week 2	
Haptic Glove (Experiment) Piano (Control)	Group 1 Group 2	Measurements	Group 2 Group 1	Measurements

Research Ethics

In the whole process from the planning of this research to its implementation, from the collection of data to its analysis, all the regulations specified in the "Ethics Directive of Higher Education Institutions Scientific Research and Publication" were followed. No action contrary to the specifications under the second part of the heading "Actions Contrary to Scientific Research and Publication Ethics" was taken.

Scientific, ethical and citation rules were followed in the writing process of this study; the participants officially agreed to participate in the current study, no modifications were made on the collected data and this study was not sent to any other academic publication medium for evaluation.

Research ethics committee approval information

Name of the committee that made the ethical evaluation: Aksaray University, Human Research Ethics Committee

Date of ethical review decision: 16.06.2017

Ethics assessment document issue number: 2017/73

FINDINGS

What are the Levels of Prospective Teachers of Being Able to Play the Notes Correctly, to Play the Note Durations Correctly and to Play with the Correct Fingers?

In the study, 13 prospective teachers were used as experimental and control groups in an order determined by equal time intervals and neutral selection. Accordingly, in the process for the control group, prospective teachers performed on the piano and played the track and the data were analysed with video recordings. The descriptive analysis of the data is given in Table 4.

Table 4
Descriptive Analysis of the Performances of Prospective Teachers Practicing Piano

Participant No	Piano Songs		Playing Notes Correctly		Playing Note Durations Correctly		Playing with the Correct Fingers		Knowledge of Notes	Knowledge of Piano
	Song	Note No	N	%	N	%	N	%		
1	Maçka Yolları	29	0	0	0	0	21	72	Yes	Yes
2	Maçka Yolları	29	29	100	29	100	0	0	Yes	Yes
3	Süt içtim	29	29	100	29	100	29	100	Yes	Yes
4	Süt içtim	29	29	100	29	100	29	100	Yes	Yes
5	Küçük Ayşe, Küçük Asker	22	22	100	12	55	22	100	No	No
6	Süt içtim	29	29	100	29	100	0	0	Yes	Yes
7	Maçka Yolları	29	29	100	29	100	0	0	Yes	No
8	Küçük Ayşe, Küçük Asker	22	22	100	22	100	22	100	Yes	No
9	Maçka Yolları	29	29	100	29	100	29	100	Yes	Yes
10	Maçka Yolları	29	0	0	0	0	0	0	No	No
11	Süt içtim	29	0	0	0	0	0	0	No	No
12	Küçük Ayşe Küçük Asker	22	0	0	0	0	0	0	No	No
13	Süt içtim	29	0	0	0	0	0	0	No	No

When the data about the teacher candidates who practice with piano are examined, it is seen that six prospective teachers had knowledge of both notes and piano and that two prospective teachers had knowledge of notes only. According to this, it is seen that the ratio of being able to play the notes and note durations correctly and to play with the correct fingers is 100% for the three prospective teachers who have both notes and piano knowledge. On the other hand, it is seen that for the prospective teacher candidates with no knowledge of notes nor piano, the ratio of being able to play the notes correctly, play the note durations correctly and play with the correct fingers is 0%.

What are the Levels, of Prospective Teachers Who Practiced with a Haptic Glove, of Being Able to Play the Notes Correctly, to Play the Note Durations Correctly and to Play with the Correct Fingers?

Accordingly, in the process for the experimental group, haptic gloves were programmed according to the notes of the song given to the teacher candidates' hands and vibration was given to their fingers according to the notes. While the haptic glove was on the hand of the participants (during the implementation), they were informed that they can do other works such as drinking, eating, writing, reading or texting. They were then asked to play the song on the piano and the data were analysed by video recordings. The descriptive analysis of the data is given in Table 5.

Table 5
Descriptive Analysis of the Performance of Prospective Teachers Performing with Haptic Gloves

Participant No	Piano Song		Playing Notes Correctly		Playing Note Durations Correctly		Playing with the Correct Fingers		Knowledge of Notes	Knowledge of Piano
	Song	Notes No	N	%	N	%	N	%		
1	Küçük Ayşe, Küçük Asker	22	4	18	2	9	6	27	Yes	Yes
2	Küçük Ayşe, Küçük Asker	22	22	100	22	100	22	100	Yes	Yes
3	Küçük Ayşe, Küçük Asker	22	18	82	13	59	18	82	Yes	Yes
4	Küçük Ayşe, Küçük Asker	22	13	59	10	45	10	45	Yes	Yes
5	Süt içtim	29	29	100	29	100	29	100	No	No
6	Maçka Yolları	29	29	100	29	100	29	100	Yes	Yes
7	Küçük Ayşe, Küçük Asker	22	0	0	17	77	22	100	Yes	No
8	Maçka Yolları	29	29	100	29	100	29	100	Yes	No
9	Süt içtim	29	10	34	10	34	10	34	Yes	Yes
10	Küçük Ayşe, Küçük Asker	22	10	45	10	45	10	45	No	No
11	Küçük Ayşe, Küçük Asker	22	5	23	4	18	5	23	No	No
12	Maçka Yolları	29	25	86	25	86	25	86	No	No
13	Küçük Ayşe Küçük Asker	22	0	0	0	0	0	0	No	No

When the data for the prospective teachers who practiced with the piano were examined, it is seen that six prospective teachers have both notation knowledge and piano knowledge, and two prospective teachers have only notation knowledge. According to this, in terms of being able to play the notes correctly, to play the notes durations correctly and to play with the correct fingers, the ratio is 100% between two prospective teachers with knowledge of notes and piano, a prospective teacher with only knowledge of notes and a prospective teacher with neither knowledge. On the other hand, for the prospective teachers with neither knowledge, it is seen that the ratio of being able to play notes correctly, to play the time durations correctly, and to play with the correct fingers differed between 0% to 86% with the application of haptic gloves. When Table 4 and Table 5 are examined, it is seen that the values of participant 13 to play the notes correctly and to play the note durations correctly are 0. However, since the data for the participant were included in the analyzes in the Wilcoxon Signed Rank Test and in the analysis of the opinions, it was deemed appropriate to include them here in the analyzes of playing the notes correctly and playing the note durations correctly.

Is There a Significant Difference Between the Levels of Playing the Notes Correctly, Playing the Notes Durations Correctly and Playing with the Correct Fingers for the Prospective Teachers Who Practiced the Piano with Haptic Gloves?

In the study, 13 prospective teachers repeated the pieces with haptic gloves and piano for an average of 45 - 60 minutes. After the application, the participants were asked to play the given song on the piano. The result of the analysis for the participants to play the work correctly is given in Table 6.

Table 6 shows the results of the Wilcoxon Signed Rank Tests conducted to test whether there is a significant difference between the scores of the prospective teachers applying haptic gloves and piano with respect to their ability to play the notes correctly, to play the note durations correctly and to play with the correct fingers. There was no significant difference between the

prospective teachers' scores obtained from haptic gloves and piano applications (p > .05). So, there is no difference between haptic glove or piano application according to the participants' ability to play the notes correctly, play the note durations correctly and play with the correct fingers.

Table 6
Analysis Results of Prospective Teachers of Playing the Notes Correctly

	Group	N	Average	Total	Z	P
Playing the Notes Correctly	Glove	8	6.25	50.00	-.315	0.753
	Piano	5	8.20	41.00		
	Total	13				
Playing the Note Durations Correctly	Glove	7	6.57	46.00	-.035	0.972
	Piano	6	7.50	45.00		
	Total	13				
Playing with the Correct Fingers	Glove	7	6.86	48.00	-.175	0.861
	Piano	6	7.17	43.00		
	Total	13				

What are the Opinions of Prospective Teachers Practicing with the Haptic Glove on the Overall Process?

13 prospective teachers, who continued their daily routines during the implementation, were asked every 10 minutes whether there was an inconvenience in their hands and the process was monitored with video. After the implementation, interviews were made with prospective teachers and the findings are given in Table 7.

Table 7
The Opinions of Prospective Teachers on the Haptic Glove

Themes	Opinion	f
Benefits	Eases learning of piano (P6, P9, P12)	3
	Saves time (P3, P4)	2
	Is very important for practice studies (P8,	2
	Facilitates learning of piano for older ages (P4)	1
	If applied at night, we'll be able to play the piano in the morning (P8)	1
	Can be good for finger exercises (P8)	1
	Can be used for all instruments (P8)	1
	Is beneficial for easy pieces. (P7)	1
	Total	12
Physical State	There was numbing in my hand (P2, P6, P13)	3
	As if a massage is being done. (P1, P8)	2
	My hands sweated (P1)	1
	I had problems in using fingers (P2)	1
	My hands felt cold due to immobility (P6)	1
	Total	8
Learning Process	I memorized the melody faster than the given time (P2, P5, P7, P8)	4
	I memorized by keeping rhythm with my feet (P7, P9)	2
	I can play a piece without knowing its notes (P3)	1
	Total	7
Improvement	The vibrations should be increased (P6, P8, P13)	3
	Solmization, musical notes can be added (P8)	1
	Total	4
State of Concentration	I could not concentrate (P1, P2)	2
	Total	2

Table 7 shows the prospective teachers' opinions on the haptic glove. Since some data has content to multiple themes, the views are not limited to a single theme. The views of prospective teachers were grouped under five themes: the benefits of the haptic glove, the physical conditions in the process, the data for learning, the need for regulation, and the focus. In general, prospective teachers expressed their opinions on the most benefits, facilitating learning (N = 3), providing time-saving (N = 2), helping with studies (N = 2) were included in the views. In the process, three prospective teachers indicated that their hands felt numb, and two of them stated feeling like being given a massage. When the data about the learning process are examined, it is seen that four prospective teachers solve the part more quickly than the given time and take it into the memory. However, four of the prospective teachers stated that haptic gloves should be improved, that it would be better if their vibrations increased and if the addition of features such as solfege and musical notes would be done. In the last theme, it is observed that two prospective teachers experienced focusing problems

RESULTS and DISCUSSION

With this research, it is aimed to develop a glove with integrated tactile interface through passive haptic learning during daily activities for new learners of piano playing, to eliminate the mentioned disadvantages (Akkuş, 2000; Kılınçer, 2013) by using glove and to test the effectiveness of the glove. For this purpose, a glove was developed which was used in the right hand and which sends vibrations to the learner in a unit of time in a way to press a single note.

In the haptic glove developed in contrast to the glove developed by Huang et al. (2008), a physical programming platform containing an Arduino Nano circuit board was used in order to not weigh down on the hand and for its size to be small. The notes of the desired songs were coded according to this physical platform. The coded notes were transmitted to the user with the help of vibration motors placed in the first knuckles of the fingers. Besides, an LED is used as a visual stimulus in addition to vibration motors.

According to the results of this study, when three prospective teachers who had both musical notes and piano knowledge and only a prospective teacher with knowledge of notes practiced on the piano, it is revealed that they play the notes correctly, play the notes durations correctly, play with the correct fingers and that they have not experienced any problems. On the other hand, it was determined that the two prospective teachers who had no notes or piano knowledge could not play the notes and the note durations correctly and could not play with the correct fingers. In this respect, using the applications on prospective teachers with knowledge of piano and notes has a positive effect on their ability of playing the song. However, it does not have any effect on prospective teachers who do not have piano or notes knowledge on their levels of being able to play the song. This result of the study shows a similarity with Xia et al. (2018) research on students who have no experience in playing flute. Only three participants of the study were able to play the melody correctly, and the application had no effect on the 13 participants. However, in our study, there was no effect on the students without musical notes and piano knowledge abilities to play the track after application, and our findings are different from the findings of Ashimori and Igarashi (2018b). In their study, it was seen that the tactile interface feedback applied to the participants who started the guitar had a positive effect on the students' performance.

It was determined that between those practicing with the Haptic glove two prospective teachers who had knowledge of both notes and piano, a prospective teacher with only knowledge of notes, and a prospective teacher with neither knowledge were able to play the notes correctly, to play the notes durations correctly and to play with the correct fingers. Based on this result, the effectiveness of haptic glove appears to be positive on prospective teachers with or without knowledge of notes. Huang et al. (2010) found that participants who had no piano experience could play the works correctly after passive training; and that those with piano experience could not play the works correctly. In the study of Huang et al. (2008), it was determined that among postgraduate students, those without any previous piano experience or knowledge of notes

could play pieces better with tactile or haptic gloves than the pieces that were not tactile. Similarly, also in this study, a prospective teacher who did not have piano or note knowledge was found to play the part correctly. Based on this finding, it is revealed that the effect of haptic glove on individuals who do not have piano and note knowledge needs to be clarified with different studies.

According to another result of the study, it was determined that there was no significant difference between the scores of the participants using the haptic glove and the piano in terms of their states of playing the notes correctly, playing the note durations correctly and playing with the correct fingers. In other words, there is no difference between haptic glove or piano application according to the participants' ability to play the notes correctly, play the note durations correctly and play with the correct fingers. This shows that the piano and the haptic glove can be used interchangeably according to the specified criteria. However, unlike this study, in the study of Seim et al. (2015), it was found that participants had a reduction in errors in playing piano songs after taking passive haptic learning (after application with haptic glove). In addition, after a short training period in Hsiao et al. (2015) research, it was determined that the subjects had a single finger touch to the score with a very good performance of more than 89% and with two finger touches resulted in a good performance of around 85%.

According to the opinions taken from the participants during the application process and at the end of the application process, it was determined that haptic glove had effects such as facilitating learning, saving time, assisting with studies and solving the song in less than the given time. The results of the haptic glove, such as facilitating learning and saving time, are similar to those of Huang et al. (2008).

Considering the positive opinions, it is thought that the haptic glove can be a good exercise tool and finger opener for opening the piano before playing the piano in the music education departments and may help to better understand the finger numbers. However, the participants stated that there should be arrangements such as increasing the vibration in their views about the use of haptic glove (Huang et al., 2008) and reflecting the sounds to the ear as a note.

On the other hand, some of the female participants stated that their hands were cold because they were immobile, and that they experienced numbness and sweating. One possible reason for this may be that they have used a new method (glove) that they have not met before. Another reason may be anemia, especially because of the particular indication of female participants. However, in order to obtain a healthier outcome, further studies may be repeated with a physiotherapist.

Limitations of the Study and Suggestions

Because the study used gloves developed for the right hand, restrictions may have formed for left-handed students. The practice can be repeated with different groups of participants with and without piano and musical notes. Research can be done where applications can send musical sounds of pieces which are being taught through tactile methods through vibrations with the Haptic glove. The effect of the haptic glove can also be explored on instruments requiring only the right hand such as the flute, saxophone etc. This application which is done only on the right hand can be repeated by designing gloves where both the right hand and left hand can work together. The study can be repeated with a design that includes stronger vibration and alongside a physiotherapist.

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Statement of Contribution Rate

First author planned and lead all the phases of the manuscript and was a major contributor in writing the manuscript. All authors conceptualized the study together. Third author guided important issues related to music education. Second author supported in literature review, data analysis, and contributed in writing the manuscript. All authors read and approved the final manuscript.

Declaration of Conflict of Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests. This study was funded by the Aksaray University Scientific Research Project Coordination Unit with project number 2017/040.

Statement of Publication Ethics

All the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" were complied with in the whole process from the planning of this research to its implementation, from data collection to data analysis. None of the actions specified under the heading "Actions Contrary to Scientific Research and Publication Ethics", which is the second part of the directive, have been taken.

Scientific, ethical and citation rules were followed in the writing process of this study; No falsification has been made on the collected data and this study has not been sent to any other academic media for evaluation. This section under the heading Method is mandatory. Case reports should include information that the informed consent/consent form was signed.

All authors agree that the author list is correct in its content and order and have seen and approved the manuscript being submitted and agree to its submission.

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REFERENCES

Akkuş, R. (2000). Instrument study behaviours. *The Journal of Buca Faculty of Education*, *12*, 107-111.

Ashimori, K., & Igarashi, H. (2017, June). Skill assist system for musical instruments by skilled players force feedback. In *2017 IEEE 26th International Symposium on Industrial Electronics* (ISIE) (pp. 2008-2013). IEEE.

Ashimori, K., & Igarashi, H. (2018a, March). Complemental Learning Assist for Musical Instruments by Haptic Presentation. In *2018 IEEE 15th International Workshop on Advanced Motion Control (AMC)* (pp. 175-180). IEEE.

Ashimori, K., & Igarashi, H. (2018b, July). Complementary Learning Assist System: Guitar Performance Assist by Haptic Presentation. In *International Conference on Human-Computer Interaction* (pp. 11-16). Springer, Cham.

Aveni, T. J., Seim, C., & Starner, T. (2019, July). A preliminary apparatus and teaching structure for passive tactile training of stenography. *In 2019 IEEE World Haptics Conference (WHC)* (pp. 383-388). IEEE.

Aydıner Uygun, M. & Kılınçer, Ö. (2018). Examination of strategies professional music education Students use while practicing and learning instrumental music. *Mehmet Akif Ersoy University Journal of Education Faculty*, *47*, 317-339.

Barfield, W. (2010). The use of haptic display technology in education. *Themes in Science and Technology Education*, *2* (1-2), 11-30.

Baumann, A., & Grinstein, G. (2008). Haptic Sound: Expressive Control of Song Playback Using Haptics. International Community for Auditory Display. Proceedings of the *14th International Conference on Auditory Display*, Paris, France.

Bircan, K. E. (2018). *Music teacher candidates the strategies of musical learning investigation from different variables.* [Unpublished Master of Science Thesis]. Ondokuz Mayis University, Graduate School of Educational Sciences, Samsun.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2011). *Scientific research methods*. Pegem Akademi, Ankara.

Civelek, T., Ucar, E., Ustunel, H., & Aydın, M. K. (2014). Effects of a Haptic Augmented Simulation on K-12 Students' Achievement and their Attitudes towards Physics. *Eurasia Journal of Mathematics, Science & Technology Education*, *10* (6).

El Saddik, A., Orozco, M., Eid, M., & Cha, J. (2011). *Haptics technologies: bringing touch to multimedia*. Springer Science & Business Media.

Ercan, N. (2006). The importance of practicing in piano education and some suggestions. *Mehmet Akif Ersoy University Journal of Education Faculty, 7* (12), 104-108.

Grindlay, G. C. (2007). *The impact of haptic guidance on musical motor learning.* [Doctoral dissertation, Massachusetts Institute of Technology.]

Grindlay, G. C. (2008, March). Haptic guidance benefits musical motor learning. In *2008 Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems* (pp. 397-404). IEEE.

Hallam, S. (1997). What do we know about practicing? Towards a model synthesising the research literature. *Does practice make perfect? Current theory and research on instrumental music practice*, *1*, 179-231.

Hamza-Lup, F. G., & Stanescu, I. A. (2010). The haptic paradigm in education: Challenges and case studies. *The Internet and Higher Education*, *13*(1-2), 78-81.

Hsiao, C. P., Li, R., Yan, X., & Do, E. Y. L. (2015, January). Tactile teacher: Sensing finger tapping in piano playing. In Proceedings of the *Ninth International Conference on Tangible, Embedded, and Embodied Interaction* (pp. 257-260). ACM.

Huanhuan, L. (2009). *Computer assisted music instrument tutoring applied to violin practice [Doctoral dissertation, National University of Singapore]*.

Huang, K., Do, E. Y. L., & Starner, T. (2008). PianoTouch: A wearable haptic piano instruction system for passive learning of piano skills. In *Wearable Computers, 2008. ISWC 2008. 12th IEEE International Symposium* (pp. 41-44). IEEE.

Huang, K., Starner, T., Do, E., Weinberg, G., Kohlsdorf, D., Ahlrichs, C., & Leibrandt, R. (2010). Mobile music touch: mobile tactile stimulation for passive learning. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 791–800). Atlanta, GA: Special Interest Group on Computer-Human Interaction.

Huberman, A. M., & Miles, M. B. (1994). *Data management and analysis methods*, in N. Denzin and Y. Lincoln (eds) Handbook of Qualitative Research, pp. 428-444. London: Sage.

Jain, A. (2011). *Mobile Tactile Stimulation for Passive Haptic Learning of Simple Melodies*. In Partial Fulfillment of the Requirements for the Degree B.S. Computer Science with Research Option in the College of Computing Georgia Institute of Technology.

Karasar, N. (2007). *Scientific research methods*. Nobel Yayınevi, Ankara.

Kılınçer, Ö. (2013). Evaluation of the learning strategies used in piano class in terms of different variables. *[Unpublished Doctoral Dissertation],* Erciyes University, Institute of Fine Arts, Kayseri.

Kılınçer, Ö. & Aydıner Uygun, M. (2017). The examination of strategies of amateur and professional musicians' use while practicing and learning music in the instruments. *International Journal of Eurasia Social Sciences*, *8*, 28, 523-534.

Kohlsdorf, D., & Starner, T. (2010, October). Mobile music touch: The effect of primary tasks on passively learning piano sequences. In *International Symposium on Wearable Computer*s (ISWC) 2010 (pp. 1-8). IEEE.

Luzhnica, G., Veas, E., & Seim, C. (2018, October). Passive haptic learning for vibrotactile skin reading. In *Proceedings of the 2018 ACM International Symposium on Wearable Computers* (pp. 40-43). ACM.

Meneses, J. (2014). *Haptic Keyboard Aid. A Major Qualifying Project Report*. In partial fulfillment of the requirements for the Degree of Bachelor of Science. The Faculty of the Worcester Polytechnic Institute.

Nicolau, H., Guerreiro, J., Guerreiro, T., & Carriço, L. (2013, October). UbiBraille: designing and evaluating a vibrotactile Braille-reading device. In *Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility* (p. 23). ACM.

Nielsen, J. (2012, June 03). How many test users in a usability study? *Nielsen Norman Group*. https://www.nngroup.com/articles/how-many-test-users

Pala, F. K. & Mihci Turker, P. (2019). Developing a haptic glove for basic piano education. *World Journal on Educational Technology: Current Issues*. 11(1), 038–047.

Pescara, E., Polly, T., Schankin, A., & Beigl, M. (2019, September). Reevaluating passive haptic learning of morse code. In *Proceedings of the 23rd International Symposium on Wearable Computers* (pp. 186-194). ACM.

Rodríguez, J. L., Velázquez, R., Del-Valle-Soto, C., Gutiérrez, S., Varona, J., & Enríquez-Zarate, J. (2019). Active and passive haptic perception of shape: passive haptics can support navigation. *Electronics*, *8*(3), 355.

Seim, C., Chandler, J., DesPortes, K., Dhingra, S., Park, M., & Starner, T. (2014, September). Passive haptic learning of Braille typing. In *Proceedings of the 2014 ACM International Symposium on Wearable Computers* (pp. 111-118). ACM.

Seim, C., Estes, T., & Starner, T. (2015, June). Towards passive haptic learning of piano songs. In *World Haptics Conference* (WHC), 2015 IEEE (pp. 445-450). IEEE.

Seim, C., Reynolds-Haertle, S., Srinivas, S., & Starner, T. (2016, September). Tactile taps teach rhythmic text entry: passive haptic learning of morse code. In *Proceedings of the 2016 ACM International Symposium on Wearable Computers* (pp. 164-171). ACM.

Takegawa, T., Terada, T., & Tsukamoto, M. A. (2012, September). Piano Learning Support System considering Rhythm. *Proceedings of the 38th International Computer Music Conference* (ICMC), Ljubljana, Slovenia, 2012, p. 325-332.

Yıldırım A., & Şimşek, H. (2006). *Qualitative Research Methods*. Seçkin Yayınevi.

Xia, G., Jacobsen, C., Chen, Q., Yang, X., & Dannenberg, R. (2018, June). ShIFT: A Semi-haptic Interface for Flute Tutoring. In *Proceedings of the international conference on new interfaces for musical expression*, Blacksburg, VA, USA, 2018.

Zhang, Y., Li, Y., Chin, D., & Xia, G. (2019, June). Adaptive Multimodal Music Learning via Interactive-haptic Instrument. *In Proceedings of the international conference on new interfaces for musical expression,* Porto Alegre, Brazil, 2019, p. 140–145.

GENİŞLETİLMİŞ ÖZ

Giriş

Öğrenme süreçleri beş duyu organımızın etkileşimini içermektedir. Ne kadar çok duyu organımızı öğrenme sürecine katarsak öğrenmelerimizin kalıcılığı o oranda artmaktadır. Öğrencinin merkezde olması ve aktif öğrenme gibi kavramlar eğitimde önem kazandığından beri, eğitim ortamlarında farklı teknolojilerin kullanımına yönelik talep artmış ve bu konuda yapılan çalışmalar önem kazanmıştır. Dokunma duyumuzu etkin bir şekilde kullanmayı amaçlayan haptik teknolojileri mühendislik, robotik, psikoloji, biliş ve askeri araştırmalarda sıkça karşımıza çıkmaktadır ve eğitim araştırmalarında da yeni yeni kendine yer edinmeye başlamıştır (Karal & Reisoglu, 2009). Enstrüman öğrenmek yeni başlayan bireyler için uzun ve zorlu bir süreçtir. Hallam (1997) yeni başlayan enstrüman öğrencilerinin bilişsel, işitsel ve teknik becerilerindeki gelişimlerinin otomatikleştirilebilmesi için düzenli tekrar yapmayı tavsiye etmektedir. Benzer şekilde pek çok araştırmacı eserdeki pasajların iyice öğrenilmesi için hâkimiyet kazanılıncaya kadar tekrar edilmesi gerektiğini öne sürmektedir (Akkuş, 2000; Ercan, 2006; Jain, 2011; Meneses, 2014).

İlgili çalışmalar

Pasif haptik öğrenme, metin girişi (Seim, Reynolds-Haertle, Srinivas ve Starner, 2016), cilt okuma – skin-reading (Luzhnica, Veas ve Seim, 2018), braille girişi (Nicolau, Guerreiro, Guerreiro ve Carriço, 2013; Seim vd., 2014), mors alfabesi (Pescara, Polly, Schankin ve Beigl, 2019; Seim vd., 2016) gibi eğitim çalışmalarında kullanılmaktadır. Sonuçlar, pasif dokunsal uygulamaların mors kodunun daha etkili bir şekilde öğrenilmesinde etkili olduğunu (Seim vd., 2016) ve bunları cilt okuma üzerinde aktif öğrenmeye bir alternatif olarak sunulabileceğini (Luzhnica vd., 2018).) ve Braille alfabesini tanımada kullanılabileceğini göstermektedir. Haptiklerin müzik eğitimi alanında da yer aldığı, öğrencilerin piyano gibi enstrümanları öğrenmelerine yardımcı olduğu ve pratik yapmalarına olanak sağladığı görülmektedir (Hsiao, Li, Yan ve Do, 2015; Huang vd., 2008; Huang vd., 2008; Huang vd., 2010; Jain, 2011; Kohlsdorf ve Starner, 2010; Meneses, 2014; Seim vd., 2015).

Enstrümantal müziğin çalışılması ve öğrenilmesi yorucu, zahmetli ve zaman gerektiren bir süreçtir. Sistemli ve bilinçli çalışılmadığı takdirde hem fiziksel problemlere yol açmakta hem de süreç öğrenciler açısından sıkıcı hale gelmektedir. Ek olarak, çalışma sonucunda yeterli verim alınamamakta süreç başarısızlıkla sonuçlanmaktadır. Bu problemler göz önüne alınarak, bu araştırmayla, piyano çalmayı yeni öğrenenler için günlük etkinlikler sırasında pasif haptik öğrenme yoluyla dokunsal arayüz entegre edilmiş bir eldiven yardımıyla bahsedilen dezavantajların ortadan kaldırılması ve eldivenin etkililiğinin sınanması amaçlanmıştır.

Yöntem

Araştırma, nicel ve nitel araştırma tekniklerinin birlikte kullanıldığı kontrol gruplu yarı deneysel bir çalışmadır. Çalışma kapsamında hem nitel hem nicel yöntemin bir arada kullanıldığı zenginleştirilmiş desenden yararlanılmıştır. Öğrencilerin notaları ve nota sürelerini doğru çalabilme ve doğru parmaklarla çalabilme gibi becerilerini karşılaştırmak amacıyla yarı deneme modellerinden eşit – zaman örneklemli model kullanılmıştır. Öğrenciler ile sürece yönelik görüşmeler yapılmıştır. Görüşmeler ve uygulama süreci video kayıtları ile gerçekleştirilmiştir.

Katılımcılar

Çalışmada eşit-zaman örneklemli model kullanılmış bu sebeple tek bir grup ile uygulama gerçekleştirilmiştir. Aynı katılımcılar eşit zaman aralıkları ve yansız seçimle belirlenen bir sırada deney ve kontrol grubunda yer almıştır. Çalışmaya Bilgisayar ve Öğretim Teknolojileri Eğitimi (BÖTE) ve Müzik Eğitimi bölümünden öğrenciler gönüllü olarak katılmıştır.

Veri toplama araçları

Uygulama sürecinde deney grubunda yer alan katılımcılar 45 ile 65 dakika arasında haptik eldiveni kullanmıştır. Uygulama esnasında verilen parçanın notalarının titreşimleri katılımcıların parmaklarına uygulanırken katılımcıların başka işlerle uğraşmalarına izin verilmiştir. Süreç video kaydına alınmıştır. Daha sonra video kayıtları metne aktarılmıştır.

Verilerin analizi

Çalışma sonunda her iki grupta yer alan katılımcılardan parçaları piyanoda çalması istenmiş ve süreç video kaydına alınmıştır. Müzik ve Sahne Sanatları Bölümü'nde görev yapan araştırmacı tarafından video kayıtları izlenmiş, katılımcıların eser bütünlüğü, notaları doğru çalabilme ve nota sürelerini doğru çalabilme ve doğru parmaklarla çalabilme oranları analiz edilmiştir. Katılımcılar ile gerçekleştirilen görüşmelerden elde edilen veriler benzer şekilde video kayıtları izlenerek analiz edilmiş ve nitel analiz yöntemlerinden betimsel analizden yararlanılmıştır.

Tartışma ve Sonuçlar

Bu çalışmanın sonuçlarına göre, hem nota bilgisi hem piyano bilgisi olan öğretmen adayı ve sadece nota bilgisi olan bir öğretmen adayının notaları doğru çalabilme, nota sürelerini doğru çalabilme ve doğru parmaklarla çalabilme oranının %100 olduğu belirlenmiştir. Diğer yandan nota ve piyano bilgisi olmayan öğretmen adaylarının piyano ile uygulama sonucunda notaları doğru çalabilme, nota süresi ve doğru parmakla çalabilme oranı % 0 olarak tespit edilmiştir.

Haptik eldiven ile uygulama yapılan öğretmen adaylarından hem nota hem piyano bilgisi olan öğretmen adayının ve sadece nota bilgisi olan öğretmen adayı ile nota ve piyano bilgisi olmayan bir öğretmen adayının notaları doğru çalabilme, nota sürelerini doğru çalma ve doğru parmakla çalabilme oranının %100 olduğu belirlenmiştir.

Çalışmanın bir diğer sonucuna göre, haptik eldiven ve piyano çalgısında uygulama yapan katılımcıların notaları doğru çalabilme, nota sürelerini doğru çalabilme ve doğru parmaklarla çalabilme durumuna yönelik puanlar arasında anlamlı bir farklılığın bulunmadığı belirlenmiştir.

Katılımcılardan uygulama sürecinde ve uygulama süreci sonunda alınan görüşlere göre, haptik eldivenin öğrenmeyi kolaylaştırması, zamandan tasarruf sağlaması, etüt çalışmalarına yardımcı olması ve eseri verilen süreden daha kısa zamanda çözülmesi gibi etkileri olduğu belirlenmiştir.

Olumlu görüşler dikkate alındığında haptik eldivenin müzik eğitimi bölümlerinde piyano eğitimi için piyano çalmadan önce parmakları açmada iyi bir alıştırma aracı ve parmak açıcı olabileceği ve parmak numaralarının daha iyi kavranmasında yardımcı olabileceği düşünülmektedir. Bununla beraber, katılımcılar haptik eldivenin kullanımıyla ilgili görüşlerinde titreşimin artırılması (Huang vd., 2008) ve nota olarak da seslerin kulağa yansıması gibi düzenlemelerin olması gerektiğini belirtmişlerdir.

Diğer yandan özellikle kadın katılımcıların bazıları ellerinin hareketsiz kaldığı için üşüdüğünü, uyuşma olduğunu ve terleme yaptığını belirtmişlerdir. Bu durumun olası nedenlerinden biri daha önce karşılaşmadıkları yeni bir yöntemi (eldiven) kullanmış olmaları olabilir. Bir diğer neden ise özellikle kadın katılımcıların belirtmesinden dolayı kansızlık olabilir. Ancak daha sağlıklı bir sonucun alınabilmesi için ileriki çalışmalarda bir fizyoterapist eşliğinde çalışma yinelenebilir.

Haptik eldivenle titreşimler yoluyla dokunsal olarak öğretilmeye çalışılan eserlerin nota seslerinin kulağa da iletilmesiyle uygulanabilecek çalışmalar yapılabilir. Sadece sağ el kullanımıyla ilgili olan flüt, saksafon vb. enstrümanlar üzerinde de haptik eldivenin etkisine bakılınabilinir. Yalnızca sağ el üzerinden yapılan bu uygulama, sağ ve sol elin birlikte çalışabileceği eldivenler tasarlanarak tekrarlanabilir. Titreşimin daha güçlü olduğu bir tasarımla ve bir fizyoterapist eşliğinde çalışma yinelenebilir.