Cypriot Journal of Educational Sciences

Volume 17, Issue 1, (2022) 01-17

www.cjes.eu

The effects of yawn-sigh, lip trill and tongue relaxation exercises on frequency and amplitude perturbation of voice in vocal training

Elif Şahin Orhon [a] *, Dr. Ilter Denizoglu Vocology Center, Izmir 35220, Turkey https://orcid.org/0000-0002-8662-007X

Tülün Malkoç [b], Marmara University, Atatürk Faculty of Education, Department of Music Education, Istanbul 34722, Turkey https://orcid.org/0000-0002-4276-8574

Suggested Citation:

Sahin Orhon, E. & Malkoc, T. (2022). The effects of yawn-sigh, lip trill and tongue relaxation exercises on frequency and amplitude perturbation of voice in vocal training. *Cypriot Journal of Educational Science*. *14*(1), 01-17. https://doi.org/10.18844/cjes.v17i1.6649

Received from October 10, 2021; revised from November 10, 2021; accepted from Janurary 02, 2022.

Selection and peer review under responsibility of Prof. Dr. Huseyin Uzunboylu, Higher Education Planning, Supervision, Accreditation and Coordination Board, Cyprus.

Abstract

In this study, the usability of lip trill, yawn–sigh and tongue relaxation exercises in vocal training programmes was evaluated. The exercise programmes were carried out with first-year students in a music teacher education programme, and the effect of these exercises on the quality of the voice was measured using acoustic measurement techniques. Thirty-one subjects were included in the study. The experimental group (n = 16) and the control group (n = 15) were determined randomly. While determining the groups, attention was paid to ensure that the characteristics of the groups were the same. An 8-week vocal exercise programme (one session per week) was carried out with the students in the experimental group. The voices of the students were recorded before and after each exercise, and then acoustic measurements of these recordings were made. The data obtained from the measurements conducted before the vocal exercises were compared with the measurement data obtained after the vocal exercises were carried out. The significance assessment of the differentiation of voice parameters in both the short term (comparison of the data obtained before the exercise and the data obtained immediately after the exercise) and in the long term (after the 8-week implementation phase) was made. A significant improvement was shown in voice quality in terms of frequency and amplitude perturbation parameters compared to the control group after each session and at the end of the 8-week exercise programme.

Keywords: Vocal training, music education, lip trill, yawn-sigh, tongue relaxation, frequency perturbation, amplitude perturbation

* ADDRESS FOR CORRESPONDENCE: Elif ŞAHİN ORHON, Maltepe Mah. 3. Sok. Oasis Park Sitesi B1 Da: 1, Güzelbahçe, Izmir 35310, Turkey

E-mail address: soprano.elif@gmail.com / Tel.: +90-532-603-4142

1. Introduction

Voice is one of the main elements or tools that play a role in an individual's communication and interaction with their social environment. Humans communicate with the outside world better by taking advantage of an array of elements that make the voice more meaningful and powerful. Individuals use their voices to express themselves in all areas of life, be it in their private lives or professional careers. Voice is of critical importance for those who are known as professional voice users, such as teachers, singers, lawyers, anchors and actors.

Teachers use their voices much more intensely than other professions by the nature of their profession. This is among the reasons that increase the risk of experiencing voice problems. A study was conducted on a group of 54 randomly selected high school teachers and a group of 220 people of other professions on the voice problems they experienced. According to the results of the study, 32% of the teachers stated that they experienced problems regarding their voices. In addition, 20% of the teachers stated that they missed job opportunities because of their voice problems (Smith et al., 1997). In a study, it was found that the professional use of voice by the hour is two times more than the professional use of voice in other professions. The average use of voice during working hours is stronger by around 1 dB SPL (Sound Pressure Level). The use of voice as such continues until the end of a given day (Hunter & Titze, 2010).

Music teachers are with the highest risk of experiencing voice problems compared to the teachers of other branches. The unbalanced use of the muscle groups responsible for voice production outside the normal physiological limits by music teachers, who perform their profession by continuously using their voice and perform on stage, causes larynx behaviour and vibration changes in the vocal folds during phonation, causing deterioration in voice quality (Kocak et al., 1996). Therefore, music teachers, who are professional voice users, should use their voice as efficiently as possible for a sustainable career. Thus, with an accurate and effective vocal training programme that can be provided during vocational education, problems related to the voice that can be experienced by individuals as both a student and a teacher can be minimised, resulting in a healthy and successful academic and professional life.

In order to increase the efficiency of the vocal education provided in institutions that train music teachers, scientific-based, joint studies should be conducted with phonologists, voice pedagogues, voice pathologists and voice physicists on the basis of an interdisciplinary approach. Vocology (voice habilitation science) supports this point of view. The term 'vocology', which is defined by voice physicist Ingo Titze and ENT specialist Dr. George Gates as 'scientific studies and applications on the habilitation of the human voice', has come to address a broader audience with clinical and pedagogical disciplines taking an active role as a result of the increased interest and curiosity in the human voice. By looking at the concept of vocology from a wider perspective, Denizoglu (2016) defined the concept in three subdivisions: basic vocology (multidimensional research, measurement and evaluation of the human voice), clinical vocology (diagnosis and treatment of voice disorders using clinical applications) and pedagogical vocology (habilitative and rehabilitative studies for professional vocal performance. Today, studies in the field of vocology are conducted using a multidisciplinary approach. The pedagogical vocology, in this sense, aims to develop and protect the professional voice through pedagogical exercises and to ensure that the voice is used and maintained in a healthy and efficient manner at the desired performance level. Solutions to the voice problems of professional voice users at every level, from singers and actors to professional groups who perform their profession using their voices, such as anchors, teachers and lawyers, are sought by pedagogical vocology. Scientifically proven effects of vocal exercise programmes will make vocal training more efficient and provide a sustainable vocal performance.

1.1. Yawn-sigh, lip trill, and tongue relaxation exercises

The use of voice varies among individuals. Even in an ordinary individual, different tones of speech or singing styles can occur. The phenomena that create these differences are the behavioural changes in the laryngeal (larynx), breathing and resonance zones. These differences are important because the health and quality of the voice are directly affected by these differences. Especially laryngeal behaviour has a direct influence on the production of the voice. It is because the vocal folds that make up the voice are there. Incorrect laryngeal behaviours, developed for whatever reason, cause stretching, straining and deterioration of the organs that produce voice and disorders, such as nodules, polyps and oedema in the vocal folds emerge.

In order to have a good voice, it is necessary to:

- Sing with an appropriate technique (balanced breathing, phonation, resonance, and articulation)
- Correctly determine the singer's voice category and sing in accordance with this category
- Sing in the right tessitura
- Choose a song suitable with the range
- To have the necessary skills of vocalizing the works of the most appropriate music genres.

(Shrivastav & Wingate, 2006).

These skills can only be acquired through correct and high-quality vocal training. According to the satellite-core model of the famous vocal pedagogue Chapman (2006), there are two main building blocks of vocal education: Core elements and the structure built on these elements. The core elements are actually the innate instincts of every ordinary individual, which may diminish and disappear in time because of the environmental and psychological reasons. These elements are primal sound, breath and posture. The process of structuring these elements consists of various exercises and visualisations carried out by the trainer (Chapman, 2006).

Although vocal education is generally carried out in an abstract, sensory way and by illustrations, it is thought that the utilisation of contemporary, evidence-based methods will yield a more efficient vocal education process and that voice and breath exercises developed based on acoustics and phonology should be used along with the conventional empirical methods. Vennard (1967) supported this idea by saying, 'There are certain principles of acoustics that should be known to all vocal educators'. As it is not possible to fully consciously control the act of singing, scientific knowledge is usually considered to be insignificant in vocal training. According to many educators who do not attach importance to the science of acoustics, scientific input will negatively affect the progress of the student and make singing a mechanical activity rather than an artistic one. However, even though it is possible to provide vocal training in a completely abstract and sensory way, it is clear that direct methods will bring about quicker and more efficient results. Therefore, new techniques will contribute more to voice improvement.

Technical exercises are decided in line with the skill aimed to be predisposed. At this point, the educator should have a good musical ear and the necessary technical knowledge in order to detect the students' incomplete and erroneous vocal movements. According to Shewell (2009), there are three ideas behind technical exercises:

* Technical ideas: physical instructions that influence the particular aspects of voice are utilized. These instructions aim to improve aspects of voice such as breath control, pitch range, and vocal onset.

* Imaginative ideas: a metaphor or image in order to explore a particular aspect of voice.

* Text ideas: materials such as books, poems, and plays are utilized to carry out vocal exercises.

There are some special technical exercises that combine these three ideas. The vocal exercises selected for this study are among these exercises.

Brief descriptions of the vocal exercises used in this study are given below.

1.1.1. Lip trill exercise

A sustainable performing voice is achieved by being economical and efficient. It is achieved by inducing a behavioural change in students through various voice exercises. One of the most important of these exercises is lip trill. It coordinates phonation and airflow. The aim is to achieve normal voice intensity and power with less mechanical stress to the laryngeal tissues, less effort for the muscles and less energy loss. These factors reduce the risk of laryngeal hyperfunction (tension in the throat muscles due to excessive muscle fatigue), vocal fatigue and injury (Croake et al., 2017; Meerschman et al., 2019). Lip trill is classified as a semi-occluded vocal tract exercise. Semi-occluded vocal tract (SOVT) exercises are well-known and popular methods that have been used by vocal pedagogues for centuries for the healthy and economical production of voice. Throughout history, vocal pedagogues have developed these techniques to improve the human voice through artistic intuition. Professional voice users utilise SOVT exercises as breath control and vocal exercises before going on stage. Semi-occluded vocal tract exercises (SOVTE) have long been used by both singing instructors and clinicians around the world to reduce excessive tension in the vocal tract and improve the quality of resonant voice (Andrade et al., 2014; Nam et al., 2019; Sahin, 2020).

Lip trill is carried out by using airflow to vibrate the lips. The patient is instructed to take a deep breath and produce a lip trill with airflow while exhaling. First, the lips are trilled with airflow without making a sound; the sound is added afterwards. The exercise starts on one pitch and is developed and continued through the range of the pitch. The lip trill creates a 'br' sound (Schneider & Sataloff, 2007). Although its mechanism is not clear, lip trill is known to have effects such as the maintenance of the sustainability of vocal fold vibration, increased glottal closure and the relaxation of oral and vocal muscles. The potential benefits of the lip trill exercise include maintaining breath flow, adjusting subglottal pressure, relaxing the tongue and other muscles for articulation and maintaining vocal fold configuration by preventing hyperadduction (Nam et al., 2019). These exercises are mostly carried out to relax the muscles and to get the feeling of vibration in the lips. Although it is an easy exercise for the vocal folds, this exercise also ensures that the respiratory system is ready for performing. The scientific fact is that the pressure currents that create lip or tongue trills are very important. It should first be recognised that there are two sources of trill (vibration) that occur during the creation of the trill. One of these sources is the larynx and the other is the front of the mouth. Both are fed by the same airflow. It is important to keep in mind that lip trills are fed (they gain the energy for the vibration) by the same airflow used by the vocal folds. The energy should be used in a balanced manner. For example, if lip trilling absorbs too much energy, the vocal folds will not vibrate enough; if the vocal folds absorb too much energy, the lips will not vibrate when they should (Titze, 1996).

Gaskill and Ericson (2007) also investigated the effect of lip trill exercise on glottal closure (glottal closed quotient). The glottal closure levels of the group which has not received vocal training were measured and compared before and after applying the lip trill exercise. The results showed that the pre-exercise closure rate was found to be 54.94%, whereas this rate increased to 56.25% post-exercise. The relationship between the experimental group and time (before and after exercise) was found to be statistically significant ($p < 0.001$).

1.1.2. Yawn-sigh exercise

This technique is mostly used as a voice therapy for voice problems related to hyperfunctional voice disorders. It is particularly effective in preventing signs of tension caused by a raised larynx and unnecessary muscular use in the vocal tract during phonation. Vocal hyperfunction is associated with excessive effort of and excessive muscle strain on the respiratory, resonance and phonation system. Brodnitz (1968) stated that 'yawning and sighing' are important natural functions that can be used in overcoming vocal congestion. Both exercises are very helpful in dealing with the raised larynx. While natural yawning offers benefits in vocal training, an artificial yawn is potentially harmful to the voice and may cause tension of some muscles and structures. This is why 'the pre-yawn position' is used in vocal pedagogy in general.

The yawn and sigh technique improves awareness of soft palate and tongue; creates an open and relaxed pharynx; creates better positioning of the soft palate; and is very useful in vocal resonation (Boone & McFarlane, 1993; Heuer et al., 2005).

The yawn and sigh exercise is performed to achieve better breathing and to reduce muscle tension in the throat. In this study, a wider oral cavity is achieved by lifting the soft palate. The feeling of a wider oral cavity and an open throat is achieved by making the 'ah' sound while exhaling. The tongue is placed behind the incisive teeth loosely. Advanced exercise skills can be achieved after practice. In the next step, the yawn part gets smaller and the exercise turns into an open-mouth breathing exercise and various words and sentences are uttered while exhaling (Schneider & Sataloff, 2007).

1.1.3. Tongue relaxation exercises

These exercises are used to relax the involuntarily tensed tongue. The tongue is very important in producing the right voice in a healthy manner. Especially, the position of the tongue and the tension in the root of the tongue are among the elements that affect the voice and resonance. Individuals such as teachers, lawyers, singers and actors, who have to use their voices frequently due to their professions, should look in the mirror and examine their tongues. The individual should examine whether the tongue moves involuntarily, whether the centre is hollow or high, whether the tongue is touching the back of the front lower teeth easily or whether the tongue is in a marginally retracted position.

Tongue has a complex muscular anatomy and it is very sensitive to the mental state. In case of nervousness, the tongue shrinks back into the back of the mouth. This causes changes in the shape of the throat and oral cavity. This negatively affects the resonance and, consequently, the voice quality. Since the tongue is attached to the larynx, the tension in the tongue spreads to the larynx, which affects the free movement of the vocal folds. Likewise, the tension in the larynx spreads to the tongue and affects articulation. Tongue awareness and behaviours are developed by learning to fully flex and relax the tongue, which is achieved through a number of technical exercises. One of the exercises is to touch behind the front lower teeth with the tip of the tongue and move the tongue back and forth. The back of the tongue must not be domed but slanted. In order for the voice to resonate easily, the throat must be completely open. Another technical exercise is where the tongue is extended forward, the tip touching the inner surface of the lower lips; the tongue should be in a very relaxed state. To allow the rear tongue muscles to relax, it is necessary to extend the tongue forward and count from 1 to 10; this exercise should be repeated thrice. This exercise can also be carried out by uttering various words and syllables (Heuer et al., 2005; Linklater, 2006). Another tongue exercise can be performed by vocalising the syllable 'ng' (as in the word Angel) in German. This exercise is known to be an important one for the tongue as well as for resonance. In this exercise, the tongue is in the nasal singing position. Such words are not very common in Turkish. But the French always speak and sing nasally. Therefore, there is much more room for breathing. This creates a very suitable environment for resonance (Helvaci, 2003; Lehmann, 1902).

1.2. Problem

This study mainly aims to evaluate the usability of lip trill, yawn–sigh and tongue relaxation exercises in the vocal training courses of institutions that train music teachers. An 8-week programme was carried out in which the aforementioned voice exercises were performed, and the effect of these exercises on the voice was measured using acoustic measurement techniques. For this purpose, the following hypotheses have been tested:

1. In the experimental group, after voice exercises, a significant difference occurred in the values of parameters related to the regularity of the frequency compared to values obtained before exercises. The effect of the 8-week exercise period on these parameters was significant.
2. In the control group, in terms of the parameters related to the regularity of the frequency, there is no significant difference between the results of the first and second measurements.
3. In the experimental group, after voice exercises, a significant difference occurred in the values of parameters related to amplitude perturbation compared to the values obtained before exercises. The effect of the 8-week exercise period on these parameters was significant.
4. In the control group, in terms of the parameters related to amplitude perturbation, there is no significant difference between the results of the first and second measurements.

1.3. Limitations

1. The findings of this study are limited to the available data collection methods.
2. The research population is limited to the students of Marmara University, Atatürk Faculty of Education, Department of Music Education.
3. The reviewed literature was limited to the owned printed sources and sources found on the Internet.

2. Method

In this study, a comparative evaluation model was used in line with the standards determined for the analysis of subjects. Accordingly, in order to use the evaluation model, the technical standards of the computer-aided system were determined in line with the basic criteria; the subjects were tested one by one; and the findings were evaluated and compared by using statistical methods and techniques.

The results were evaluated at a significance level of $p < 0.05$ using descriptive statistics, regression analysis and analysis of variance (ANOVA) in the Statistical Package for the Social Sciences (SPSS) Platform for Windows. In order to determine whether a significant difference occurred in voice parameters and other measurement values (dependent variable) as a result of the vocal exercise programme (independent variable) consisting of yawn–sigh, lip trill and tongue relaxation exercises applied to the experimental group, research designs suitable to be used with the ANOVA were used.

2.1. Study population

The research was conducted between 21 December 2010 and 6 April 2011 at Marmara University, Atatürk Faculty of Education, Department of Music Education. Research groups were randomly assigned as experimental and control groups. While determining the groups, attention was paid to ensure that the characteristics of the groups were the same.

The study group consisted of students who had not previously received vocal training and who started their education in the 2010–2011 academic year at Marmara University, Atatürk Faculty of Education, Department of Music Education. At the beginning of the study, the number of participants in the experimental group was determined to be 20. However, four of the subjects were excluded from the study because they did not regularly attend the exercises. Experimental (n = 16) and control (n = 15) groups were formed by the random assignment method.

Table 1. Distribution of frequency by gender in experimental and control groups

	Experimental group		Control group	
	N	Age	N	Age
Female	11	18-20	13	18-20
Male	5	18-20	2	18-20
Total	16		15	

The 8-week vocal exercise programme, which consists of 'yawn–sigh', 'lip trill' and 'tongue relaxation' exercises and was carried out for one period each week with 16 participants who were first-year students in the 2010–2011 academic year, was carried out with the experimental group but it was not carried out with the control group.

2.2. Application and data collection

During the implementation phase of the study, data were collected in a silent environment in Marmara University, Atatürk Faculty of Education, Department of Music Education. The instant outcomes of the exercises were examined with the measurements carried out right after the exercises.

In order to evaluate the effectiveness of the exercises, acoustic sound measurements were made to the students in the study group before and after each exercise. With the measurements made right after the exercises, it was possible to examine both the immediate and long-term outcomes of the exercises throughout the 8-week implementation phase. Philips SHM 1000 microphone was used for sound recording to be used in the acoustic analysis. The frequency range of the microphone is 100–10,000 Hz. Sound samples were transferred to a Samsung computer with the Microsoft Windows XP Professional Version 2002 operating system, 1.99 GB RAM and Intel Atom® 1.66 GHz processor. The Multi-Dimensional Voice Programme (MDVP, Kay Elemetrics, CSL Multi-Dimensional Voice Programme, Model 5105, Version 2.3) was used for acoustic examination. During the vocal exercises carried out with the experimental group, a large-size mirror was used for visual feedback and an acoustic piano was used for auditory feedback.

Acoustic sound measurements were made to test the hypotheses of the study. During the assessment of the quality of voice, in order to reveal the differences in the values of sound parameters of Fo, jitter, vFo, Shimmer and vAm, in both the long term (over the 8-week programme) and the short term (immediately after the exercises), the participants were asked to utter the /a/ sound in the normal speaking tone, at a sampling rate 44.100 Hz, and to continue the uttering for 3 seconds. The /a/ sound is the sound used in the MDVP programme to measure the acoustic properties of the voice (MDVP Manual, 1993), during the measurement, the distance between the mouth and the microphone was set to be 15 cm and the microphone was placed 45° below the mouth. The measurement was repeated thrice for each experiment.

As required by the used research method, the data obtained from the subjects during the implementation were evaluated together with an expert in the sound laboratory of the ENT department.

2.3. Implementation examples

As necessitated by the used research method, the vocal exercise programme consisting of lip trill, yawn–sigh and tongue relaxation exercises were applied individually to each prospective music teacher in the experimental group for 8 weeks for 45 minutes/session each week. Before vocal exercises were applied to the participants in the experimental group, five measurements consisting of acoustic sound measurements and aerodynamic measurements were made in a silent environment. Each exercise was repeated and recorded thrice; the obtained data and their average were accepted as pre-test data. These measurements were made repeatedly over a 2-month period before each exercise. Then, vocal exercises selected for this study were applied to the participants in the experimental group individually for 45 minutes a week for 2 months. The exercises were carried out in the following four stages:

1. Since breathing should be done correctly in order to perform the exercises efficiently and correctly, the students were first made to do diaphragmatic breathing exercises.
2. The students were instructed to do the lip trill exercise for about 15 minutes to ensure healthy vocal fold vibration and mucosal wave movement. The lip trill exercise was done in several ways. In order to have an effective breathing exercise and to reinforce all the exercises done, it was done by shifting the right sounds from the deep voice to the low voice. Each exercise is demonstrated to the participants once by the implementer. Later, different lip trill exercises were done, accompanied by the piano (Figure 1).

Figure 1. The note demonstration of the sounds in the accompaniment of which lip trill exercises were done

3. In the third stage, the participants were instructed to do the 'Yawn–sigh' exercise to relax the oropharyngeal muscles. The exercise was first done separately, then it was combined with the resonance exercise to increase the resonance with relaxation. The participants were asked to yawn and then make a 'hah' sound like a groan, then go on with making the /m/ sound with a closed mouth. The participants were to feel the resonance of their voices in the facial bones during this exercise. In order to check whether the exercise was being done correctly, the participants were constantly asked where the vibration was felt during the exercise.
4. In the fourth stage, the participants were given various tongue exercises to relax and loosen the tongue and to stretch the tongue behind the lower front teeth without pulling it behind the throat. They were first instructed to touch the rear of the lower front lower teeth with the tip of the tongue, and while the tongue was in this state, to move it back and forth. The participants

were asked to make a sound similar to /eya/ when their tongue was at this state. Exercises were done by taking into account the characteristics and limits of the participants' voice, in high and low semitones.

Another tongue exercise was performed by vocalizing the syllable 'ng' (as in the word Angel) formed by the back of the tongue in order to loosen and relax the back of the tongue and to feel the voice in the face (Figure 2).

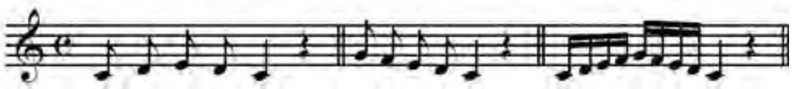

Figure 2. The note demonstration of the sounds with which /ng/ voice was uttered during tongue exercises

The vocal exercises were repeated with the experimental group over a period of 2 months and five acoustic sound measurements were made in a silent environment after each session. Each exercise was repeated and recorded thrice; the obtained data and their average were accepted as post-test data.

At the beginning of the 8-week implementation phase, five acoustic sound measurements were done with participants in the control group in a silent environment. Each exercise was repeated and recorded thrice and the obtained data were averaged. These data were accepted as the pre-test data. The vocal exercise programme was not applied to the participants in the control group. At the end of the implementation phase (after 2 months), these measurements were made again. The obtained data were accepted as the post-test data.

2.4. Data analysis and interpretation

The obtained data were evaluated at a significance level of $p < 0.05$ using descriptive statistics, regression analysis and ANOVA in the SPSS Platform for Windows. The significance of the differentiation in the values of the parameters of the fundamental frequency (Fo), jitter, vFo, Shimmer, and vAm which were measured using the MDVP voice analysis programme, in both the long term and in the short term, was evaluated by regression analysis.

3. Findings

3.1. Findings regarding hypothesis 1

3.1.1. Jitter parameter values

Table 2. 'Jitt' values before and after the vocal exercises and the effect of the 8-week vocal exercise programme on the 'Jitt' value

Jitt	*N*	Minimum	Maximum	Mean	Std. Dev.
Before	128	0.289	2.027	1.0672	0.386
After	128	0.308	1.336	0.801	0.247
Model	Squares total	df	Squares avg.	F	Sig.
Regression	5.873	2	2.937	29.412	.000[a]
Remaining	25.260	253	0.100		
Total	31.133	255			

Ho: $A_i = 0$, i = 0, 1, 2 (A_0 = constant, A_1 = Pre-Post, A_2 = weeks) H1: $A_i \neq 0$.

As the significance level (sig.) seen in Table 2 is less than 0.05, Ho is rejected. The rejection of Ho is the rejection of the hypothesis that the regression coefficients are 0. This means that the model in the chart above cannot be rejected.

Table 3. Coefficients

	Non-standard coefficients		Standard coefficients	*t*	sig.
	B	Std. error	Beta		
Constant	1.478	0.074	-	20.106	0.000
Pre-Post	-0.264	0.039	-0.379	-6.696	0.000
Week	-0.032	0.009	-0.212	-3.740	0.000

According to Table 3, the dependent variable is a linear combination of the 'A' (jitt) independent variables. The coefficients are -0.379 and -0.212. So, when "jitt" is taken as the dependent variable, the best regression equation is as follows: jitt = 1.478+(-0.264)*week+(-0.032)*Pre-Post.

Dependent variable is (-0.379, -0.212).(A). Accordingly, the difference between the Jitt values obtained before and after the vocal exercise was found to be significant (p <0.05). It is also seen that the 8-week exercise programme is an important (significant) predictor of the 'Jitt' parameter.

3.1.2. vFo parameter values

Table 4. 'vFo' values before and after the vocal exercises and the effect of the 8-week vocal exercise programme on the 'vFo' value

vFo	*N*	Minimum	Maximum	Avg.	Std. dev.
Before	128	0.485	2.436	1.108	0.326
After	128	0.479	2.967	0.840	0.265
Model	Squares total	df	Squares avg.	F	Sig.
Regression	8.066	2	4.033	70.645	0.000[a]
Remaining	14.443	253	0.057		
Total	22.509	255			

Ho: $A_i = 0$, i = 0, 1, 2 (A_0 = constant, A_1 = Pre-Post, A_2 = weeks) H1: $A_i \neq 0$.

As the significance level (sig.) seen in Table 4 is less than 0.05, Ho is rejected. The rejection of Ho is the rejection of the hypothesis that the regression coefficients are 0. This means that the model in the chart above cannot be rejected.

Table 5. Coefficients

	B	Std. error	Beta	*t*	Sig.
Constant	1.597	0.056	-	28.728	0.000
Pre-Post	-0.279	0.030	-0.470	-9.342	0.000
Week	-0.048	0.007	-0.370	-7.349	0.000

According to Table 5, the dependent variable is a linear combination of the 'A' (vFo) independent variables. The coefficients are -0.470 and -0.370. So, when 'vFo' is taken as the dependent variable, the best regression equation is as follows: vFo =1.597+(-0.279)*week+(-0.048)*Pre-Post.

Dependent variable is (-0.470, -0.370).(A). Accordingly, the difference between the vFo values obtained before and after the vocal exercise was found to be significant (p <0.05). It is also seen that the 8-week exercise programme is an important (significant) predictor of the 'vFo' parameter (p = 0.05).

3.2. Findings regarding hypothesis 2

3.2.1. Jitt parameter values

Table 6. Results of the regression analysis carried out to determine the difference between the first and second measurement results of control group Jitt values.

Jitt	*N*	Minimum	Maximum	Mean	Std. dev.
First Measurement	15	0.533	2.499	1.327	0.568
Second Measurement	15	0.514	2.453	1.164	0.497
Model	Squares total	df	Squares avg.	F	Sig.
Regression	0.198	1	0.198	0.693	0.412[a]
Remaining	7.991	28	0.285		
Total	8.189	29			

Ho: A_i=0, i=0, 1, 2 (A_0 = constant, A_1 = 1stmeas. - 2ndmeas.) H1: A_i = 0.

As the significance level (sig.) seen in Table 6 is greater than 0.05, Ho is rejected. The rejection of Ho is the failure to reject the hypothesis that the regression coefficients are 0. This indicates that the model in the chart above will be rejected.

Table 7. Coefficients

	Non-standard coefficients		Standard coefficients	*t*	sig.
	B	Std. error	Beta		
Constant	1.490	0.308	-	4.830	0.000
1stmeas. - 2ndmeas.	-0.162	0.195	-0.155	-0.833	0.412

According to Table 7, the dependent variable is a linear combination of the 'A' (jitt) independent variables. The coefficients are -0.379 and -0.212. So, when 'jitt' is taken as the dependent variable, the best regression equation is as follows: jitt=1.490+(-0.162)*1stmeas.-2ndmeas. The dependent variable is (-0.155).(A). Accordingly, no significant difference was found between the Jitt values obtained before and after the vocal exercise (p <0.05).

3.2.2. vFo parameter values

Table 8. Results of the regression analysis carried out to determine the difference between the first and second measurement results of control group vFo values

vFo	*N*	Minimum	Maximum	Mean	Std. dev.
Before	15	0.636	2.126	1.383	0.412
After	15	0.613	1.892	1.094	0.298
Model	Squares total	df	Squares avg.	F	Sig.
Regression	0.629	1	0.629	4.856	0.036[a]
Remaining	3.626	28	0.130		
Total	4.255	29			

Ho: A_i=0, i=0, 1, 2 (A_0 = constant, A_1 = 1stmeas. - 2ndmeas.) H1: A_i = 0.

As the significance level (sig.) seen in Table 8 is greater than 0.05, Ho is rejected. The rejection of Ho is the failure to reject the hypothesis that the regression coefficients are 0. This indicates that the model in the chart above will be rejected.

Table 9. Coefficients

	Non-standard coefficients		Standard coefficients	*t*	sig.
	B	Std. error	Beta		
Constant	1.674	0.208		8.055	0.000
Pretest-posttest	-0.290	0.131	-0.384	-2.204	0.036

According to Table 9, the dependent variable is a linear combination of the 'A' (vFo) independent variables. The coefficients are 1.674 and -0.290. So, when 'vFo' is taken as the dependent variable, the best regression equation is as follows: vFo =1.674+(-0.290)*1stmeas.-2ndmeas. The dependent variable is (-0.384).(A). Accordingly, no significant difference was found between the vFo values obtained before and after the vocal exercise ($p < 0.05$).

3.3. Findings regarding hypothesis 3

3.3.1. Shimmer parameters

Table 10. 'Shimmer' values before and after the vocal exercises and the effect of the 8-week vocal exercise programme on the 'Shimmer' value

Shimmer	*N*	Minimum	Maximum	Mean	Std. dev.
Before	128	2.289	6.356	3.985	0.966
After	128	1.691	6.012	3.109	0.639
Model	Squares total	df	Squares avg.	F	Sig.
Regression	66.021	2	33.010	56.705	0.000[a]
Remaining	147.282	253	0.582		
Mean	213.302	255			

Ho: A_i=0, i=0, 1, 2 (A_0 = constant, A_1 = Pre-Post, A_2 = weeks) H1: $A_i \neq 0$.

As the significance level (sig.) seen in Table 10 is less than 0.05, Ho is rejected. The rejection of Ho is the rejection of the hypothesis that the regression coefficients are 0. This means that the model in the chart above cannot be rejected.

Table 11. Coefficients

	B	Std. Error	Beta	*t*	Sig.
Constant	5.347	0.178	-	30.124	0.000
Pretest-posttest	-0.894	0.095	-0.490	-9.371	0.000
Week	-0.105	0.021	-0.264	-5.059	0.000

According to Table 11, the dependent variable is a linear combination of the '*A*' (Shim) independent variables. The coefficients are -0.894 and -0.105. So, when 'Shim' is taken as the dependent variable, the best regression equation is as follows: Shim = 5.347+(-0.894)*week+(-0.105)*Pre-Post

Dependent variable is (-0,490, -0,264).(*A*). Accordingly, the difference between the Shim values obtained before and after the vocal exercise was found to be significant ($p < 0.05$). It is also seen that the effect of the 8-week exercise programme on the Shim parameter was significant (at the 0.05 significance level).

3.3.2. vAm parameter

Table 12. 'vAm' values before and after the vocal exercises and the effect of the 8-week vocal exercise programme on the 'vAm' value

vAm	*N*	Minimum	Maximum	Avg.	Std. dev.
Before	128	6.644	24.424	12.776	3.633
After	1280	0.051	27.239	11.567	3.702
Model	Squares total	df	Squares avg.	F	Sig.
Regression	537.238	2	268.619	23.871	0.000[a]
Remaining	2846.992	253	11.253		
Total	3384.230	255			

Ho: A_i=0, i=0, 1, 2 (A_0 = constant, A_1 = Pre-Post, A_2 = weeks) H1: $A_i \neq 0$.

As the significance level (sig.) seen in Table 12 is less than 0.05, Ho is rejected. The rejection of Ho is the rejection of the hypothesis that the regression coefficients are 0. This means that the model in the chart above cannot be rejected.

Table 13. Coefficients

	B	Std. Error	Beta	*t*	Sig.
Constant	16.530	0.780	-	21.180	0.000
Pre-Post	-1.091	0.419	-0.150	-2.602	0.010
Week	-0.586	0.092	-0.369	-6.401	0.000

According to Table 13, the dependent variable is a linear combination of the '*A*' (vAm) independent variables. The coefficients are -0.150 and -0.369. So, when 'vAm' is taken as the dependent variable, the best regression equation is as follows: vAm =16.530+(-1.091)*week+(-0.586)*Pre-Post. The dependent variable is (-0.150, -0.369).(A). Accordingly, the difference between the vAm values obtained before and after the vocal exercise was found to be significant ($p < 0.05$). It is also seen that the effect of the 8-week exercise programme on the vAm parameter was significant (at the 0.05 significance level).

3.4. Findings regarding hypothesis 4

3.4.1. Shimmer parameter

Table 14. Results of the Regression Analysis carried out to determine the difference between the first and second measurement results of control group Shim values

Shim	*N*	Minimum	Maximum	Avg.	Std. dev.
First Measurement	128	2	6	3.99	0.967
Second Measurement	128	2	6	3.11	0.640
Model	Squares total	df	Squares avg.	F	Sig.
Regression	16.146	1	6.146	6.243	0.019[a]
Remaining	27.568	28	0.985		
Total	33.715	29			

Ho: A_i=0, i=0, 1, 2 (A_0 = constant, A_1 = 1stmeas. - 2ndmeas.) H1: $A_i = 0$.

As the significance level (sig.) seen in Table 14 is greater than 0.05, Ho is rejected. The rejection of Ho is the failure to reject the hypothesis that the regression coefficients are 0. This indicates that the model in the chart above will be rejected.

Table 15. Coefficients

	Non-standard coefficients		Standard coefficients	*t*	sig.
	B	Std. Error	Beta		
Constant	5.873	0.573	-	10.252	0.000
1stmeas. - 2ndmeas.	-0.905	0.362	-0.427	-2.499	0.019

According to Table 15, the dependent variable is a linear combination of the '*A*' (Shim) independent variables. The coefficient is -0.427. So, when 'Shim' is taken as the dependent variable, the best regression equation is as follows: Shim = 5.873+(-0.905)*1stmeas-2ndmeas. The dependent variable is (-0,427).(A). Accordingly, no significant difference was found between the shim values obtained before and after the vocal exercise ($p < 0.05$).

Table 16. Results of the regression analysis carried out to determine the difference between the first and second measurement results of control group vAm values

vAm	*N*	Minimum	Maximum	Mean	Std. dev.
First meas.	15	9.470	17.391	13.999	2.443
Second meas.	15	8.969	17.992	13.268	2.422
Model	Squares total	df	Squares avg.	F	Sig.
Regression	4.005	1	4.005	0.677	0.418[a]
Remaining	165.662	28	5.917		
Total	169.667	29			

Ho: A_i=0, i=0, 1, 2 (A_0 = constant, A_1 = 1stmeas. - 2ndmeas.) H1: A_i = 0.

As the significance level (sig.) seen in Table 16 is greater than 0.05, Ho is rejected. The rejection of Ho is the failure to reject the hypothesis that the regression coefficients are 0. This indicates that the model in the chart above will be rejected.

Table 17. Coefficients

	Non-standard coefficients		Standard coefficients	*t*	Sig.
	B	Std. Error	Beta		
Constant	14.730	1.404	-	10.489	0.000
1stmeas. - 2ndmeas.	-.731	0.888	-0.154	-0.823	0.418

According to Table 17, the dependent variable is a linear combination of the '*A*' (vAm) independent variables. The coefficient is -0.154. So, when 'vAm' is taken as the dependent variable, the best regression equation is as follows: vAm = 14.730 +(-0.731)*1stmeas. - 2ndmeas. The dependent variable is (-0.154).(A). Accordingly, no significant difference was found between the vAm values obtained before and after the vocal exercise ($p < 0.05$).

4. Discussion

Voice training is a process that raises self-awareness. The techniques used by music teachers and voice instructors in voice training are illustrating, application and perception, as well as the imitation of the voice produced by the trainee. This imitation is sometimes evaluated by an auditory method and sometimes through acoustic analysis. This assessment can be made by subjective and objective methods. In subjective assessment, the changes in the student's voice are perceived by the instructor. Also, how the student's voice is perceived by the instructor and the instructor's opinions on the student's voice enables the student's voice to be objectively evaluated. Objective evaluation of voice consists of visualising the structure and movement of vocal folds, making aerodynamic measurements and analysing acoustic parameters (spectrographic evaluations through which the fundamental frequency, frequency regularity, amplitude, amplitude perturbation and volume regularity can be observed) (Morrison & Rammage, 1994).

The vocal exercises used as a part of this study affected the voice characteristics of the participants. The fundamental frequency indicates the number of vibrations of the vocal folds per second. This concept is related to the frequency of the voice that is created naturally while an individual is singing and speaking. No changes occurred in the fundamental frequency of the participants' voices in the long term (after the 8-week implementation). However, significant improvements were observed in the short term (after every exercise). The results obtained from the control group show that the difference between the average Fo values measured before and after the vocal exercises was not statistically significant.

Some vocal exercises prioritise breath support. Increased breath support causes an increase in subglottic pressure. One of the reasons for the increase in the fundamental frequency of the voice is the increase in subglottic pressure. The increase in the fundamental frequency after voice exercises and this increase remaining constant is related to this phenomenon. It can be concluded, however, that behavioural changes occurred after vocal exercises were retained for a long time but were not permanent. Therefore, in the experimental group, although the behavioural change could not be retained after the voice exercises, the quality of the voice and relevant parameters gradually improved throughout the implementation phase. No such changes were observed in the control group. Relevant studies in the literature support the findings of this study. In their study, Chen and Hsiao (2006) applied a voice exercise programme consisting of various voice exercises to teachers, and a significant difference occurred between Fo values obtained before and after the vocal exercises. Fo values increased as a result of the vocal exercises.

Jitter parameter is a parameter that shows the irregularity of the frequency in each period. In this study, the Jitter values of the students in the experimental group showed significant improvement (decrease) in both the short term and the long term. The improvement in the jitter values indicates that the vocal fold vibrations become regular. Studies have shown that vocal exercises improve the jitter parameter in pathological cases. These voice therapy techniques selected for this study effectively improve the vibration of the vocal folds. Frequency irregularity (perturbation) parameters are the parameters related to the irregularity of vocal folds' vibration. Therefore, the change in the parameters related to frequency irregularity and the improvement observed after the vocal exercises are very significant. When the average jitt value of the control group was examined, it was seen that there is no significant difference between the values obtained from the first measurement and the second measurement.

Shimmer perturbation measurement shows the amplitude variation of the voice in each period. In this study, the mean shimmer values of the participants in the experimental group significantly decreased in both the short and the long term. This decrease shows that each vocal fold vibration had become regular. In the control group, no significant difference was found between the mean shimmer values obtained after the first and the second measurements ($p < 0.05$).

There are studies in the literature on shimmer voice therapy. In their studies, Walzak et al. (2007), Amir et al. (2005) and Bovo et al. (2007) observed significant improvement in shimmer values after carrying out a vocal exercise programme.

vAm is one of the parameters of amplitude irregularity (perturbation). Very short-term changes in the amplitude of voice signals are measured. vAm is the standard deviation of the change in amplitude between the peaks of sound waves. vFo is a parameter related to frequency perturbation. It shows the peak-to-peak fundamental frequency changes in the analysed voice sample (Campisi et al., 2000). 'vFo' and 'vAm' indicate the fluctuations of the frequency and amplitude of the voice signal under study. The voice techniques used in this study reduced these fluctuations in both the short and in the long term. This is particularly relevant to breath control and tone consistency. The difference can be more clearly seen when the vAm values of the control group are compared with the vAm values of the experimental group. Accordingly, in the control group, no significant difference was found between the vAm values obtained before and after the vocal exercise ($p < 0.05$).

5. Conclusion

This controlled study included subjects with music teacher training followed for 8 weeks with vocal exercises (lip trill, yawn–sigh and tongue relaxation). The regular exercise programme was shown to decrease the perturbation levels of voice that points the advanced control on the vocal use. These vocal exercises seem to be beneficial in terms of tone consistency and breath control in advance. The acoustic consequences have been stable during the study.

References

Amir, O., Amir, N., & Michaeli, O. (2005). Evaluating the influence of warmup on singing voice quality using acoustic measures. *Journal of Voice*, *19*(2), 252-260. https://doi.org/10.1016/j.jvoice.2004.02.008

Andrade P., Wood G., Ratcliffe P., Epstein R., Pijper A. & Svec J. (2014). Electroglottographic study of seven semi-occluded exercises: laxvox, straw, lip-trill, tongue-trill, humming, hand-over-mouth, and tongue-trill combined with hand-over-mouth. *Journal of Voic*e, *28*(5), 589-595. https://doi.org/10.1016/j.jvoice.2013.11.004

Bengisu, S. (2004). *The relationship between muscle tension dysphonia type 1 and soft phonation index and the effectiveness of voice therapy,* Unpublished Master's Thesis

Boone, R. D., & McFarlane (2000) *The voice and voice therapy*. (6th edition), Allyn and Bacon

Bovo, R., Galceran, M, Petrucelli J. & Hatzopoulos, S. (2006). Vocal problems among teachers: Evaluation of preventive voice program. *Journal of Voice, 12*(6), 705-722. https://doi.org/10.1016/j.jvoice.2006.07.002

Brodnitz, F. (1968) *Vocal rehabilitation: A manual paperback.* American Academy of Ophthalmology and Otolaryngology; n edition

Campisi, P., Tewfik, T. L., Pelland-Blais, E., Husein, M. & Sadeghi, N. (2000) Multi-dimensional voice program analysis in children with vocal cord nodules. *The Journal of Otolaryngology*, *29*(5), 302-308.

Chapman, J. (2006) *Singing and Teaching Singing* (pp. 13-15), Plural Publishing Inc.

Chen, H. S., & Hsiao, T. Y. (2006). Outcome of resonant voice therapy for female teachers with voice disorders: perceptual, physiological, acoustic, aerodynamic, and functional measurements. *Journal of Voice*, *21*(4), 415-425 https://doi.org/10.1016/j.jvoice.2006.02.001

Croake, D., Andreatta, R., & Stemple, J. (2017). Immediate effects of the vocal function exercises semi-occluded mouth posture on glottal airflow parameters: A preliminary study. *Journal of Voice*, *31*(2), 245-249. https://doi.org/10.1016/j.jvoice.2016.08.009

Denizoglu, I. (2016). *The use of "lax vox" water blowing techniques in individual voice education courses*, (Unpublished Master's Thesis), Ege University Institute of Health Sciences, Izmir.

Gaskil, S. C., & Erickson L. M. (2007). The effect of voiced lip trill on estimated glottal closed quotient. *Journal of Voice*, *22*(6), 634-643. https://doi.org/10.1016/j.jvoice.2007.03.012

Helvacı, A. (2003). *The reflection of usage properties of the register and resonance regions to voice quality in voice education*, (Unpublished Ph.D. Thesis).

Heuer, R. J., Rulnick, R. K., Hormann, M., Perez, K. S., Emerich, K. A., & Sataloff, RT. (2005). In: Sataloff R. T. (ed.). *Treatment of voice disorders* (pp. 15-39). Plural Publishing.

Hunter, J. E., & Titze, I. R. (2010). Variations in intensity, fundamental frequency, and voicing for teachers in occupational versus nonoccupational settings. *Journal of Speech, Language, and Hearing Research, 53*(4), 862-875. https://doi.org/10.1044/1092-4388(2009/09-0040)

Kocak, I., Yorulmaz, I., Dursun, G., & Demireller, A. (1996). Videosengostroboscopy. In Oguz, A., Demireller, A. (Eds.), *Voice and Voice Disorders* (pp. 28–44). Ankara.

Lehmann, L. (1902). *Meine gesangskunt*, The Macmillan Company

Linklater, K. (2006). *Freeing the natural voice*, Nick Hern Books. https:// https://www.linklatervoice.com/linklater-voice/kristin-s-books/22-freeing-the-natural-voice-imagery-and-art-in-the-practice-of-voice-and-text

Meerschman, I., Van Lierde, K., Ketels, J., Coppıeters, C., Claeys, S., & D'haeseleer, E. (2019). Effect of three semi-occluded vocal tract therapy programmes on the phonation of patients with dysphonia: Lip trill, water-resistance therapy and straw phonation. *International Journal of Language & Communication Disorders*, *54*(1), 50-61. https://doi.org/10.1111/1460-6984.12431

Morrison, M.D., & Rammage, L.A. (1993). Muscle Misuse Voice Disorders: Description and classification. *Acta Otolaryngol Supplement*, *113*(3), 428-434. https://doi.org/10.3109/00016489309135839

Multi-Dimensional Voice Program (MDVP) (1993). *Operations manual* (vol. 1, pp. 97-121), *Kay Elemetrics Corp.*

Mumovic, G. M. (2011). Vocal therapy with larynx compression after partial laryngectomy. *Medicinski Pregled, 64*(7-8), 357-361. https://doi.org/10.2298/mpns1108357m

Nam, I., Kım, S., Joo, Y., Park, Y., Shim, M., Hwang, Y., & Sun, D. (2019). Effects of voice therapusing the lip trill technique in patients with glottal gap. *Journal of Voice*, *33*(6)**,** P949.E11-949.E19. https://doi.org/10.1016/j.jvoice.2018.07.013

Schneider, L. S., & Sataloff, R. T. (2007). Voice therapy for the professional voice. *Otolaryngologic Clinics of North America, 40*(5), 1133-1149. https://doi.org/10.1016/j.otc.2007.05.013

Shewell, C. (2009). *Voice work*. Wiley Blackwell. https://www.wiley.com/en-bm/Voice+Work:+Art+and+Science+in+Changing+Voices-p-9780470019924

Shrivastav, R., & Wingate, J. (2006) *Perceptual attributes and assessment of the singer's voice* (pp. 103-115). Plural Publishing

Smith, E., Lemke, J., Taylor, M., Kirchner, H., & Hoffmann H. (1997). Frequency of voice problems among teachers and other occupations. *Journal of Voice, 12*(4), 480-488. https://doi.org/10.1016/s0892-1997(98)80057-x

Sahin, E. (2020) Semi-occluded vocal tract exercises in singing therapy. Voice Education Workshop, In T. Malkoc (Ed.), *Voice Education Workshop*. Marmara University Press. No:871 https://marmaraedutr-my.sharepoint.com/personal/yayinevi_marmara_edu_tr/_layouts

Titze, I. (1996). Lip and tongue trills what do they do for us? NATS *Journal of Singing. 52*(3)*,* 51-52.

Vennard, W. (1967) *Singing: The mechanism and the technique*, Dance-Music-Culture, Translation Research Journal, No: 61, Boğaziçi University Press.

Walzak, P., McCabe, P. Madill, C., & Sheard, C. (2007). Acoustic changes in student actors' voices after 12 months of training. *Journal of Voice, 22*(3), 300-313. https://doi.org/10.1016/j.jvoice.2006.10.006