Research Acticle

THE EFFECT OF USING MULTIPLE METHODS FOR TEACHING SOUND TOPICS IN A SECONDARY SCHOOL CURRICULUM ON STUDENT ACHIEVEMENT

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ABSTRACT

In this study, a "Sound Unit" from secondary school science courses was provided to eighth grade students in accordance with the curriculum using different methods and techniques, and effects of these methods on student achievement were investigated. A quasi-experimental study design with pre and post-testing on one control and three experimental groups was used in the study. Lessons were taught to the students in these three experimental groups using computer-assisted teaching techniques including animation and videos (N=35), laboratory activities (N=34) and both computer-assisted teaching techniques and laboratory activities (N=30). Traditional teaching methods included in the current program were used with the students in the control group (N=34). The implementation took a total of 12 hours (four hours each week for three weeks). An achievement test consisting of 43 questions developed by the researcher was administered to all groups before and after the implementation as the pre- and post-tests. Based on the results, the students in the computer + laboratory group and those in the laboratory group were significantly more successful than those in the control group. The computer + laboratory group was the most successful group. Comparisons of pre- and post-test results revealed a significant increase in student success for all groups. The results of this study suggest that having the most successful students in the computer + laboratory group was due to the learning by doing and living and the enriched teaching activities.

Keywords: Science education, sound, basic sound concepts, student achievement.

INTRODUCTION

Much attention has been focused on increasing primary and secondary school students' success in Science courses. This issue is reflected in scientific research on science education, and an increasing number of studies have been conducted every year (Beaton, 1996; Berger and Hänze, 2015; Bozkurt and Aydoğdu, 2009; Cameron et al., 2016; Çetin, 2015; Demircioğlu and Geban, 1996). Sound and acoustics, one of the main topics in the Science curriculum, is an interdisciplinary subject that includes many science concepts. Basic physical concepts related to sound are also used in other disciplines, such as physics of music, mathematics of music, therapy with music, music history and music sociology. In addition to these disciplines, this topic is also associated with fields such as biology, art, engineering, medicine and psychology. Sound and its properties are used while developing diagnosis and treatment tools in medicine. Therefore, studies investigating methods for increasing students' success on the "sound" unit are necessary. The concepts of sound that were examined in this study are included in physical acoustics, which is one of the subfields of acoustics that has wide applicability. It is one of the basic science subjects that students may encounter in their education after secondary school.

Theoretical Framework: Teaching the "Sound" Topic

Active participation in a lesson helps students to make sense of the knowledge they learned. For this reason, the implementation of activities and materials increases the success of the students (Yavru and Gürdal, 1998). Experiments evoke natural instincts in students and improve their attitudes toward science. Experiments in science courses also teach students to ask questions, to identify problems and to seek solutions by collaborating with others (The Council of Higher Education, 1997). It is not easy for students to grasp the abstract concepts of science and to gain permanent habits without using laboratory methods (Ayas et al., 1995). Permanent knowledge can be achieved with individualized learning (The Council of Higher Education, 1997), which can be achieved by student-centered teaching methods in which students actively participate in the lessons. In addition to experiments, animations and simulations have become indispensable tools in education because they contain interactive moving images and sounds. With the help of computer-assisted teaching techniques, a variety of learning environments can be created to teach physics. Jimoyiannis and Komis (2001) proposed computer simulations as an important field of instruction because they create a powerful environment for teaching the concepts of physics.

In the literature, there are many studies about sound and sound concepts. Some of them are about to determine knowledge/comprehension levels, misconceptions/alternative concepts and thoughts of participants (Beaty, 2000; Efe, 2007; Eshach and Schwartz, 2006; Hrepic, 2002; Katherine et al., 2004; Küçüközer, 2009; Linder, 1992, 1993; Linder and Ericson, 1989; Maurines, 1993; Mazensa and Lautrey, 2003; Menchen and Thompson, 2005; Merino, 1998; Paliç, 2011; Bolat and Sözen, 2009; Sözen and Bolat, 2011, Sözen and Bolat, 2014; Wittmann, 2002, 2003; Whittaker, 2012), to analyze the participants' conceptual change processes (Atasoy et al., 2013; Barman et al., 1996; Evrekli et al., 2007, Fide, 2011; Gölgeli and Saraçoğlu, 2011; Karamustafaoğlu et al., 2010; Aydın and Kömürkaraoğlu, 2015; Kömürkaraoğlu, 2011;

Magnusson, 1996; Okur, 2009; Özdemir and Dindar, 2013; Öztürk, 2013; Pektaş et al., 2009; Sağlam, 2005; Salgut, 2007; Sözen, 2016; Tiryaki, 2009; Yücel, 2015) and to analyze the participants' mental models and the changes in their mental models (Hrepic, 2002; Hrepic et al., 2002, 2003, 2010; Sözen and Bolat, 2016; Wittmann et al., 2002, 2003).

As seen, many studies have analyzed the conceptual change processes of participants for the subject and concepts of sound. However, few studies find differences in conceptual changes by using more than one method. Only Okur (2009), Tiryaki (2009) and Sözen and Bolat (2016) have conducted studies on conceptual change processes by using more than one method. The number of studies that implement different teaching methods at the same time and that cover detailed information about physical properties of sound (the propagation and production of sound, velocity of sound, energy of sound, relationship with musical instruments, height, intensity and frequency of sound) is limited. Therefore, the effectiveness of computer-assisted and laboratory methods is said to be qualified to fill this gap.

In this study, a "sound unit" covered in an 8th grade Science course was taught to the students in accordance with the curriculum using different methods and techniques, whose effects on student achievement were investigated.

METHOD

A quasi-experimental study design – an experimental research method – was used in the study, including one control group and three experimental groups. Lessons were taught to the students in these three experimental groups using computer-assisted teaching techniques, including animation and videos, laboratory activities and both computer-assisted teaching techniques and laboratory activities. In the control group, lessons were taught with the current teaching methods. All implementation was carried out by the same teacher. Figure 1 shows the study's plan.

The criteria for the determination of the study groups were as follows;

- Lessons in both experimental and control groups will be taught by the same teacher,
- The teacher participating in the study should be a volunteer,
- The classrooms in which the lessons take place should have the necessary equipment for the implementation,
- The number of students in each class should be similar, and
- The study should be supported by school management before, during and after the study.

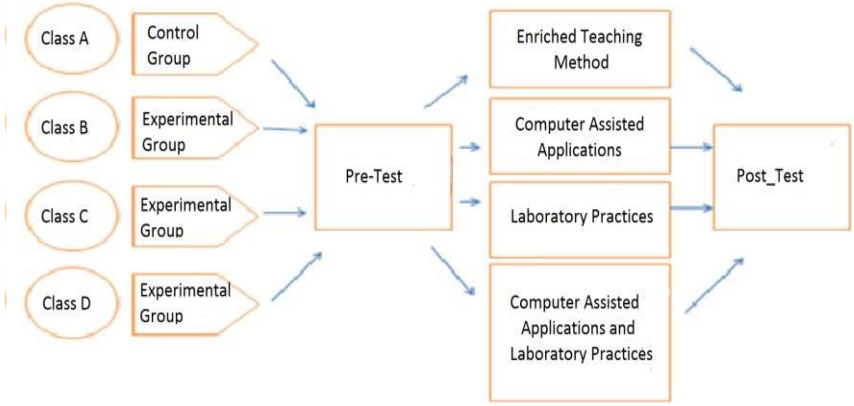

Figure 1. Study Diagram

Study group

The sample for the study was chosen from the 8th grade students attending a state secondary school in Samsun province in the 2013-2014 academic years. The elementary science curriculum includes a helical structure, and the extent of the program gradually expands from the fifth grade to the eighth grade, where it becomes most comprehensive. Therefore, eighth grade was chosen, and instructions were implemented to this group of students. A random sampling method was used in the study. The sample consisted of one control and three experimental groups. The experimental groups were named the laboratory group, the computer group and the computer +laboratory group. Demographic data from the groups are presented in Table 1.

Table 1. Distribution of Groups by Gender

	Girl		Boy		Total
	N	%	N	%	N
Control Group	19	54	16	46	35
Laboratory Group	18	53	16	47	34
Computer Group	17	50	17	50	34
Computer + Laboratory Group	16	53	14	47	30

Course Implementation Process

The course of the lessons is shown below as sub-headings.

Implementation in the Control Group

The lessons were taught to this group of students by implementing a method enriched by the lecturer. There was no intervention during the lessons, but it was observed that the teacher often preferred narrating techniques and used warm-ups by providing related information or making jokes. The teacher also allowed students to take note sand used question-answer methods. In addition, the teacher rarely included activities in the courses except for two: an experiment with sound on a string instrument and sound generation with a tuning fork. The procedures for this implementation are shown in Figure 2.

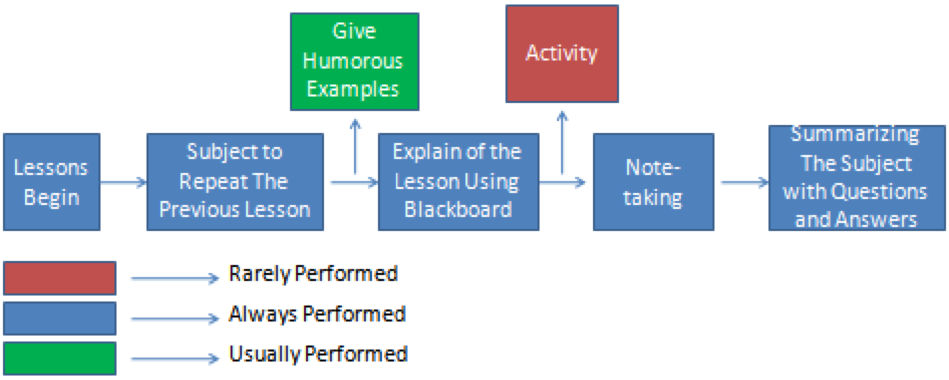

Figure 2. Course Outline for the Control Group

Implementation in the Laboratory Group

In this group, the lessons were taught using laboratory activities, and the lesson plans were prepared by the researcher. To draw students' attention in this group, warm-ups were frequently used. Experiments related to the desired acquisitions were then performed by the students. Before the experiments, reports about the experiments were distributed, and the students were asked to fill them out. Experiments were performed in groups. Groups were formed before the instruction and did not change during the procedure. Students were separated into groups to discuss the results and to reach a conclusion cooperatively. Students asked all kinds of question related to the experiments. The teacher was only a guide for the students and did not transfer any knowledge to them to make them reach a desired conclusion. After the experiments, the results were discussed by the class, and conclusions were reached. The teacher finally gave the definitions related to the concepts. At the end of the course, the lessons were outlined, and learning was reinforced with examples. Reports of the experiments were collected from the students after the completion of the course. The procedures for this implementation are shown in Figure 3.

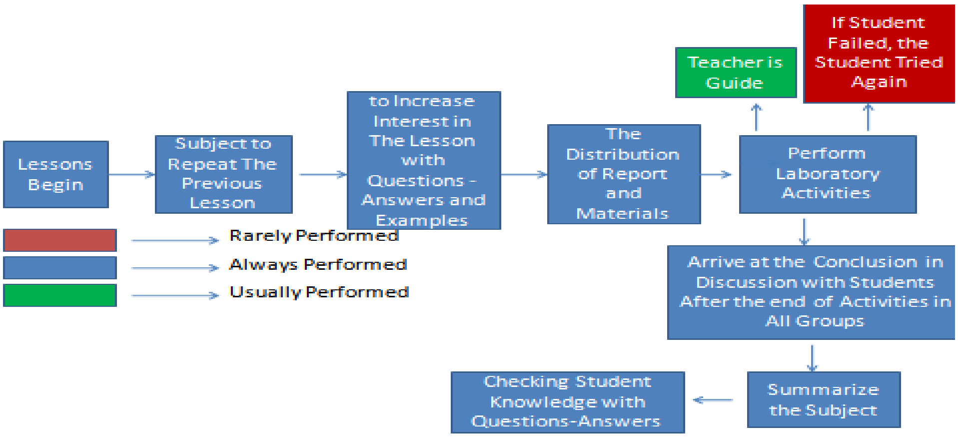

Figure 3. Course Outline for the Laboratory Group

Implementations in Computer Group

In this group, instructions were supported by the computer implementations prepared by the researcher. As a warm up activity, the previous subjects were revised and students were asked questions about the subject. Students' motivations were tried to be maintained by making use of question-answer method. After drawing students' attention, animations, videos and simulations were watched by the students and the necessary instructions were implemented. Where necessary, the teacher stopped playing the animations, videos and simulations and made statements about the subject and repeated the implementations. Thus, complete instruction was achieved. The computer- assisted activities to be implemented were reviewed by the lecturer and the researcher one week before the implementation. Thus, the teacher had a chance to grasp the computer implementations and possible troubles that may occur during the implementation were minimized. The students watched animations, simulations and videos with interest, the teacher made statements about the implementations and asked them questions about what they have understood from the animations. At the end of the course, the subject was summed up and the knowledge of the students was checked by question-answer method. Procedures during the implementation are shown in Figure 4 roughly.

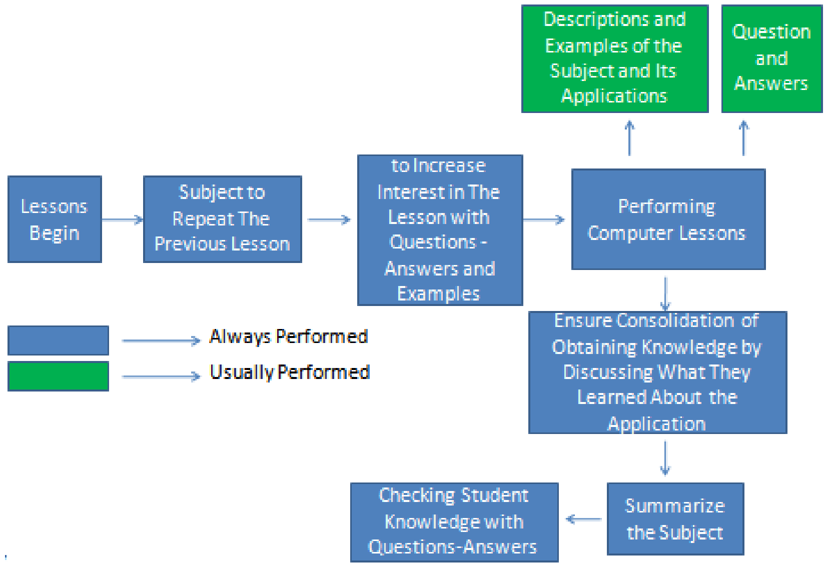

Figure 4. Course outline for the computer- assisted group

Implementation in the Computer + Laboratory Group

In this group, the lesson plan was prepared by the researcher and enriched with computer lessons and laboratory activities. The implementation in this group included instructions in both computer and laboratory groups. However, some computer lessons and lab activities were eliminated. In other words, all lessons were not implemented. Starting the lesson (warm-up), motivational techniques, and implementations were the same as in other groups. The lessons began with the revision of the previous subjects, motivation was maintained with questions, answers and examples, and then, computer lessons and laboratory activities related to animations were carried out. Issues related to laboratory activities and computer-assisted lessons were also considered in this group. At the end of the course, the subjects were summed up by the students, and their knowledge was checked using the question-answer method. The procedures for this implementation are shown in Figure 5.

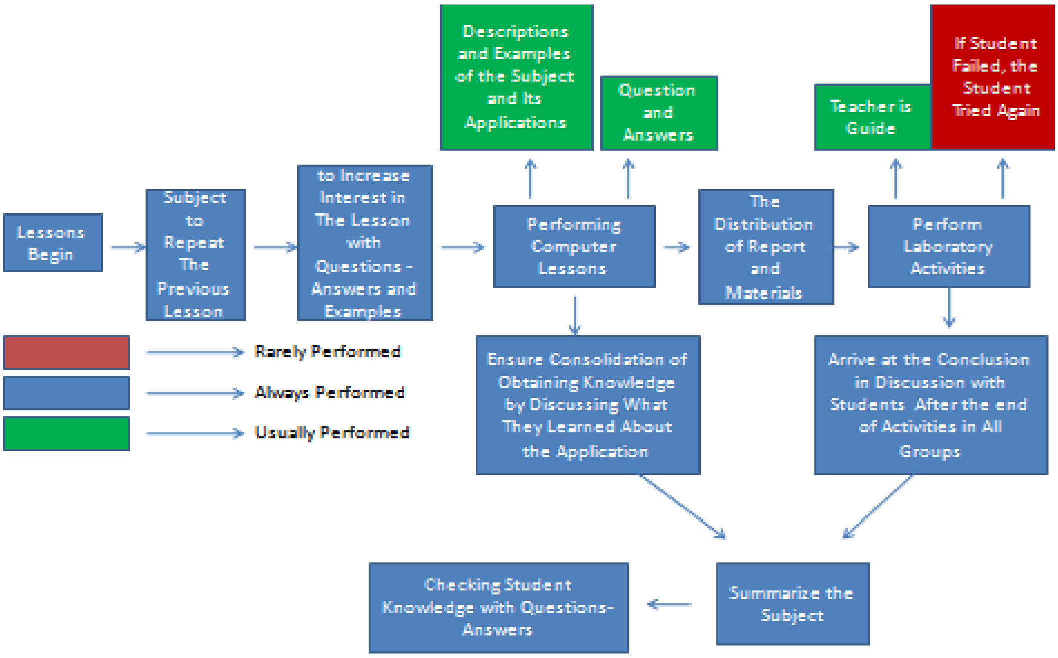

Figure 5. Course Outline for the Computer + Laboratory Group

Development and Implementation of the Assessment Tool

The scale used in the study, the Sound Achievement Test (SAT), was developed by the researchers (Sözen and Bolat, 2016).The questions were prepared by utilizing various sources, such as test books and high school entrance exams, in accordance with the acquisitions involved in the eighth grade curriculum. The pilot test was applied to 234 ninth grade students. The preparation process for the measurement tool is shown in Figure 6.

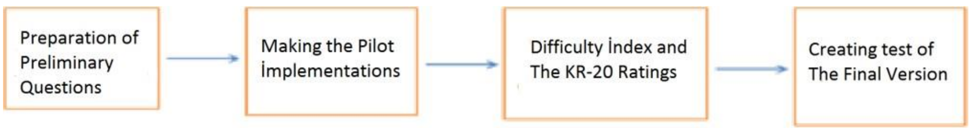

Figure 6. Preparation Process for the Questions

The KR-20 and item analysis results of the pilot and final form of the prepared test are shown in Table 2

Table 2. Difficulty, Discrimination and KR-20 Values for the SAT

	Total Item	N	Difficulty p	Discrimination rjx	KR 20
Pilot	85	234	0.55	0.57	0.92
Final	43	234	0.59	0.53	0.83

According to the analysis results, the KR-20 for the pilot test was 0.92. As a result of item analysis applied to the pilot test, a final test consisting of 43 questions was created. The KR-20 for the 43-question test was 0.83, which is a suitable value for the reliability of achievement tests (Saipanish et al., 2015). The final form of targeted subjects, question numbers and the number of questions on the SAT are given in Table 3.

Table 3. The Number of Questions Involving the Concepts and the Questions Covering Those Concepts

Subjects targeted by the test	Question no	Number of questions
The propagation and production of sound	5, 13, 16, 19, 30,36	6
The speed of sound	1, 4, 11, 20, 32, 35	6
The energy of the sound	9, 14, 15, 21, 23, 34	6
Musical instruments and concepts of sound	7, 24, 26, 27, 31, 39, 40, 41,42, 43	10
The sound features (height, intensity and frequency)	2, 3, 6, 8, 10, 12, 17, 18, 22, 25, 28, 29, 33, 37, 38	15

Data Analysis

To test the neutrality of the groups, SAT scores were compared before analyzing the data to determine whether the groups are homogenous or equal. Normal distribution was assessed by the Kolmogorov-Smirnov test (Yazıcıoğlu and Erdoğan, 2004; Ural and Kılıç, 2005).Table 4 shows achievement test pre- and post-test data from the control and experimental groups and the Kolmogorov-Smirnov and p values.

Table 4. Normal Distribution of Pre- and Post-Test Data

SAT	Pre-Test	Post-Test
Kolmogorov-Smirnov (Z)	1.340	0.979
p	0.550*	0.293*

*p>0.05

A significance value (p) in Table 5 greater than 0.05 shows that the pre- and post-test data from the students in the control and experimental groups had a normal distribution. The above results demonstrate that the results fit anormal distribution. It is impossible to infer from these results on a group basis. Therefore, the normal distribution of the data on a class basis is shown in Table 5.

Table 5. Data Showing the Normal Distribution Test of the Control and Experimental Group Pre- and Post-Test

	Pre-test				Post-test			
	Computer	**Control**	**Com+Lab**	**Laboratory**	**Computer**	**Control**	**Com+Lab**	**Laboratory**
Kolmogorov -Smirnov (Z)	0.761	0.971	1.094	0.475	0.746	0.627	0.591	0.526
p	0.608*	0.302*	0.182*	0.978*	0.633*	0.826*	0.875*	0.945*

*p>0.05

Significance values specified in Table 6 greater than 0.05 show that pre- and post-test data from the students in the control and experimental groups had a normal distribution. In light of these data, the groups are similar in terms of pre- and post-test scores. On the basis of these results, whether the implementations were parametric or nonparametric was determined with the number of students. To use parametric tests, data should be quantitatively normally distributed and homogenous with sample size greater than 30 (Ural and Kılıç, 2005). Because the sample size is greater than 30, and the data were normally distributed, one-way analysis of variance (ANOVA), aparametric test, was used to analyze the data. ANOVA compares the means of two or more groups on a single independent variable (Ural and Kılıç, 2005; Yazıcıoğlu and Erdoğan, 2004). For this reason, the equality of variance was tested, and significance was interpreted according to the post-hoc test results (Büyüköztürk et al., 2010).

FINDINGS

Statistical analysis of the data obtained from the study was performed, and a p-value of 0.05 was considered significant. In this study, we aimed to determine whether there was a significant difference between pre- and post-test scores of the 8th grade control and experimental groups. Table 6 shows the mean and standard deviation values of the pretest scores of the control and experimental groups.

Table 6. Pre-Test Descriptive Statistics of the Groups

Groups	N	Mean	SD
Control Group	35	17.86	5.05
Laboratory Group	34	18.38	7.20
Computer Group	34	19.29	5.56
Computer and Laboratory Group	30	16.77	7.32

Table 7 provides the results of one-way analysis of variance achievement test scores of the control and experimental groups.

Table 7. Pre-Test One-Way Analysis of Variance

SourceofVariance	Sum of Squares	df	Mean Squares	f	p
Between Groups	106.568	3	35.523	0.889	0.449
Within Groups	5152.741	129	39.944		
Total	5259.308	132			

(p>0.05)

As seen in Table 7, no significant differences were observed between the achievement test scores of the students in the control and experimental groups (p>0.05). In Table 8, pre- and post-test results of the groups were matched within the groups, and the results of the differences between the two groups (paired-samples t-test) are shown to demonstrate whether pre- and posttest results were significant within the groups.

Table 8. Paired-Samples t-test Results of the Pre- and Post-Test

Groups	Standard Deviation	t	df	p
Computer Group	6.94234	-10.524	33	0.001*
Computer and Laboratory Group	6.71043	-12.298	29	0.000*
Laboratory Group	10.64849	-4.348	33	0.000*
Control Group	7.58481	-5.460	34	0.000*

*p<0.05

Table 8 shows paired-sample t-test results for each group. There was a significant difference between pre- and post-test scores in favor of post-test scores (p<0.05).

The mean and standard deviation results of the control and experimental groups for post-test scores are given in Table 9.

Table 9. Post-test Descriptive Statistics of the Groups

Groups	N	Mean	SD
Control Group	35	24.86	7.19
Laboratory Group	34	30.79	7.42
Computer Group	34	27.24	9.05
Computer and Laboratory Group	30	31.73	7.71

Table 10 presents the one-way analysis of variance results for the control and experimental groups' achievement post-test scores.

Table 10. Post-test One-Way Analysis of Variance

SourceofVariance	Sum of Squares	df	Mean Squares	f	p
Between Groups	996.646	3	332.215	5.334	0.002*
Within Groups	8034.286	129	62.281		
Total	9013.098	132			

*p<0.05

Analysis of the achievement test scores showed a significant difference between control and experimental groups (p <0.05). Tukey's HSD test, a post-hoc technique, was performed to determine the source of differences obtained from the one-way ANOVA. The results are presented in Table 11.

Table 11. Tukey's HSD Test Results for Achievement Test Post-Test Scores for the Control and Experimental Groups

Groups		Mean Difference	p
Control Group	Com. and Lab. Group	6.88	0.003*
	Computer Group	2.38	0.594
	Laboratory Group	5.94	0.011*
Computer and Laboratory Group	Control Group	6.88	0.003*
	Computer Group	4.50	0.108
	Laboratory Group	0.94	0.594
Computer Group	Control Group	2.38	0.108
	Laboratory Group	4.50	0.964
	Com. and Lab. Group	3.56	0.249
Laboratory Group	Control Group	5.94	0.011*
	Com. and Lab. Group	0.94	0.964
	Computer Group	3.56	0.249

*p<0.05

Tukey's HSD test was performed to make pair wise comparisons of the achievement test scores of the students instructed with different teaching methods. According to the results in Table 11, there were significant differences between the control group and the computer and laboratory groups in favor of the computer and laboratory group (p<0.05). In addition, significant differences were observed between the control and laboratory group scores in favor of the laboratory group (p<0.05). On the other hand, there were no significant differences between the control and computer groups with respect to post-test scores (p>0.05). No significant differences were observed between experimental groups. As seen in Tables 10 and 11, the most successful group was the computer + laboratory group. It will be useful to indicate the mean of the correct number of the answers in each section. Thus, the amount of increase in each section can also be expressed in detail. Table 12 shows the mean number of correct answers on the pre- and post-tests.

Table 12. The Percentage of Correct Answers by Section

		Pre-Test	Post-Test
Sections	**Groups**	**Mean (%)**	**Mean (%)**
1. Section (The propagation and	Control Group	35.1	46.2
	Laboratory Group	35.3	55.9
	Computer Group	37.4	50.3
	Com. and Lab. Group	24.3	65.0
2. Section (The speed of sound)	Control Group	32.0	43.4
	Laboratory Group	35.3	64.2
	Computer Group	40.0	42.6
	Com. and Lab. Group	30.7	66.0
3. Section (The energy of the sound)	Control Group	53.2	73.5
	Laboratory Group	56.0	74.7
	Computer Group	60.0	79.7
	Com. and Lab. Group	58.0	74.7
4. Section (Musical instruments and concepts of sound)	Control Group	32.8	52.1
	Laboratory Group	38.8	67.6
	Computer Group	38.5	57.1
	Com. and Lab. Group	35.3	67.3
5. Section (The sound features)	Control Group	36.9	54.3
	Laboratory Group	35.6	60.0
	Computer Group	38.0	55.9
	Com. and Lab. Group	32.3	67.3

When Table 12 was analyzed, it was observed that the mean pre-test scores were close in each group. On the other hand, according to the post-test results, the computer + laboratory group was more successful than other groups. When the computer + laboratory group is excluded, the laboratory group was the most successful group for all sections except for the energy and energy transformation section. The computer-assisted group was the most successful group for energy and energy transformation. For the speed of sound and musical instruments, the success levels of all groups except for the computer + laboratory group and the laboratory group seem to be quite low. With regard to the properties of sound and sound propagation, the computers + laboratory group was more successful than the other groups.

DISCUSSION AND CONCLUSION

According to the findings obtained from this study, which aimed to investigate the effect of using different methods in teaching the “sound unit” from secondary school science courses on student achievement, the mean score of the laboratory + computer group was higher than that of other groups (Table 9). The mean score of the laboratory group was close to that of the computer + laboratory group. As seen from Table 9, the differences between the post-test scores of the control and experimental groups were significant.

Paired-samples t-test results showed significant differences between the pre- and post-test results (Table 8). One way analysis of variance results showed that there were significant differences between the achievement of the students in the control group and those in experimental groups based on post-test achievement scores (Table 10).The difference between academic achievement post-test scores for the control and computer + laboratory groups favored the computer + laboratory group (Table 11). In addition, the difference between academic achievement post-test scores of the control and laboratory groups was significant and favored the laboratory group.

The results demonstrated that the highest achievement was observed in the computer + laboratory group. In contrast, the laboratory group students were more successful than those in the control and computer groups. Study results also revealed that the computer group did not improve more than the control group, suggesting that the laboratory is more effective than the computer and that, when supported by laboratory activities; computers may provide a more efficient method of teaching. In their study, Gunhaart and Srisawasd (2012) found that computer assisted instruction was an effective way to teach concepts related to the properties of sound (sound wave). These findings were not consistent with the findings of our study. There have also been studies demonstrating that computer-assisted instruction is effective for different aspects of science education (Akçay et al., 2005; Demircioğlu and Geban 1996; Jaakkola et al., 2011; Olympiou and Zacharia 2012; Pektaş et al., 2009; Saka and Yılmaz 2005; Zacharia, 2007). Papastergiou (2009) concluded that science education through computer animations and computer games positively affected students’ achievement and attitudes and can be used effectively in education. In his thesis study, Büyükkara (2011) investigated the effects of laboratory, computer-assisted instruction and 5E learning methods in teaching the sound topic and found that computer-assisted instruction was more effective than the other two methods. Pektas et al. (2009) showed that computer-assisted instruction affected student success in learning the sound and light unit involved in the fifth-grade courses. Sammons (1995) stated that computer-assisted instruction is quite useful in the schools and contributes to education. These studies are not consistent with our study because in this study the single implementation of computer-assisted instruction in teaching the sound unit was not effective.

In parallel with the results obtained in this study, Zacharie and Anderson (2003) investigated both experiments and simulations and found that experiments improved the students' ability to explain the concepts, where assimulations supported conceptual change. In their studies, Aktepe and Aktepe (2009) concluded that teachers frequently conduct experiments in science courses, and Aydoğdu and Ergin (2008) found that science experiments improve students' scientific process skills. Hançer, Şensor and Yıldırım (2003) reported that experiments are an important and indispensable part of an effective science education. In this study, the laboratory method was quite effective in teaching all the concepts of the sound unit involved in primary education programs, and when implemented along with computer-assisted instruction, it became more effective. Therefore, the results of the aforementioned studies are consistent with the findings of our study.

Okur (2009) evaluated student success as a result of different teaching methods and found that the 5E method of instruction was more effective than the other methods, including computer-assisted methods. In short, computer assisted instruction seems to be not as effective on its own. This finding is consistent with the findings of our study, which showed that computer-assisted instruction was not effective when implemented alone. Çalık, Okur and Taylor (2011) expressed that methods using conceptual change texts with computer animations and analogies were more effective. In his study, Coyne (2000) aimed to prepare manual laboratory activities related to sound wave sand light and stated that the success rate increases with the implementation of instruction provided by this method. Additionally, in their study, Aydoğdu and Ergin (2008) emphasized that experiments increased students' scientific process skills. Mueller et al. (2004) concluded that instruction of the sound unit with visual materials and activities (such as experiments) contributes to ensuring more permanent and effective learning. We obtained similar results. When the questions in the measurement tool (SAT) were analyzed with respect to sub-sections (Table 12), except for the "energy of the sound" section, changes in the other six subdivisions occurred in the computer + laboratory group. These results suggest that diversity in teaching methods is important for the instruction of sound concepts, such as sound production, advance of sound, velocity of sound and musical instruments. In addition, the percent age of the correct answers to the questions about sound energy in the pre-test was very high, which may be because this topic is frequently encountered in everyday life and is already understood by the students.

The study results can be summarized as follows.

- The success of the students in the computer and laboratory groups was higher than those in other groups.
- In addition, students in the laboratory group were significantly more successful than those in the control group.

- When compared with the control and other groups, the differences between the pre- and post-test scores of the students in the computer group were not significant, which suggests that the laboratory method is more effective than the computer method. However, when assisted by laboratory techniques, computer assisted instruction provides more effective learning.
- In conclusion, the laboratory method of teaching is more effective than the computer method of teaching in instructing all concepts of the sound topic involved in the elementary Science curriculum and, when implemented with computer-assisted instruction, its efficacy increases incrementally; the results obtained in this study showed that students in the "computer + laboratory" and "laboratory" groups were significantly more successful than those in "control" and "computer" groups.

SUGGESTIONS

- In the light of the data obtained, active learning approaches should be adapted during learning and teaching processes, as there were significant differences between post-test scores of 8th graders in favor of the laboratory and computer + laboratory groups.
- Especially while teaching science subjects that contain abstract concepts, activities that concretize abstract concepts and bring about meaningful learning should be included. Experiments, animations, videos and simulations can be used. Thus, students will do what they learn, and meaningful learning will be observed.
- This study was limited to 8th graders. Thus, further studies can be repeated for other grades.
- This study used laboratory, computer and computer + laboratory methods. Other studies can repeat this study by the changing methods analyzed to gain information about the effective teaching of the subject of sound.
- This study was a quantitative study. The same study can be supported with qualitative data, and the students' existing misconceptions and mental models can be explored.
- In addition, this study can be supported by developing and using an attitude scale to determine the extent to which these methods affect students' attitudies toward science.

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