

The Effects of Web 2.0 Tools Supported Inquiry-Based Activities on Students' Attitudes Towards Chemistry Lesson ¹

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SUMMARY

In this study, it was aimed to examine the effects of inquiry-based activities supported by web 2.0 tools on the attitudes of students towards the chemistry lesson in the unit of 'Acids, Bases and Salts' in the 10th grade chemistry lesson. Considering the relevant achievements in the 2018 chemistry curriculum and using the web 2.0 tools Padlet and Quizizz, the activities prepared were implemented, and the "Chemistry Lesson Attitude Scale", which was adapted into Turkish by Şenocak, was used as a data collection tool. The study, which was carried out with a quasi-experimental design with pretest-posttest control group, was carried out in the second term of the 2021-2022 academic year, in a high school in the Germencik district of Aydın, with a total of 51 students, one experimental (n=26) and one control (n=25) group. In the seven-week study, while the experimental group and the web 2.0 tools Padlet and Quizizz were used, the lessons were taught according to the current curriculum in the control group. As a result of the research, no significant difference was reached in the attitudes of the students towards the chemistry course. When the sub-dimensions of the chemistry attitude scale were examined, a significant difference was determined in favor of the pretest only in the "evaluative beliefs about school chemistry" of the control group.

Keywords: Acids, Bases and Salts, Web 2.0 Tools, Padlet, Quizizz

INTRODUCTION

In the globalizing world, there has been a rapid adaptation of technology in learning environments, as in all other fields, and curricula have been structured and updated to meet this competency. These updates are shaped according to the needs of the age and the human factor that is aimed to be raised. Raising multi-faceted, career-conscious individuals who are aware of their own potential in the future is related to the content of the curriculum and its practitioners. The main characters in the practitioners of the curriculum are the teachers. In the studies on teachers in the literature, we see that they resist change and prefer classical teaching methods for various reasons.

It is thought that classical teaching methods are one of the factors in the problems we encounter in education and that they are not sufficient in raising the individual needed in coordination with the rapid development of science and technology. The prominent features in the structure of classical teaching include intensive transfer of information (Aydın, 2021; Özkan, 2008), the active role of the teacher and the passive role of the student (Aydın, 2021; Cabur, 2019), the inability to direct students to environments where they will apply their knowledge (Aikins & Nyarko, 2019; Yanardağ, 2021), the fact that it is mostly limited to classroom practices (Kaynar, 2019), and the inability to highlight and develop students' individual differences (Ergin, 2009).

In order to eliminate these deficiencies and to raise strong and self-aware individuals, the search for innovations in science teaching intensified in the 1950s in the world. After the World War II, many curricula were developed and their common point was to train students in an investigative identity. The most prominent of these adaptations in our country are the CHEM Study (Chemistry Study), BSCS (Biological Science Curriculum Study) and PSSC (Physical Sciences Study Committee) curricula developed in the USA (United States). These programs were implemented in nearly 900 high schools until the 1980s, but were abolished in 1984 because they were unsuccessful. In the same process, in the West, it was determined that students' interest in science decreased and new approaches were tried to be developed that included more students (Ayas, 1995). With the arrangements made in the curriculum since 2005, constructivism, which will replace the traditional methods, enable the student to take an active role and develop the student cognitively, emotionally and socially, and teaching methods based on this approach have been tried to be revealed.

Feyzioğlu (2006) expressed the aims of teaching mathematics and science as scientific perception, knowing by research, designing, discovering, valuing and applying to life. It is not possible to realize these aims, which are

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aimed with traditional methods. In the chemistry course curriculum, a multidisciplinary curriculum has been created, in which the determined acquisitions are handled with the integrity of values, skills and competencies at every education level, thus leading to the use of metacognitive skills and providing permanent and meaningful learning (MEB, 2018). In the chemistry curriculum, the aim of education is stated as raising individuals with knowledge, skills and behaviors in an integrated structure.

In order to increase the effectiveness of chemistry teaching, it is recommended to determine appropriate methods and techniques that activate the student, instead of teaching methods in which the teacher is active and the student is more passive, and cannot sufficiently provide the opportunity for the student to learn by him or herself (Cabur, 2019). The pandemic process has also shown that technology, especially information technologies, will have an important place in these new methods and techniques that are needed and thought to be developed. In the 21st century, known as the information age, innovations and developments in information technologies have enabled these technologies to quickly take their place in education. There are many studies related to learning environments prepared using information technologies are effective in fostering 21st-century skills emphasized in instructional approaches (Çepiç, 2020; Korucu and Yücel, 2015; Yıldırım, 2020). Additionally, numerous researches have demonstrated that these learning environments have a significant contribution to students' academic achievement (Çelikler, Güneş, and Güneş, 2011; Çetinkaya, 2015; Durmaz, 2021; Keskin, 2021; Keskin, Karagölge, and Ceyhun, 2021; Küçükü, 2021; Şan, 2020; Yıldırım, 2020; Üker and Bülbül, 2021) and increasing their motivation levels (Çevikbaş, 2019). Using information technologies with appropriate teaching approaches (Çapkın, 2019; Eskicioğlu, 2021; Gündoğdu, 2017; Gürleroğlu, 2019; Kırmızıoğlu, 2018; Sönmez, 2018; Tekin, 2020) can further increase the effectiveness of teaching. The increasing number and diversity of web 2.0 tools can be considered as tools that can be continuously used, especially in constructivist-based instructional models, even though they were not initially designed for education (Arabacı, 2021). Due to the increasing emphasis on information technologies in the 2018 Chemistry curriculum compared to previous teaching programs, research related to the use of information tools in the delivery of chemistry lessons becomes more crucial and pioneering.

Chemistry is an integral part of our lives, yet students find it abstract and encounter difficulties in learning it (Baltacı, 2020). One of the units that students find challenging is the "Acids, Bases, and Salts" unit. In reality, many substances we use in our daily lives exhibit acid, base, and salt properties. Despite their widespread use in various aspects of life, it is observed that students do not sufficiently understand the reactions, beneficial and harmful aspects, and industrial importance of these substances, or they lack sufficient interest in the subject. To enhance students' interest and skills, it is possible to utilize information technologies, which students are highly interested in, to create more effective lesson content. Examining a limited number of studies conducted after 2018 that focused on the use of information technologies in the "Acids, Bases, and Salts" unit (Keskin et al., 2021; Kumbasar, 2019; Özkan, 2021), it has been determined that information technologies have a positive impact on students' academic achievements, logical thinking abilities, motivation, and attitude towards science subjects.

It is believed that the use of Web 2.0 tools significantly improves students' achievements in subjects where they have misconceptions due to abstract concepts, struggle to internalize the material when they cannot actively participate, and have low interest (Eskicioğlu, 2021). In many educational researches, it is suggested that Web 2.0 tools play an important role in overcoming these negative aspects. By adapting to the changing teaching approaches in the field of Science Education, it has become essential to explore various applications of Web 2.0 tools and investigate their impact on instruction. This will help in multiplying examples of how these tools can enrich the educational process.

In this study, the applications of the web 2.0 tools Padlet and Quizizz in the chemistry class are rarely encountered. Web 2.0 technologies hold significant potential for increasing learners' interest in education and instruction (Karaman, Yıldırım, and Kaban, 2008). The use of web 2.0 tools in teaching can facilitate students' active participation in lessons (Yaşar Sağlık and Yıldız, 2021), enable them to access the most current and functional information easily (Sarı, 2019), and support their socialization, empathy, and knowledge exchange through group work (Özudoğru, 2014). Through web 2.0 tools, students can see the results of their efforts by creating products, and the multisensory appeal of these tools can contribute to the retention of knowledge (Eskicioğlu, 2021). The reasons for selecting Padlet and Quizizz applications in the research are their easy installation, a wide range of features in free usage, compatibility with various devices, the ability to share both in-class and out-of-class environments, ease of learning how to use them, and suitability for high school students' level.

"Padlet" can also be defined as a digital wall (board). With the Padlet application, concept maps can be created for lessons to facilitate understanding and lists can be made for performance and project assignments. Özipek (2019) states that this digital board, which has many important features, can also be used by teachers for teaching purposes. This application enables the continuity of the learning process and duration since it can be used both in and outside of the classroom.

In this study, the information about activities to be conducted in lessons with Padlet was shared, allowing students to come prepared to class. Student groups were formed for experimental activities, and they were encouraged to

share visual materials such as photos and videos of the activities they performed during the lessons. Students were asked to redesign and arrange the theoretical information in the lesson content. The instructor shared prepared lecture notes with the students, and based on some of the shared lecture notes, in-class games were designed and organized. The picture below (Figure 1) shows a sharing from students' experimental activities.

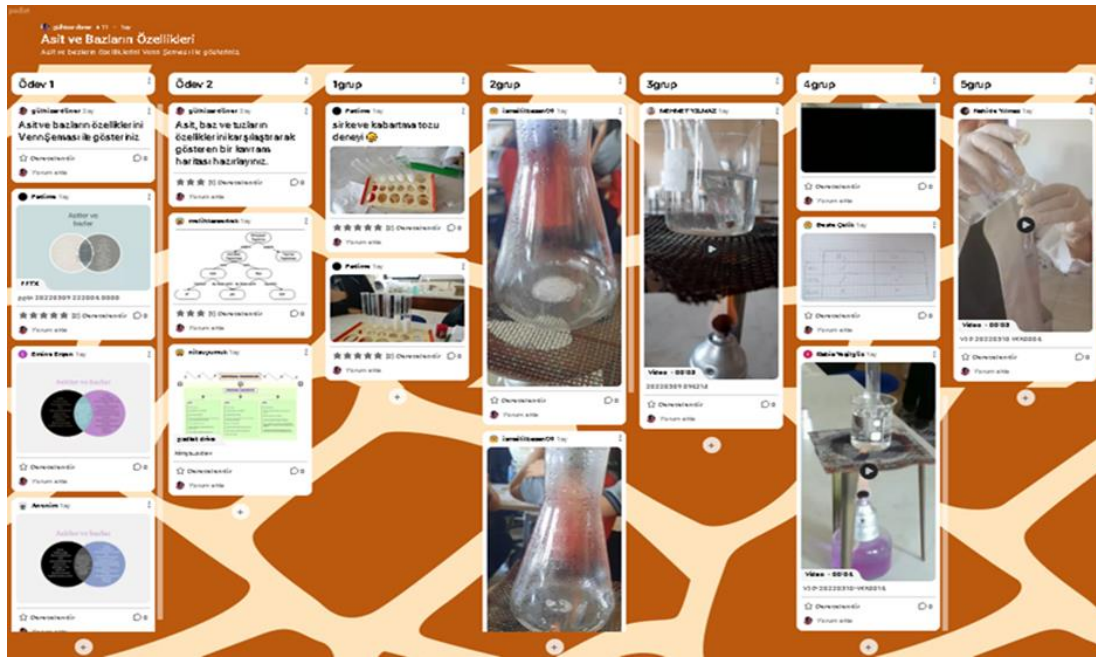


Figure 1. Dashboard view of students' shared experimental activities on Padlet

Quizizz, on the other hand, is a web 2.0 tool that can be installed on computers, tablets, and mobile devices and can be used in different stages of lessons, such as pre-preparation and evaluation. With its rich content and features, Quizizz is a user-friendly application that is easy to learn and implement by educators, making it easy to incorporate into lessons. After a survey, short quiz, or competition is prepared by the teacher or obtained from the application, students can easily connect to the system and answer the questions within the specified time frame. The app can be used for homework with necessary adjustments, allowing students to practice as much as they want and see their mistakes. The scoring of the competition or test can be based on both correct answers and speed. In this research, the Quizizz application was used to validate the results of laboratory activities and evaluate the achievements. The picture below (Figure 2) shows the result report of the answers given by the experimental group students.

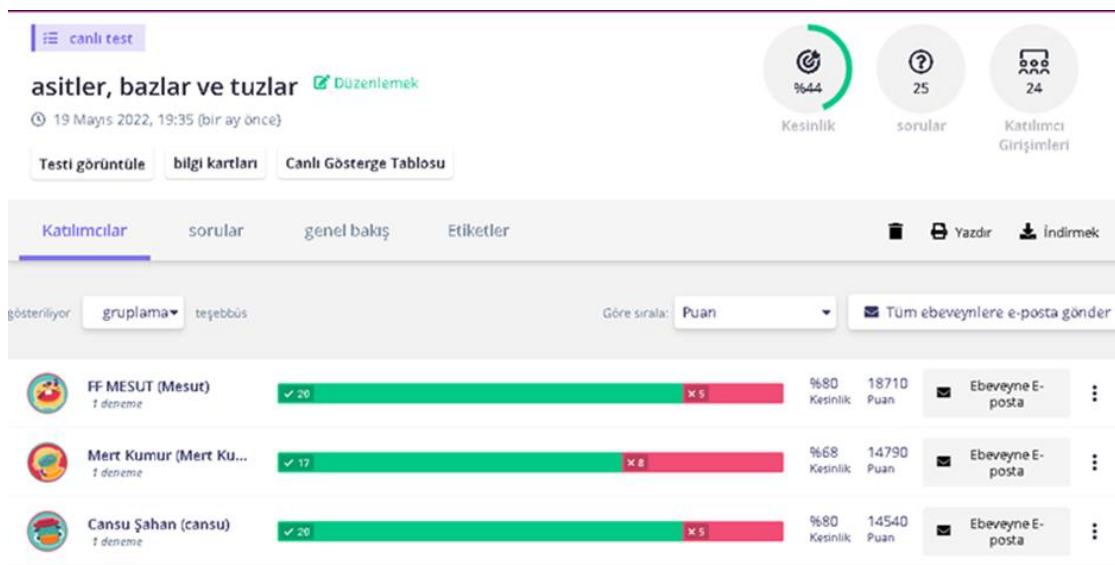


Figure 2. The result report of the answers given by the experimental group students.

There are a limited number of studies in the literature that include Quizizz application (Çevikbaş, 2019; Gül, 2022; Nerse, 2021; Şan, 2020; Zainuddin, Haruna & Kai Wah Chu, 2020). In most of these studies, it has been found that the Quizizz application positively affects students' attitudes towards the subject.

In this study, the impact of activities supported by web 2.0 tools such as Padlet and Quizizz in chemistry classes on students' attitudes towards chemistry was examined.

METHOD

Research Design

In this study, a semi-experimental design, which is one of the types of experimental research in quantitative studies, was used. Experimental research aims to determine the effects of created differences on the dependent variable (Büyüköztürk, 2016). The measurements obtained from the studied groups under at least two different conditions are compared. In two-group studies, there is an experimental group where the dependent variable is tested and a control group where usually no intervention is made (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, and Demirel, 2020).

Sample and Procedure

When determining the study groups, two classes with similar end-of-term chemistry course averages for the first semester of the 2021-2022 academic year were selected. At the beginning of the second semester, the researcher started teaching the classes of these two groups. One of the groups was randomly assigned as the experimental group, and the other as the control group. In the experimental group, chemistry activities supported by web 2.0 tools were implemented based on research inquiry, while in the control group, chemistry activities based on research inquiry were conducted without web 2.0 support. The study lasted for seven weeks for both groups, and both groups went through the processes of pre-test and post-test. The "Acids, Bases, and Salts" unit was taught for a total of five weeks and 15 class hours.

In the experimental group, activities supported by web 2.0 tools were used, and assessments were carried out, followed by the preparation of appropriate lesson plans. In the control group, lessons were conducted based on the activities included in the curriculum. Both groups used the activities found in the tenth-grade skill-based activity book and the chemistry textbook provided to students by the Ministry of National Education, General Directorate of Secondary Education, through the Education Information Network (EBA). The activities in both groups were based on a research inquiry approach.

Table 1. Numerical data of the study group

Groups	Female	Male	Total
Experimental Group	11	15	26
Control Group	13	12	25
Total	24	27	51

There are total of 6 tenth-grade classes in the school. There is no specific criterion for forming the classes. The number of students in the classes varies between 28 and 35. The researcher worked with two classes, 10A and 10E, where they taught. Class 10A, with 31 students, was assigned as the experimental group, and Class 10E, with 33 students were assigned as the control group, randomly. Three students from Class 10A and four students from Class 10E were excluded from the study because of continuous absenteeism. Additionally, a hearing-impaired student included in the Individualized Education Program (IEP) in Class 10E was not subjected to pre-tests and post-tests due to different learning outcomes, but participated in the activities. Two students from Class 10A and four students from Class 10E, who were included in the research but had irregular attendance and interrupted their education, were removed from the study. The numerical data of the groups included in the study are presented in Table 1.

Data Collection Tools

Şenocak (2011) adapted the scale developed by Cheung (2009) to determine the attitudes of secondary school students (aged 16-19) towards chemistry to Turkish. The scale, adapted by Şenocak (2011) to our language, consists of twelve items and four dimensions ("liking for theoretical chemistry classes," "liking for chemistry laboratory work," "evaluative beliefs about school chemistry," and "behavioral tendencies towards learning chemistry"). The scale, in a seven-point Likert-type format, has a calculated alpha reliability coefficient of 0.88.

Data Analysis

To determine whether the data follows a normal distribution, kurtosis and skewness coefficients were examined, and the Shapiro-Wilk test was used to check the normality of the scores. Based on this analysis, a decision was made regarding the use of parametric and nonparametric tests.

FINDINGS

The pre-test scores of the experimental and control groups regarding their attitudes towards the chemistry class are normally distributed (Experimental group (10A): Skewness=-0.449, Kurtosis=-0.623, Control group (10E): Skewness=-0.331, Kurtosis=-1.036, Std=0.902). As seen in Table 2, the independent samples t-test results indicate that there is no statistically significant difference ($t(49): 0.247, p>0.05$) between the pre-test scores of the groups. Since there is no significant difference in the pre-test scores for attitudes towards the chemistry class between the groups, both the paired samples t-test and independent samples t-test results are provided.

Table 2. Independent samples t-test results for the pre-test scores of the students in the experimental and control groups regarding their attitudes towards the chemistry class.

Group (Pre-Test)	n	\bar{X}	SD	t	df	p
Experimental Group	26	51,3	17,5	0,247	49	0,806
Control Group	25	50,2	12,9			

($p<0,05$)

The difference between the pre-test and post-test scores of the experimental group regarding their attitudes towards the chemistry course is normally distributed (Difference, Skewness=-0.046, Kurtosis=-0.807). As seen in Table 3, the paired samples t-test results indicate that there is no statistically significant difference ($t(25)=-0.843, p>0.05$) between the pre-test and post-test scores.

Table 3. Paired samples t-test results for the pre-test and post-test scores of the students in the experimental group regarding their attitudes towards the chemistry course.

Group (Experimental)	n	\bar{X}	SD	t	df	p
Pre-Test	26	51,3	17,5	-0,843	25	0,407
Post-Test	26	53,3	14,9			

($p<0,05$)

The difference between the pre-test and post-test scores of the control group regarding their attitudes towards the chemistry class is normally distributed (Difference, Shapiro-Wilk=0.911, $p>0.05$). As shown in Table 4, the paired samples t-test results indicate that there is no statistically significant difference ($t(24)=-0.928, p>0.05$, Cohen's d: 0.19) between the pre-test and post-test scores.

Table 4. Paired samples t-test results for the pre-test and post-test scores of the students in the control group regarding their attitudes towards the chemistry class.

Group (Control)	n	\bar{X}	SD	t	df	p
Pre-Test	25	50,24	12,9	0,928	24	0,363
Post-Test	25	47,12	14,6			

($p<0,05$)

The post-test scores of both the experimental and control groups regarding their attitudes towards the chemistry class are normally distributed (Experimental group (10A): Skewness=-0.637, Kurtosis=0.688, Control group (10E): Skewness=0.433, Kurtosis=-0.277). As seen in Table 5, the independent samples t-test results indicate that there is no statistically significant difference ($t(49)=1.497, p>0.05$) between the post-test scores of the groups.

Table 5. Independent samples t-test results for the post-test scores of the students in the experimental and control groups regarding their attitudes towards the chemistry class.

Group (Post-Test)	n	\bar{X}	SD	t	df	p
Experimental Group	26	53,31	14,93	1,497	49	0,141
Control Group	25	47,12	14,57			

($p<0,05$)

The findings obtained from the analyses indicate that there is no significant difference between the attitudes towards the chemistry class of the experimental group students, who were taught using web 2.0 supported instructional activities and inquiry-based approach, and the control group students, who were taught using only the inquiry-based approach.

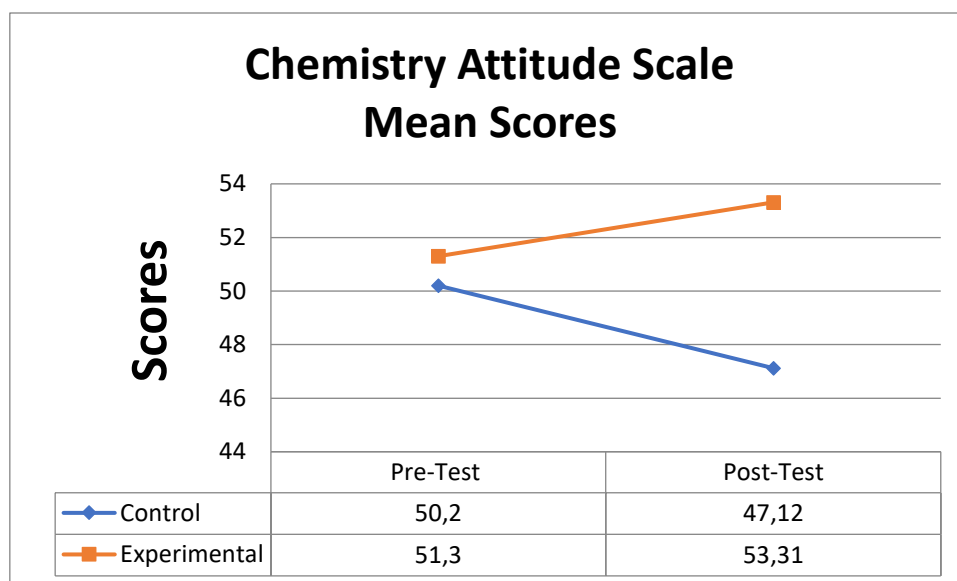


Figure 3. Graphical representation of scale score averages

Although there is no statistically significant difference in the score averages, the graph above (Figure 3) shows that while the score average of the control group decreased, the experimental group students, who were taught using Padlet and Quizizz tools, showed an increase in their attitude score averages.

When the same analyses were applied to the four subscales of the attitude scale, it was found that only in the "evaluative beliefs about school chemistry" subscale of the control group, there was a significant difference in favor of the pre-test. The attitude scores of the control group students decreased in this subscale, while no significant difference was found in the other analyses.

DISCUSSION and CONCLUSION

In this study, there was no significant difference observed in the attitudes towards chemistry lessons between the experimental group, where chemistry activities were supported with web 2.0 tools and taught through research-based inquiry, and the control group, where activities based on research-based inquiry were integrated into the instructional program. While some studies have found significant effects of instructional approaches supported by web 2.0 tools on attitudes towards science (Can and Usta, 2021; Çetin, 2010; Eskicioğlu, 2021; Gül, 2022; Hakkari, 2016; Özgen, 2017; Sarı, 2019), others have reported no significant differences (Gürleroğlu, 2019; M. Uysal, 2020; Ünal, 2012; Yanardağ, 2021; Yıldırım, 2020). Some studies recommend extending the duration of the application to observe differences in academic achievement and attitudes towards chemistry lessons (Gürleroğlu, 2019; Öztaş, 2016; Uysal, 2020). Öztaş (2016) examined the academic achievements of a group where 7E constructivist instructional model was used with computer support for three weeks and a control group where traditional methods were used in the context of biology lessons and found no significant difference between the two groups' academic success. In this study, it was emphasized that both groups' achievement improved and longer-term implementations might yield different results. Uysal (2020) investigated the impact of web 2.0-based animation applications in the fourth-grade science lessons on students' academic achievements, attitudes, and motivation. While a significant difference was found in academic achievement in the experimental group where the Powtoon application was used, no significant difference was found in attitudes and motivation. It was mentioned that attitude, being an affective characteristic, might be difficult to change in short periods, and longer-term studies could result in differences. Gürleroğlu (2019) interpreted the lack of difference in students' attitudes towards science as being due to the novelty of applications for students, their inability to adapt to technology, and the insufficient duration of the application. Time-consuming laboratory practices, students' inadequate readiness, delays in submitting assignments, and curriculum intensity might have affected the results of the study, and longer implementation periods might have yielded different findings.

As seen in many studies, the physical infrastructure of schools, the inadequacy of students' technological equipment both at school and at home, and the insufficient utilization of information technologies might negatively affect students' attitudes towards their lessons. This finding is consistent with the qualitative research conducted by Baltacı (2022) with high school students. In her study with tenth, eleventh, and twelfth-grade students, Baltacı (2022) examined the reasons for students' negative attitudes and motivations towards chemistry lessons and asked students to produce positive or negative metaphors. The most prominent factors in the data were the attitudes of chemistry teachers in the classroom, their professional knowledge, their ability to use technology, the non-use of the laboratory, the negative physical conditions of the school, and the belief that chemistry knowledge is not necessary in the careers they consider for the future.

In the study conducted by Özipek (2019), Padlet from web 2.0 tools was used in the experimental group, while the EBA smartboard application was used in the control group. There was no significant difference in the attitudes towards Turkish lessons between the two groups. Özipek conducted her research in a boarding school where there was no information technology class, and students did not have computers in their dormitory. Additionally, they could only use the Padlet application for two hours per week in class, and collaborative learning could not be implemented as desired. These factors might have contributed to the lack of significant difference in attitudes towards the lessons. Similar conditions were present in the physical environment where this research was conducted. Some of the students came from surrounding villages, and there were hardware and infrastructure problems. There was no well-equipped technology class.

The sub-dimensions of the chemistry attitude scale are as follows: enjoyment of theoretical chemistry lessons, enjoyment of chemistry laboratory work, evaluative beliefs about school chemistry, and behavioral tendencies towards learning chemistry.

From the four sub-dimensions of the chemistry attitude scale, only the control group's attitudes towards evaluative beliefs about school chemistry showed a significant decrease, while no significant difference was observed in the experimental group's post-test attitude scores in the same sub-dimension. The result for the control group in the evaluative beliefs about school chemistry sub-dimension might be attributed to the conceptual difficulty of the "Acids, Bases, and Salts" unit, the active involvement of students in experiments during lessons, and their unwillingness towards it. No change in attitude scores was detected in the other sub-dimensions for both groups. This result is consistent with other studies in the literature. We can conclude that students tend to resist changes in attitude, and it takes time for their attitudes to change.

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