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Abstract

In this study, the effect of internet-based applications on the academic achievement, motivation, and awareness of Web 2.0 tools of 6th grade middle school students on "Matter and Heat" was examined. The study group consisted of 73 (experimental: 50, control: 23) 6th grade students from a public school in Istanbul, Turkey. The study was conducted with an experimental design with pretest-posttest control group among quantitative research models. In the experimental group, science lessons were taught with the support of web 2.0 tools such as Nearpod, Canva and Quizizz, while in the control group, no additional application was made and the lessons were taught as specified in the curriculum. The data of the study were collected with the "Motivation Scale in Science Education", "Matter and Heat Achievement Test" and "Awareness Scale for Web 2.0 Tools". T-test and one-way factor analysis (ANCOVA) test were used to analyze the data. The results of this study showed that the academic achievement test scores of the experimental group students were higher than the control group and there was a significant difference between the academic achievement test scores of the experimental and control groups. The results showed that the science motivation scores showed a significant difference in favor of the experimental group and the science motivation scores of the experimental group students who were supported with web-based applications were higher than the control group. In addition, according to the results of the one-way analysis of covariance regarding the awareness of web 2.0 tools, there was a significant difference between the experimental group and the control group in favor of the experimental group in the post-test scores. In this study, the importance of planning and implementing science lessons supported by internet-based applications at the secondary school level was revealed.

Introduction

Advances in science and technology are the most important indicators of a country's development. Science and technology are two concepts that are in cooperation. The main goal of states is to raise people who can think creatively, solve problems, make sense of and interpret information, and produce new knowledge and technologies in this context (Mısır, 2017; Kaplan Öztuna, 2013). In recent years, with the innovations made in science education, it has been emphasized that learners should have modern science thinking and the main goal of science course is to educate students as science literate (Lederman & Lederman, 2004). In Turkey, the Ministry of National Education (MoNE) made a number of new arrangements in the science curriculum in 2005, 2013 and 2017. In 2018, MoNE published the expected characteristics of technology literate students in the science curriculum. In terms of "digital competence", it was described that students should be able to access information, record information, produce original information and participate in common connections on the internet by making active, reliable and critical use of information and communication technologies (MoNE, 2018). With these regulations, the vision of science courses is defined as educating students to be science and technology literate individuals. Developments in science and technology differentiate the structure of communities and necessitate the metamorphosis of education to ensure integration into communities. Educational applications in technological devices (smart boards, mobile phones, tablets, computers) used in the learning environment add excitement to students' learning processes (Bediroğlu, 2021). Because of changes in information technologies, education is changing (Alkan, 2005). This process of change in education continues in an uninterrupted and unpredictable manner. Also, education and training environments have moved to internet networks, virtual world and digital environments (Şirin, 2016). Applications developed as a result of changes in information technologies are used for this purpose even if they are not intended to contribute to education and training. These applications change and enrich learning environments and learning styles and even the roles of students and teachers (Arslan & Elibol, 2015). The idea of technology in education has been expressed as another way of connecting with students other than direct interaction (Bates & Poole, 2003). Since the current century students are Generation Z people who are one with technology, it can be argued that the use of modern technologies in the educational atmosphere is important in terms of enabling students to assimilate information more effectively (Korkmaz et al., 2019).

The main element of technology-supported teaching in the century we live in is the internet. The era we are in is a period in which the internet is completely important, digital applications take place more in daily life and the communication styles of the masses have changed (Arslan & Elibol, 2015; Kirbas & Bulut, 2024; Ozturk, 2023). The use of the Internet during teaching allows students to learn according to their personal pace (Aykaç, 2014). According to Yıldız (2014), with the introduction of technology into teaching environments, it has become easier to achieve course outcomes and has made significant contributions to the concretization of abstract subjects. Technology improves the quality of teaching and makes teaching activities fun. The teaching process equipped and developed with technology increases the interaction between students and teachers and creates more qualified teaching environments (Afşin, 2015). Especially the technological development of portable devices can offer more interaction opportunities for teaching environments than in previous times and play a role in organizing more realistic multimedia elements. The incredible increase in the speed of network systems has greatly facilitated the sharing of multimedia elements in the teaching environment (Özdemir, 2017). The use of technology in teaching activities increases the level of individuals' perception of the lessons; improves the level of access to knowledge of all students in terms of learning outcomes; provides an unbiased evaluation of student achievements; provides opportunities for each learner to suit their personal characteristics during learning; reduces the rate of students forgetting their knowledge; encourages students by preparing an innovative and modern learning environment; motivates students to participate in in-class activities and provides lifelong learning opportunities (Alpar et al., 2007; Cetin & Bora, 2023; Kaphle & Rana, 2023; Otgonbaatar & Miyejav, 2024; Yulia et al., 2024).

In the century we live in, the main element of technology-supported teaching is the Internet. The term web is a system that enables the sharing and access to data such as music, videos, pictures and documents on this platform with the active use of the internet (Davis, 2008). The internet, which started to develop with Web 1.0, is the point where users can transform what is on it instead of one-way communication with Web 2.0 (Bozkurt, 2013). With the developing needs, some changes have occurred in the web since the aim is not only the presentation of information, but also the organization and publication of information through users. As a result, the classical term web 1.0 has developed and evolved into web 2.0 (Cormode & Krishnamurthy, 2008). With Web 2.0, the internet has turned into an environment where ready-made information is not only disseminated and shared, but also its content is produced, published, connected and transferred with the cooperation of the participants (Horzum, 2010). It has become imperative to use Web 2.0 applications actively in education and training within the possibilities for lessons with more student participation and interaction. Today, Web 2.0 applications are used by instructors to increase the knowledge of learners about a subject and deliver it to all students (Abou Afach et al., 2018). In Internet-based teaching studies, both student achievement has been positively affected and it has been observed that students' high-level cognitive thinking skills have increased.

For this reason, it was deemed important to utilize these tools, which enable active use of all senses, during education and training. Related literature has shown that there is a significant difference in favor of internet-based teaching processes in studies comparing internet-based teaching practices with traditional teaching methods (Akçay et al., 2003; Altawalbeh, 2023**;** Chang, 2002;). With advancing technology, internet tools have proliferated and web 2.0 tools that can be easily applied in education have emerged. With the Covid-19 outbreak at the end of 2019, distance education has gained importance. For this reason, there has been a significant increase in the use of technology in education and Web 2.0 tools have facilitated education in this context. However, it has been determined in the literature that studies using Web 2.0 tools in science education in Turkey are quite weak. In addition, in the context of an experimental study, there is no study that examines middle school students' academic achievement, motivation and awareness of Web 2.0 tools for a specific science subject in the science curriculum as a whole. Therefore, this study aims to examine the effect of Internet-based applications on the academic achievement, motivation, and awareness of Web 2.0 tools of 6th grade middle school students on "Matter and Heat". It is thought that this study will set an example for teachers for teaching science lessons with Web 2.0 tools and encourage them to use these tools. In this context, the research questions guiding the study are as follows:

RQ1. Is there a significant difference in terms of academic achievement between the students (experimental group) who were supported with internet-based applications and the students (control group) who were supported with the current science curriculum?

RQ2. Is there a significant difference in terms of science course motivation between the students (experimental group) who were supported with Internet-based applications and the students (control group) who were supported with the current science curriculum?

RQ3. Is there a significant difference in terms of awareness of web 2.0 tools between the students (experimental group) who were supported with internet-based applications and the students (control group) who were educated with the current science curriculum?

Theoretical Framework

Technology Use in Science Education and Web 2.0

The use of technological devices in learning environments has become as widespread as possible and academic studies on this subject suggest that the integration of education and technology should be strengthened (Aksoy, 2003). In particular, the technological development of portable devices plays a role in the organization of more realistic multimedia elements that can offer more interaction opportunities and more realistic multimedia elements for educational and training environments than in previous times. The incredible increase in the speed of network systems has greatly facilitated the sharing of multimedia elements in the teaching environment (Özdemir, 2017). For these reasons, it is thought that education and training environments carried out with traditional methods will be insufficient to attract students' attention and gather their attention as in previous generations (Somyürek, 2014).

Especially in the teaching of courses such as science and mathematics, there has been a greater need for these technological applications and it has become easier to benefit from these materials. Thus, web 2.0 applications have become more widely used in learning environments (Greenhow et al., 2009). The education and training process equipped and developed with technology increases the interaction between students and teachers and creates more lively education and training environments (Afşin, 2015). In many countries around the world, especially in the USA and China, there are activities to integrate technology into education. The common aim of these activities is to improve the quality of education and training by using technology and at the same time to adapt the teaching activities to the current era. Since the introduction of the Internet, technologies and how these technologies are used have undergone a continuous evolution. Web 2.0 is a complex umbrella concept that includes many applications (Fuchs, 2014). Web 2.0 tools, virtual worlds, simulations, haptics and mobile technologies continue this trend of co-evolution and provide a new beginning to understand what the trajectory of this co-evolution will be. Web 2.0 tools not only publish, but also encourage and support users to upload and share digital information. The social interface of Web 2.0 provides users with new ways to communicate with each other, share ideas and debate (Conole & Alevizou, 2010). Web 2.0 tools have been called social software according to Horzum (2010) and are transforming from being web readers to web literate. Moreover, with Web 2.0, the internet has transformed into an environment where ready-made information is not only disseminated and shared, but also where its content is produced, published, connected and transferred with the cooperation of the participants. In a science teaching environment using Web 2.0 tools, the teacher can monitor how much students make sense of and evaluate a problem or information (Bediroğlu, 2021). In this way, the education and training process will be under the control of the teacher and he/she will be able to intervene in case of possible deficiencies because he/she observes the whole process. While there are many web 2.0 tools, the web 2.0 tools used in this study and their features are as follows:

Quizizz: It is a game-centered tool that enables multi-player and more enjoyable activities in the classroom. In the classroom, students can participate in the exercises simultaneously with their own electronic devices. It differs from other tools in that it has fun avatars, themes and music within the application, making it similar to a game. It creates an environment of competition among students and provides competition. Thus, it encourages students to study. All students in the class take the test simultaneously and can see the results live. The teacher follows this process and can observe the report while evaluating the students (Zhao, 2019).

Learningapps: It is an application that enables educators to create activities that can be implemented in a digital environment such as puzzles, voting, word matching, gap filling (Susanti et al., 2021). Research indicates that the application of gamification for educational purposes can encourage students, raise their interest, create an exciting experience, and motivate learning and problem solving (Dyer, 2020).

Wordwall: It is an educational tool that can be played interactively or individually, such as matching, wheel of fortune, puzzle, quiz, etc. The instructor can create games related to the topic from existing templates and add words or pictures (Çil, 2021). Interactions can be implemented on any web-enabled device such as a computer, tablet, phone or interactive whiteboard. Students can do them individually or take turns in front of the class. The app features arcade-style games such as Maze Chase and Airplane. The teacher can switch between templates with just one click. This feature allows differentiation of activities and saves the teacher time (Bueno et al., 2022).

Nearpod: It is a multi-platform e-learning tool where students interact with each other and the teacher simultaneously, regardless of the size of the learning space (Ryan, 2017). The use of Nearpod in lessons is an excellent tool for student engagement and motivation. Nearpod software has been found to be very useful by both students and lecturers, especially its attention-grabbing features (Beranek et al., 2014). Presentations from Powerpoint or PDF files can be imported to the platform. A hyperlink can be established to redirect to another web page. On this platform, the teacher can share presentations synchronously or asynchronously and can include a digital board, questionnaire, drawing area, three-dimensional visuals, and fun games for assessment. In survey mode, students can share their answers without their names appearing.

Canva: It is an intuitive, drag-and-drop, web-based design tool that can be used to design banners and documents. The platform is free when designing with your own images. Canva is a website that can be used to design, edit images, create reports, presentations, brochures, flyers, Web site mock-ups (Klug & Williams, 2016). It is a site with a useful interface that allows you to add images from your own library, add text with various colors and fonts, create and edit presentations, infographics, banners, videos, and has an application for both websites and mobile phones.

Bubbl.us: Mind maps, a type of visual organizer, can be very effective in helping students organize their thoughts while brainstorming (Davies, 2011). Bubbl.us is a free, easy-to-use, brainstorming website that allows users to create visual tools and mind maps related to topics (Stair, 2013).*Phet :* PhET simulation is one of the most effective tools in science teaching today. It gives students the chance to participate in activities and allows them to practice simulation exercises in the most appropriate places (Salame & Makki, 2021). PhET simulation is an effective tool for students to strengthen their critical thinking skills in physics discipline (Sulisworo et al., 2019; Gottschalk, 2018).

Google Forms: Google forms is an application provided by Google free of charge to meet the needs of users in the form of templates and has various functions and uses (Simarmata et al., 2018). According to Simarmata et al.

(2018), various forms such as questionnaires, exam forms, activity sheets, all of which can be done online (paperless) can be used for learning purposes.

Related Research

As a result of their study, Deperlioğlu and Köse (2010) stated that Web 2.0 tools have a lot of interaction, are effective for creating a multi-faceted education process, and that face-to-face education prepared by combining technology will create an efficient blended learning method. In his master's study, Gürleroğlu (2019) investigated the effect of using web 2.0 tools according to the 5E method in teaching "Force and Energy" subjects to seventh grade students on students' achievement, motivation, attitude and digital literacy. As a result of the research, while there was a significant difference in favor of the students in the experimental group in terms of achievement and motivation, there was no significant difference in terms of their attitudes towards science course and digital literacy. It was stated that the opinions of the experimental group students towards web 2.0 tools were positive. In the master's study conducted by Sarı (2019), it was stated that in the science course developed with web 2.0 applications, students were eager to complete the in-class activities, the teacher and students became more active during education, and there was an increase in students' cooperation.

In their study, Kırıkkaya and Yıldırım (2021) stated that the "Interaction of Light with Matter" lessons created with web 2.0 applications positively affected students' achievement and individual learning levels with technology. It was found that gender did not have an effect on achievement and individual learning level. Korkut et al. (2021) aimed to reveal the effect of using web 2.0 applications in online science lessons created with the 5E method on the achievement and digital literacy of fifth grade students. The results showed that while the academic achievement of the science lesson group using web 2.0 tools increased, there was no difference in the achievement of the control group. There was no significant difference between the digital literacy scale scores of both groups. As a result of the interviews and observations made with the students in the experimental group, it was revealed that the science lesson using web 2.0 applications was more interesting and easier to remember. In Mason's (2016) study, students stated that web 2.0 applications were useful to increase their course scores and to get information about the course. Jena et al. (2018) concluded that collaborative and individual web 2.0 applications had significant effects on middle school students' learning achievement and self-regulation of learning compared to traditional learning method. Burton (2019) stated in his study that using Nearpod, one of the web 2.0 tools, increased student participation in lessons.

Method

Research Model

In this study, a quasi-experimental design with pretest-posttest control group was used among quantitative research methods. Quasi-experimental design is a design in which there is matching on the groups but there is no random assignment (Büyüköztürk et al., 2012). Due to the quasi-experimental design of the research, the application was carried out in a state secondary school determined through convenient sampling. The research was applied in a total of four classes, two experimental groups and two control groups.

Participants

The implementation group of the study consisted of 6th grade students in a state secondary school in Başakşehir district of Istanbul. The implementation group consisted of a total of 73 students, 50 in the experimental group and 23 in the control group. Care was taken to ensure that all classes were at similar levels in terms of achievement. The school where the study was conducted is a public secondary school where the researcher works. For this reason, the study group was determined through convenience sampling. The classes in which the researcher conducts the 6th grade science course were preferred.

Research Implementation

The research was implemented in a total of four classes, two experimental and two control groups. The research was implemented within the framework of the 6th grade science course in the fall semester of the 2020-2021 academic year. This research was implemented within the scope of the 6th grade science course "Matter and Heat" unit. Two of the classes selected for the study were determined as the experimental group and two as the control group. In the experimental group, science lessons were carried out with the support of web tools, while in the control group, lessons were taught in accordance with the current curriculum without using any other tools. Pre-tests and post-tests were applied to both experimental and control groups. The study plan is shown in Figure 1.

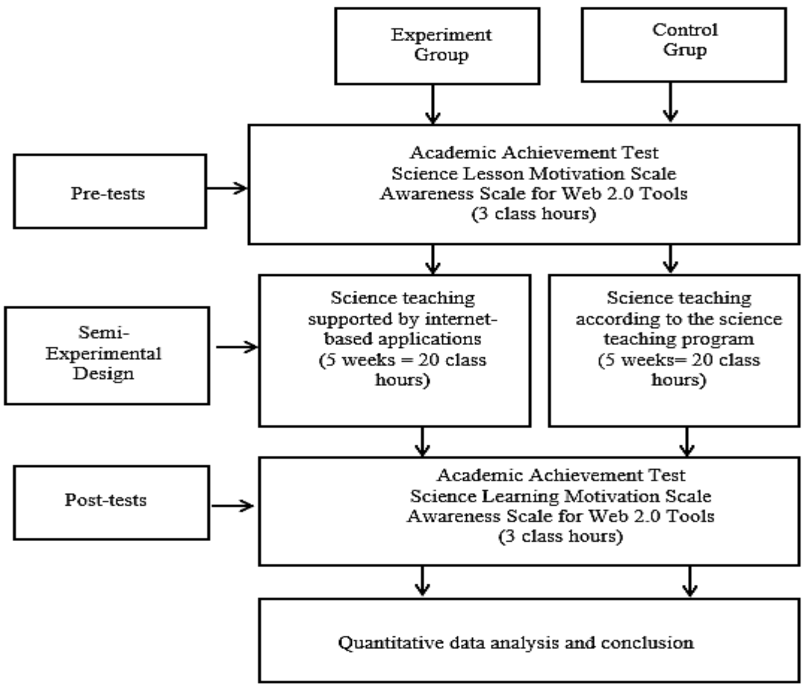

Figure 1. The Study Plan

In this study, activities were prepared with Nearpod, Google Form, Quizizz, Learning.Apps, Wordwall, Canva and Bubbl.us web 2.0 tools for the students in the experimental group and all of these activities were uploaded into the Nearpod application and the lesson was taught based on these applications. In this process, students used technology and web 2.0 tools effectively and actively participated in the process (See Appendix 1 and Appendix

2). In the control group, the lessons were carried out in accordance with the science curriculum with a focus on the presentation technique. The activities were based on the existing textbook.

Data Collection

The data of the study were collected with "Academic Achievement Test", "Science Course Motivation Scale" and "Awareness Scale for Web 2.0 Tools". The structural features of these data collection tools are as follows:

Matter and Heat Unit Achievement Test

This achievement test was developed by Çakmak (2018). The questions in the achievement test were reviewed by two physics educators and a science teacher working at a state university. The achievement test was applied to 30 students for a pilot study. The 28 questions whose reliability and validity were determined to be appropriate were used for this study. The KR-20 reliability coefficient for the reliability of the achievement test was calculated as .91.

Motivation Scale in Science Education

"Science Motivation Questionnaire 2" developed by Glynn, Brickman, Armstrong, and Taasoobshirazi (2011) was translated into Turkish by Işın (2019). This scale is a 5-point Likert scale. The Turkish version of the scale, which originally consists of 25 items, includes 22 items. The scale consists of five sub-dimensions; Intrinsic Motivation (3 items), Self Determination (4 items), Self-Efficacy (5 items), Career Motivation (5 items) and Grade Motivation (5 items). The Cronbach Alpha internal consistency coefficient of the scale is α=.84. The Cronbach Alpha values of the sub-dimensions of the scale are as follows: α=.71 for intrinsic motivation, α=.75 for grade motivation, α=.87 for self-determination, α=.80 for career and α=.78 for self-efficacy.

Awareness Scale for Web 2.0 Tools

The Awareness Scale for Web 2.0 Tools developed by Arslan and Görgülü Arı (2021) is a 5-point Likert scale with 3 factors, 3 negative items and 24 positive items, consisting of 27 items in total. The Cronbach Alpha internal consistency coefficient of the scale is .93. The reliability coefficients of knowing, perceiving and feeling sub-dimensions are .93, .90 and .78, respectively.

Data Analysis

The data obtained from the study were analyzed with quantitative methods. When analyzing the quantitative data, parametric tests were used to determine the differences between the experimental and control groups since they showed normal distribution. Normal distribution means that the median and mean values in a data group are very close to each other. As a first step in analyzing the data, it was determined that the groups were normally distributed with the Shapiro-Wilk test, and then the independent sample t test was used for the pretest and posttest averages of the experimental and control groups for unrelated tests. When comparing the independent groups, one-way factor analysis (ANCOVA) test was applied to eliminate the effect of different pre-test scores when the pre-test scores were not equal.

Results

The results that emerged as a result of the analysis of the data of this study, which examined the effect of the "Matter and Heat" course supported with internet-based applications on students' academic achievement, motivation and awareness of web 2.0 tools, are presented below.The first sub-problem of the study was defined as "Is there a significant difference in terms of academic achievement between the students (experimental group) who received science education supported by Internet-based applications and the students (control group) who received education with the current science curriculum?". The results related to this question are given in Table 1 below.

Table 1. Results of the Academic Achievement Test of Groups

Groups	N	Pre-Test	SD	Post Test	SD
Experiment	50	10.20	4.16	21.21	4.36
Control	23	7.86	2.73	11.52	3.95

When Table 1 is examined, the mean post-test scores of the experimental group ($X_{experiment}$=21.21), which received science education supported by internet-based applications, were higher than the mean post-test scores of the control group ($X_{control}$= 11.52), which received education in accordance with the current curriculum. In addition, there is an increase in the mean post-test achievement scores of both groups. While the pre-test mean academic achievement score of the control group was 7.86, the post-test mean score increased by 3.66 points to 11.52. While the mean pretest achievement score of the experimental group was 10.20, the mean posttest score increased by 11.01 points to 21.21. An increase was observed between the mean academic achievement scores of both groups, and a one-factor analysis of covariance (ANCOVA) was conducted to investigate whether the groups' academic achievement test posttest mean scores showed a significant difference from each other in order to determine the effect of the change caused by the application. For this purpose, ANCOVA test was performed to determine whether the difference between the adjusted post-test mean scores of the groups was significant in order to compare the scores obtained by the experimental and control groups from the academic achievement tests and these results are given in Table 2.

Table 2. ANCOVA Results of the Adjusted Academic Achievement Posttest Scores of Groups

Groups	df	Mean Square	F	p	Partial Eta Square (η_p^2)
Post Test	1	150.02	8.55	.005	
Method	1	967.52	55.15	.000	.44
Error	70	1227.89			
Total	73	2670.52			

As seen in Table 2, when the achievement pre-test scores were statistically controlled, a statistically significant difference was found between the post-test mean scores of the experimental group and the post-test mean scores of the control group according to the covariance analysis ($F(1,70) = 55.15$, $p=.000$). This difference is in favor of the experimental group students. According to the table, the partial eta square value was found to be .44. Therefore, it was determined that science teaching supported by internet-based applications had a greater effect on academic achievement than science teaching according to the current curriculum.

The second problem of the study was defined as "Is there a significant difference in terms of science course motivation between the students (experimental group) receiving science course education supported by Internet-based applications and the students (control group) receiving education with the current science curriculum?". The results related to this question are presented in Table 3 below.

Table 3. Results of Groups Regarding the Motivation Scale in Science Education

Groups	N	Pre-Test	SD	Post Test	SD
Experiment	50	88.12	12.07	97.60	7.01
Control	23	88.69	10.58	89.13	9.60

When Table 3 is examined, the mean post-test scores of the experimental group ($X_{experiment} = 97.60$), which received science education supported by internet-based applications, were higher than the mean post-test scores of the control group ($X_{control} = 89.13$), which received education in accordance with the current curriculum. In addition, there is an increase in the mean post-test scores of both groups. While the pre-test mean score of the control group's motivation for science lesson was 88.69, the post-test mean score increased by .44 points to 89.13. While the experimental group's science course motivation pre-test mean score was 88.12, the post-test mean score increased by 9.48 points to 97.60.

In order to determine the effect of the change caused by the application, a one-factor analysis of covariance (ANCOVA) was performed to investigate whether the groups' posttest mean scores of the science lesson motivation scale showed a significant difference from each other. For this purpose, ANCOVA test was performed to determine whether the difference between the adjusted posttest mean scores of the groups was significant in order to compare the scores obtained by the experimental and control groups from the science course motivation scale and these results are given in Table 4.

Table 4. ANCOVA Results of Post-Test Scores of the Adjusted Motivation Scale in Science Education of the Groups

Groups	df	Mean Square	F	p	Partial Eta Square (η_p^2)
Post Test	1	1420.45	32.92	.000	
Method	1	1189.23	27.56	.000	0.28
Error	70	43.14			
Total	73	5570.65			

As seen in Table 4, when the science lesson motivation pre-test scores were statistically controlled, a statistically significant difference was found between the experimental group's science lesson motivation scale post-test mean scores and the control group's science lesson motivation scale post-test mean scores according to the covariance analysis ($F(1,70) = 27.56$, $p=.000$). This difference is in favor of the experimental group students. According to the table, the partial eta squared value was found to be .28. It was determined that science teaching supported by technology-based applications had a greater effect on science lesson motivation than science teaching according to the current curriculum. The analysis results for the sub-dimensions of the motivation scale are as follows:

Table 5. Results of Groups on Intrinsic Motivation Sub-Dimension

Groups	N	Pre-Test	SD	Post Test	SD
Experiment	50	12.26	2.38	12.64	1.71
Control	23	11.82	1.99	11.13	1.76

When Table 5 is examined, the mean intrinsic motivation posttest scores of the experimental group ($X_{experiment} = 12.64$), which received science education supported by internet-based applications, were higher than the mean intrinsic motivation posttest scores of the control group ($X_{control} = 11.13$), which received education in accordance with the current curriculum. While the mean intrinsic motivation pre-test score of the control group was 11.82, the mean post-test score decreased by .69 points to 11.13. While the mean intrinsic motivation pre-test score of the experimental group was 12.26, the mean post-test score increased by .38 points to 12.64. While the mean score of the intrinsic motivation scale increased in the experimental group, the mean score of the intrinsic motivation scale decreased in the control group. In order to determine the effect of the change caused by the application, a one-factor analysis of covariance (ANCOVA) was performed to investigate whether the posttest mean scores of the groups belonging to the intrinsic motivation sub-dimension showed a significant difference from each other. For this purpose, ANCOVA test was performed to determine whether the difference between the adjusted post-test mean scores of the groups was significant in order to compare the scores obtained from the intrinsic motivation sub-dimension of the experimental and control groups and these results are given in Table 6.

Table 6. ANCOVA Results of Post-Test Scores of the Adjusted Intrinsic Motivation Sub-Dimension of Groups

Groups	df	Mean Square	F	p	Partial Eta Square (η_p^2)
Post Test	1	38.72	15.63	.000	
Method	1	29.27	11.81	.001	.14
Error	70	173.40			
Total	73	11050			

As seen in Table 6, when the intrinsic motivation pre-test scores were statistically controlled, a statistically significant difference was found between the post-test mean scores of the intrinsic motivation scale of the experimental group and the post-test mean scores of the intrinsic motivation scale of the control group according to the covariance analysis ($F(1,70) = 11.81$, $p=.001$). This difference was in favor of the experimental group students. According to the table, the partial eta squared value was found to be .14. It was determined that science teaching supported by technology-based applications had a greater effect on intrinsic motivation than science teaching according to the current curriculum. Group results for the career motivation sub-dimension are shown in Table 7.

Table 7. Results of Groups on Career Motivation Sub-Dimension

Groups	N	Pre-Test	SD	Post Test	SD
Experiment	50	11.82	2.55	19.18	4.26
Control	23	11.86	2.00	19.13	3.76

When Table 7 is examined, the mean career motivation post-test scores of the experimental group ($X_{experiment}$ = 19.18), which received science education supported by internet-based applications, were higher than the mean career motivation post-test scores of the control group ($X_{controll}$ = 19.23), which received education in accordance with the current curriculum. While the mean career motivation pre-test score of the control group was 11.86, the mean post-test score increased by 7.27 points to 19.13. While the mean career motivation pre-test score of the experimental group was 11.82, the mean post-test score increased by 7.36 points to 19.18. An increase was observed between the mean scores of the career motivation scale in both groups, and a one-factor analysis of covariance (ANCOVA) was performed to investigate whether the post-test mean scores of the groups belonging to the career motivation sub-dimension showed a significant difference from each other in order to determine the effect of the change caused by the application. For this purpose, ANCOVA test was performed to determine whether the difference between the adjusted post-test mean scores of the groups was significant in order to compare the scores obtained by the experimental and control groups from the career motivation sub-dimension and these results are given in Table 8.

Table 8. ANCOVA Results of the Post-Test Scores of Adjusted Career Motivation Sub-Dimension of Groups

Groups	df	Mean Square	F	p	Partial Eta Square (η_p^2)
Post Test	1	168.26	11.37	.001	
Method	1	.10	.007	.93	.00
Error	70	1035.72			
Total	73	28015			

As seen in Table 8, when the career motivation pre-test scores are statistically controlled, there is no statistically significant difference between the post-test mean scores of the experimental group in the career motivation sub-dimension and the post-test mean scores of the control group in the career motivation sub-dimension according to the covariance analysis ($F(1,70) = .007$ $p=.93$). It was determined that the teaching method used had no effect on career motivation in science lessons. The results of the groups regarding the self-determination sub-dimension are shown in Table 9.

When Table 9 is examined, the mean post-test scores of the experimental group ($X_{experiment}$ = 16.28) who received science education supported by internet-based applications were higher than the mean post-test scores of the control group ($X_{control}$= 15.30) who received education in accordance with the current curriculum. While the pre-test mean self-determination score of the control group was 16.26, the post-test mean score decreased by .96 points to 15.30. While the pre-test mean self-determination score of the experimental group was 16.26, the post-test mean score increased by .02 points to 16.28. While the mean score of the self-determination sub-dimension increased in the experimental group, the mean score of the self-determination sub-dimension decreased in the control group.

Table 9. Results of Groups on Sub-Dimension of Self-Determination

Groups	N	Pre-Test	SD	Post Test	SD
Experiment	50	16.26	3.16	16.28	2.55
Control	23	16.26	2.45	15.30	2.67

In order to determine the effect of the change caused by the application, a one-factor analysis of covariance (ANCOVA) was performed to investigate whether the groups' posttest mean scores of the self-determination sub-dimension showed a significant difference from each other. For this purpose, ANCOVA test was performed to determine whether the difference between the adjusted posttest mean scores of the groups was significant in order to compare the scores obtained from the self-determination sub-dimension of the experimental and control groups and these results are given in Table 10.

Table 10. ANCOVA Results of Post-Test Scores of Adjusted Self-Determination Sub-Dimension of Groups

Groups	df	Mean Square	F	p	Partial Eta Square (ηp2)
Post Test	1	156.02	34.03	.000	
Method	1	15	3.27	.075	.04
Error	70	4.58			
Total	73	28015			

As seen in Table 10, when the pre-test scores of self-determination were statistically controlled, there was no statistically significant difference between the post-test mean scores of the experimental group in the self-determination sub-dimension and the post-test mean scores of the control group in the self-determination sub-dimension according to the covariance analysis ($F(1,70) = 3.27$ $p=.075$). It was determined that the teaching method used had no effect on self-determination in science lesson. The results of the groups regarding the self-efficacy sub-dimension are shown in Table 11.

Table 11. Results Related to the Self-Efficacy Sub-Dimension of the Groups

Groups	N	Pre-Test	SD	Post Test	SD
Experiment	50	21.18	3.48	21.68	2.82
Control	23	20.43	3.59	21.34	2.77

When Table 11 is examined, the mean posttest self-efficacy scores of the experimental group ($X_{experiment}$ = 21.68) who received science education supported by internet-based applications were higher than the mean posttest self-efficacy scores of the control group ($X_{control}$ = 21.34) who received education in accordance with the current curriculum. While the self-efficacy pretest mean score of the control group was 20.43, the posttest mean score increased by .91 points to 21.34. While the experimental group's self-efficacy pre-test mean score was 21.18, the post-test mean score increased by .50 points to 21.68. An increase was observed between the mean scores of the self-efficacy sub-dimension in both groups, and a one-factor analysis of covariance (ANCOVA) was conducted to investigate whether the groups' post-test mean scores of the self-efficacy sub-dimension showed a significant difference from each other in order to determine the effect of the change caused by the application. For this purpose, ANCOVA test was performed to determine whether the difference between the adjusted post-test mean scores of the groups was significant in order to compare the scores obtained from the self-efficacy sub-dimension of the experimental and control groups and these findings are given in Table 12.

Table 12. ANCOVA Results of Post-Test Scores of Adjusted Self-Efficacy Sub-Dimension of Groups

Groups	df	Mean Square	F	p	Partial Eta Square (ηp2)
Post Test	1	125.69	20.25	.00	
Method	1	.04	.006	.93	.00
Error	70	6.20			
Total	73	561.83			

As seen in Table 12, when the self-efficacy pre-test scores were statistically controlled, there was no statistically significant difference between the mean post-test scores of the experimental group in the self-efficacy sub-dimension and the mean post-test scores of the control group in the self-efficacy sub-dimension according to the covariance analysis ($F(1,70) = .006$ $p=.93$). It was determined that the teaching method used had no effect on self-efficacy in science lesson. The results of the groups regarding the grade motivation sub-dimension are shown in Table 13.

Table 13. Results of Groups on the Sub-Dimension of Grade Motivation

Groups	N	Pre-Test	SD	Post Test	SD
Experiment	50	22.78	3.18	24.32	3.30
Control	23	21.86	2.59	21.26	3.30

When Table 13 is examined, the mean post-test scores of the experimental group ($X_{experiment}$ = 24.32), which received science education supported by internet-based applications, were higher than the mean post-test scores of the control group ($X_{control}$ = 21.26), which received education in accordance with the current curriculum. While the pre-test mean score of the control group was 21.86, the post-test mean score decreased by .60 points to 21.26. While the mean pretest score of the experimental group was 22.78, the mean posttest score was 24.32 with an increase of 1.54 points.

While the mean score of the note motivation sub-dimension increased in the experimental group, the mean score of the note motivation sub-dimension decreased in the control group. In order to determine the effect of the change caused by the application, a one-factor analysis of covariance (ANCOVA) was performed to investigate whether the groups' post-test mean scores of the note motivation sub-dimension showed a significant difference from each other. For this purpose, ANCOVA test was performed to determine whether the difference between the adjusted post-test mean scores of the groups was significant in order to compare the scores obtained by the experimental and control groups from the note motivation sub-dimension and these results are given in Table 14.

Table 14. ANCOVA Results of Post-Test Scores of the Adjusted Grade Motivation Sub-Dimension of Groups

Groups	df	Mean Square	F	p	Partial Eta Square (ηp2)
Post Test	1	27.63	6.23	.015	
Method	1	129.02	29.13	.000	.29
Error	70	4.42			
Total	73	487.01			

As seen in Table 14, when the note motivation pre-test scores were statistically controlled, a statistically significant difference was found between the mean post-test scores of the experimental group in the note motivation sub-dimension and the mean post-test scores of the control group in the note motivation sub-dimension according to the covariance analysis ($F(1,70) = 29.13$ $p=.000$). This difference is in favor of the experimental group students. According to the table, the partial eta squared value was found to be .29. It was determined that science teaching supported by technology-based applications had a greater effect on grade motivation than science teaching according to the current curriculum.

The third problem of the study was defined as "Is there a significant difference in terms of awareness of web 2.0 tools between the students (experimental group) who were trained in science courses supported with internet-based applications and the students (control group) who were trained with the current science curriculum?". The results related to this question are given in Table 15.

Table 15. Results of Groups on the Awareness Sscale for Web 2.0 Tools

Groups	N	Pre-Test	SD	Post Test	SD
Experiment	50	83.72	26.69	111.40	2.50
Control	23	84.69	23.55	79.43	3.76

When Table 15 is examined, the mean post-test scores of the experimental group ($X_{experime}nt = 111.40$), which received science education supported by internet-based applications, were higher than the mean post-test scores of the control group ($X_{control} = 79.43$), which received education in accordance with the current curriculum. While the pre-test mean score of the control group's awareness scale for web 2.0 tools was 84.69, the post-test mean score decreased by 5.26 points to 79.43. While the mean pre-test score of the experimental group's awareness scale for web 2.0 tools was 83.72, the mean post-test score increased by 27.68 points and became 111.40. While the average score of the awareness scale for web 2.0 tools increased in the experimental group, a decrease was observed in the average score of the awareness scale for web 2.0 tools in the control group. In order to determine the effect of the change caused by the application, a one-factor analysis of covariance (ANCOVA) was performed to investigate whether the groups' posttest mean scores of the awareness scale for web 2.0 tools showed a significant difference from each other. For this purpose, ANCOVA test was performed to determine whether the difference between the adjusted posttest mean scores of the groups was significant in order to compare the scores obtained by the experimental and control groups from the awareness scale for web 2.0 tools and these results are given in Table 16.

Table 16. ANCOVA Results of Groups' Post-Test Scores of the Adjusted Web 2.0 Tools Awareness Scale

Groups	df	Mean Square	F	p	Partial Eta Square (ηp2)
Post Test	1	205.45	.51	.47	
Method	1	16156.26	40.74	.000	.36
Error	70	396.57			
Total	73	793591			

As seen in Table 16, when the pre-test scores of the web 2.0 tools awareness scale were statistically controlled, a statistically significant difference was found between the post-test mean scores of the experimental group on the web 2.0 tools awareness scale and the post-test mean scores of the control group on the web 2.0 tools awareness scale according to the covariance analysis ($F(1,70) = 40.74$, $p=.000$). This difference is in favor of the experimental group students. According to the table, the partial eta squared value was found as .36. It was determined that science teaching supported by technology-based applications had a greater effect on awareness of web 2.0 tools than science teaching according to the current curriculum.

Discussion and Conclusion

In this study, the effects of teaching "Matter and Heat" topics of sixth grade science course on students' academic achievement, science course motivation and awareness of Web 2.0 tools were examined. The results and discussion of the findings of the study are presented under three main headings (academic achievement, motivation and awareness of Web 2.0 tools).

The first finding of the study showed that the academic achievement of the students whose learning processes in the subject of matter and heat were supported by internet-based applications made a significant improvement compared to the students who learnt in the way expressed in the curriculum. This finding indicates that science teaching supported by internet-based applications has a positive effect on students' academic achievement. In support of this result, Gürleroğlu (2019) concluded in his research that the academic achievement of the students, in which the teaching was carried out with Web 2.0 applications, provided a significant increase compared to the students who learned with the teaching in accordance with the current curriculum program. In another study, Korkmaz et al. (2019) concluded that measurement and evaluation using Web 2.0 tools had positive effects on students' academic achievement. On the other hand, Batıbay (2019) concluded that Kahoot, one of the Web 2.0

tools, did not have a significant effect on students' academic achievement. This may suggest that Kahoot, a Web 2.0-based tool, may not be able to create effective studies on some science topics. In addition, since the students of the current century are Generation Z people who are one with technology, it can be argued that the use of modern technologies in the educational atmosphere is important for students to assimilate information according to different types of intelligence (Korkmaz et al., 2019). Thanks to the technology-based education, it can be said that students learn the lesson according to their own learning style and their own intelligence area, so that their learning becomes more permanent and thus their academic achievement increases. At the same time, since students do in-class applications interactively with their friends and teachers, they can see their progress statistically on internet applications while learning thanks to the opportunity to get instant feedback. Since it is possible to develop different types of materials that appeal to more sensory organs by using technology, conditions may be one of the reasons for high student academic achievement.

The second finding of the study showed that the motivation of the students whose learning processes were supported by internet-based applications in the subject of matter and heat increased significantly compared to the students whose learning processes were supported by the curriculum. This result is consistent with the results of Sharp's (2016) study showing how Web 2.0 technologies affect student achievement. In another study, Ortaakarsu and Sülün (2022) examined the effect of Kahoot, one of the Web 2.0 tools, on student motivation in science course and supported this finding. The researchers found that students' motivation increased significantly in the lessons where Kahoot! supported activities were used. In addition, Gürleroğlu and Yıldırım (2022) found that the use of Web 2.0 supported educational websites in science teaching increased the motivation of secondary school students in the lessons. On the other hand, Uysal and Çaycı (2022) concluded that the effect of Web 2.0-based tools on the motivation of 4th grade students towards science lessons was not significant. This may be due to the fact that motivation development is difficult to change in a short time and other factors affecting motivation are involved in the process. In addition, Liu et al. (2021) explain this situation as when Web 2.0-based tools will be activated in lessons and how long they will be left under the control of students. Motivation is an essential concept in science learning and should not be neglected (Dede & Yaman, 2008). Educational applications in technological devices used in the learning environment add excitement to students' learning processes (Bediroğlu, 2021). Technology improves the quality of education and makes teaching activities fun. Thanks to the gamified interactive tests in the introduction or evaluation part of the lesson, students' attention to the lesson increased and they were able to pay attention to the lesson. This may be the reason for high student motivation in science lesson. Thanks to the question and answer practices in the lesson, it was seen that the motivation of the students to the lesson increased by creating a moderate competition environment in the classroom climate. In the study, intrinsic motivation is the desire of a person to learn science lesson. The three-dimensional simulations and visual richness used during the application may be the reason for the high intrinsic motivation of the students.

The findings showed that the use of web 2.0 tools had no significant effect on career motivation. Career motivation is the students' belief that learning science will bring them a career advantage. This may be due to the fact that students could not establish a relationship between web 2.0 applications and their careers. The fact that no information was given in terms of career during the application may also be the reason for this. Again, in this study, no significant effect of web 2.0 tools on students' motivation in terms of another variable self-determination was found. Self-determination is the individual's striving to learn science, spending effort and time, and believing that he/she can learn science in a good way. The fact that the students could not associate the self-determination questions in the scale with web 2.0 applications may have led to this result. The fact that no information about self-determination was given during the application may also be the reason for this. In the study, it was observed that web 2.0 tools did not have a significant effect on students' self-efficacy. Self-efficacy is an individual's self-belief that he/she will learn science lesson. This may be because the students could not associate the self-efficacy questions in the scale with web 2.0 applications. The fact that no information about self-efficacy was given during the application may also be the reason for this. In the study, it was observed that web 2.0 tools had a significant effect on students' grade motivation. Grade motivation is the ability of individuals to get high scores in science courses and thus satisfy themselves. The increase in the students' motivation for the course with the first time they were involved in the course with technology may have motivated the grade motivation of the students.

The third finding of the study showed that students' awareness of web 2.0 tools supported by internet-based applications made a significant improvement. For this reason, it can be said that science teaching supported by internet-based applications has a positive effect on students' awareness of web 2.0 tools. Students contribute to the lesson process with web 2.0 tools, have effective heritage in the classroom thanks to these tools and think that the lesson is understood more easily.

Recommendations

In this study, the effects of the science course supported with web-based applications on students' academic achievement, science course motivation and awareness of web 2.0 tools were examined. The effects of internet-based applications on science teaching can be investigated by determining different variables and different scales. There are many applications that can be applied in education within the scope of Internet-based applications. In this study, Quizizz, Learning.Apps, Wordwall, Nearpod, Canva, Bubbl.us, Phet and Google Forms applications were used. Researchers and practitioners can conduct studies in which they prefer different web 2.0 applications than those used in this study.

Notes

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Appendix 1. Implementation Program and Schedule

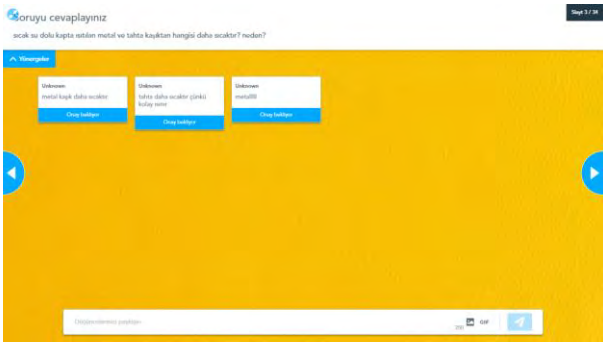
Date	Gains	Duration	Experimental Group Activities	Control Group Activities
December 6-12	Data collection tools were applied as a pre-test and information about the application was given.	Three lesson hours	-	-
December 13-19.	Classifies substances in terms of heat conduction.	Four lesson hours	-Collaborative board activity in Nearpod application to identify prior learning about heat conduction -pHet simulation related to the particulate structure of matter -Explanation on Nearpod application related to thermal conductivity -Activity on learningapss.org and Wordwall applications about heat conductivity -Time To Climb question activity via Nearpod application related to the topic	-Question-answer activity to identify prior learning about heat conduction -Lecture about the particulate structure of matter -Lecture on heat conductivity -Activity on the workbook about heat conductivity -Question and answer activity related to the subject
December 20-26	-Determines the selection criteria of thermal insulation materials used in buildings. - Develops alternative thermal insulation materials.	Four lesson hours	-Lecture on thermal insulation materials via Nearpod -Developing an alternative thermal insulation material and designing a poster in Canva application	-Heat insulation materials subject lecture -Alternative thermal insulation material development textbook activity

December 27- January 2	Discusses the importance of thermal insulation in buildings in terms of family and national economy and effective use of national resources.	Four lesson hours	- Creating a poster from Canva application about the importance of thermal insulation -Quizizzizz question activity on thermal insulation materials	-The importance of thermal insulation research activity -Question and answer activity on thermal insulation materials
January 3-9	- Classify fuels as solid, liquid and gaseous fuels and give examples of commonly used fuels. -Discusses the effects of the use of different types of fuels for heat on human and environment.	Four lesson hours	-Collaborative board activity in Nearpod application to identify prior learning about fuels -Lecture on the topic of fuels through Nearpod application -Wordwall question activity about fuels -3D simulation activity with renewable and non-renewable energy sources via Nearpod application -Collaborative board activity via Nearpod on the effects of fuels on the environment	-Question and answer activity about fuels -Lecture on the subject of fuels -Question and answer activity about fuels -Lecture on renewable and non-renewable energy sources -Question and answer activity about the effects of fuels on the environment
January 10-16	- Investigates and reports the measures to be taken regarding stove and natural gas poisonings.	Four lesson hours	-Lecture on the subject of stove and natural gas poisoning via Nearpod application -Preparing and presenting posters on Canva application to prevent stove and natural gas poisoning -Quizizzizz question activity on stove and natural gas poisoning -Creating a concept map about matter and heat from Bubbl.us	-Straight narration on the subject of stove and natural gas poisoning. -Plain lecture on the measures to be taken regarding stove and natural gas poisoning -Question and answer activity about stove and natural gas poisoning -Lecture on the subject
January 17-23	Data collection tools were applied as post-test.	Three lesson hours	-	-

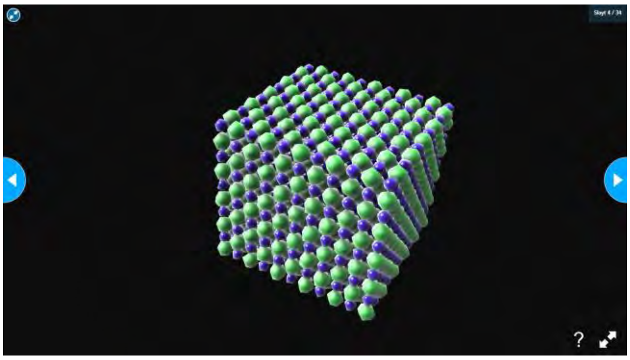
Appendix 2. Lesson Plan Sample

Course Name:	Science
Class:	Grade 6
Unit No-Name:	Unit 4: Matter and Heat
Section/Subject:	Matter and Heat
Recommended Course Hours:	4 hours
Student Learning Outcomes/Goals and Behaviors:	Classifies substances in terms of heat conduction.
Unit Concepts and Symbols:	Thermal conductivity, thermal insulation, thermal insulation
Methods and Techniques to be applied:	Presentation method, invention strategy, question-answer
Tools and Equipment to be used:	Tablet, Nearpod, Phet, Learning.Apps, Wordwall
Lesson Activities	1.Students enter the Nearpod application simultaneously with the code given by the teacher and make a virtual entrance to the lesson from their own devices.   2. "Draw what the atom, the smallest building block of matter, looks like." In response to the question, students draw and send their own drawings and students can see each other's drawings. These drawings are discussed.

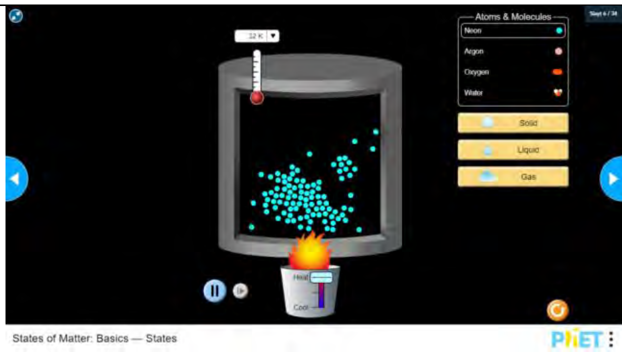
3. Ask students "Which of the metal and wooden spoons heated in a pot of hot water is hotter? Why?" and students' answers are discussed on the collaborative board.



4. Students are made to examine the structure of the atom on a 3D model.



5. A simulation of the particulate structure of matter from the Phet site is examined in the Nearpod application.

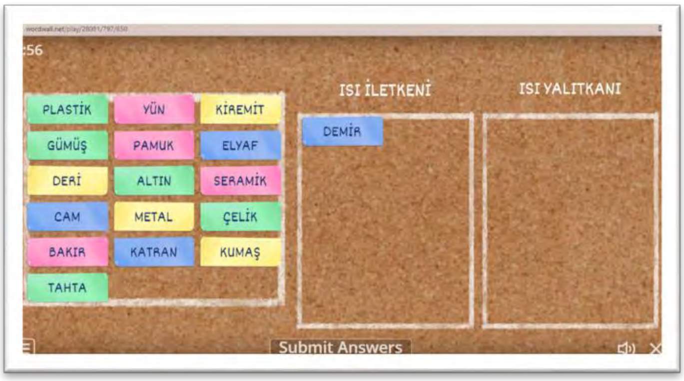


6. Lectures are given to the students via Nearpod.

Assessment and Evaluation:

1.With the link directed from Nearpod application, students are sent to the Learning.Apps site and asked to mark the heat conductor-heat insulator parts of the given items https://learningapps.org/watch?v=pk9kaz5d321

2. With the link from Nearpod, students are sent to the Wordwall site and asked to group substances as heat conductors and heat insulators. Students can check their answers by clicking on "Submit Answers" .**https://wordwall.net/play/28081/797/650**



3. Students are asked questions with the "Time to Climb" activity in the Nearpod application.

4. Students enter the game with their names and avatars of their choice.

5.Students answer the questions on their screens within the specified time limit and compete with other students.