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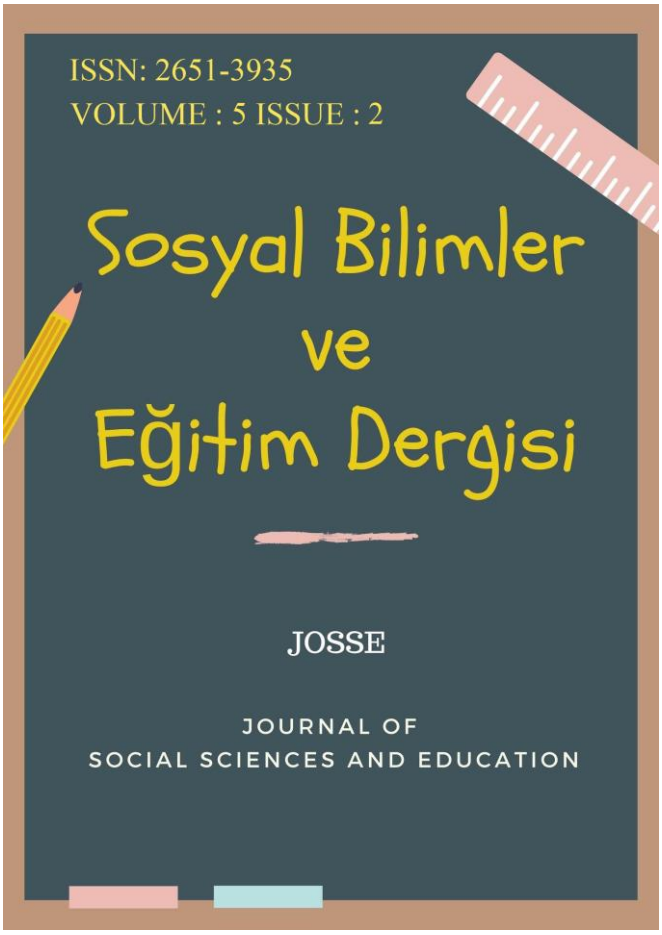

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Web 2.0 Tools for Increasing Secondary School Students' Access to Science Courses*

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Web 2.0 Tools for Increasing Secondary School Students' Access to Science Courses

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Abstract

In this study, the effect of the use of Web 2.0 tools in online education on the achievement of secondary school students in the unit "Reproduction, Growth and Development in Living Things" was examined. The sample of the research consists of 14 students studying in the 7th grade. In the study, the lessons were carried out in accordance with the current curriculum, using web 2.0 tools in an online environment. The study lasted for 6 weeks in total and a different Web 2.0 tool was applied to the students every week on the "Microsoft Teams" platform. The model of the research is a mixed model in which quantitative and qualitative methods are combined. In this direction, the "Reproduction, Growth and Development Unit Achievement Test in Living Things" was used as a quantitative data collection tool, and the "Reproduction, Growth and Development Unit Worksheet in Living Things" was used as a qualitative data collection tool. SPSS program was used in the analysis of the quantitative data, and content analysis was used in the analysis of the qualitative data. As a result of the study, it has been found that online education applications supported by web 2.0 tools have a positive effect on students' achievement in the unit "Reproduction, Growth and Development in Living Things". In the study, it was found that the students gave more correct code and frequency outputs with a significant difference after the application, and that they correctly associated the unit concepts with each other.

Keywords: Web 2.0 tools, reach, science education, secondary school students

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Introduction

Today's technological developments have made information production and sharing widespread. Thanks to technology, information has become accessible to everyone and applicable in every environment. The 21st century, which we live in and which we call the information age, has also provided important developments in information technologies. Digital technologies appear in almost every environment. Accordingly, it is very important that it becomes widespread in life-preparing courses (Mulenga & Marban, 2020). The use of technological tools is inevitable, especially in a lesson that is directly related to life and up-to-date, such as a science lesson. It is also necessary for today's students to use Web 2.0 technologies in the lessons of science teachers (Weller, 2013). In extraordinary situations such as the pandemic experienced in the past years, the use of digital technologies has accelerated to ensure the continuity of education. In addition, the digital changes that took place in the education structure became the leading global education model, "anytime and anywhere education"-based distance education. Distance education is a type of education that allows mutual video and audio communication by minimizing physical conditions such as time and space (Yamamoto & Altun, 2020). The web environments where distance education takes place have also changed over time. The most common educational technologies to be used in online classes are Web 2.0 tools. Unlike Web 1.0 environments, Web 2.0 environment is characterized as a platform where information is acquired, but also produced, shared and organized (Yuen et al., 2011).

Theoretical framework

Web 2.0 tools

Web 2.0 tools are second generation web environments that enable individuals to produce and share information and content interactively and collaboratively (Hall et al., 2010). Web 2.0 tools are expressed as exciting environments designed to improve participants' ability to create and share content on any topic (Griffin & Ramachandran, 2010). Integration of Web 2.0 tools with online education; It leads to an increase in the quality of education and the formation of an interactive and collaborative online learning environment (Rhoads et al., 2013). The use of web 2.0 in online learning environments facilitates collaborative learning among students and with the teacher, thus providing active learning. It provides an increase in learning by

providing a flexible learning environment (Tambouris et al., 2012). Web 2.0 technologies allow teachers and students to improve themselves. It also enables students with individual differences to access appropriate activities (Hargadon, 2009).

The benefits of Web 2.0 technologies are as follows:

• Provide cognitive and social learning

• Providing collaborative learning

• Provide motivation and efficient learning

• Increasing students' interest in the subject

• Fun learning and assessment opportunity

• Presenting current and long-term content

• Active participation in the lesson

• Continuing the learning and teaching process in epidemic or disaster situations (Prashnig, 2006; Conole & Alevizou, 2010; Wankel & Blessinger, 2013).

Mohammed et al. (2020), Web 2.0 tools were used in foreign language teaching. Students are divided into experimental and control groups. The design of the research is pre-final, experimental-control group and 30 students participated in the study. In the 12-week study, a developed program containing numerous Web 2.0 tools was used for the experimental group; The control group was trained using traditional teaching methodology. In the study, it was found that there was a statistically significant difference in favor of the post-test in the learning achievement of the experimental group students.

Online classes

Online education, which is a sub-title of distance education, is defined as education carried out independently of time and place with the help of information and communication technologies. In other words, online learning is explained as a type of learning that can be performed with the help of a web browser on a technological device such as a computer, smart mobile phone, tablet (Horton, 2006). Online classes provide a group work environment with collaborative activities. Thus, it allows information sharing among students and provides different perspectives (Pierce et al., 2007). Models used online are examined in two groups as synchronous (synchronous) and asynchronous (asynchronous) (Romiszowski, 2004). In this study, the simultaneous (synchronous) model was used. Simultaneous (synchronous) online

education is a learning environment where activities are carried out at the same time but in different places by using online communication tools between student-teacher or student-student. In this process, since teachers and students participate in the lesson at the same time, it is also called a simultaneous live lesson (Martin, 2010). In the simultaneous live lesson, teachers and students can communicate through audio and video, and in this way, the lessons can become interactive and more efficient. Simultaneous (synchronous) online education has some advantages and disadvantages.

Advantages:

- Creating a discussion and brainstorming environment
- Provide instant feedback and notification
- Time and place independent education
- Giving the opportunity to work with the group

Disadvantages:

- Students who are not good at using technology remain shy
- Lesson planning is difficult and/or irregular (Taylor, 2002; Midkiff & DaSilva, 2011).

Literature review

Azid et al. (2020) investigated the effect of using Web 2.0 tools on students' mathematics achievement. The model of the study is mixed model. 60 students participating in the study were divided into experimental and control groups. As a result of the study, it was found that there was an increase in the mathematical achievements and interests of the experimental group.

In a study conducted by Onbaşılı (2020), the effect of science teaching practices supported by Web 2.0 tools on the self-efficacy perceptions of primary school teacher candidates in using Web 2.0 tools was examined. Forty primary school teacher candidates participated in the study and it lasted for 14 weeks in total. After the 23 Web 2.0 tools used in the study, the opinions of pre-service teachers were examined. As a result of the study, it was found that science teaching practices supported by Web 2.0 tools had positive effects on the self-efficacy perceptions of primary school teacher candidates in using Web 2.0 tools.

In another study by Chawinga & Zinn (2016), university students' awareness of the use of web 2.0 technologies, the purpose for which they use web 2.0

applications, and the factors affecting the use of web 2.0 technologies were examined. A questionnaire was applied to 186 university students who participated in the study. As a result of the study, students' web 2.0 technologies; it has been determined that they use them to access information, communicate with their teachers, send homework, and stay in touch with their friends during their academic studies. In addition, Web 2.0 technologies; It has been found that it is very effective on undergraduate students and academicians and is frequently used for social networks.

Abdoli-Sejzi et al. (2015) investigated the effectiveness of Web 2.0 technologies in virtual universities. A questionnaire was applied to 384 students who participated in the study. As a result of the study, it has been found that there is a positive relationship between the use of Web 2.0 technologies and student success in the virtual university.

In a study by Huang et al. (2013), university students' views on using web 2.0 technologies were examined. A questionnaire was applied to 423 university students participating in the study. As a result of the study, it has been found that web 2.0 tools have a positive effect on students' learning, provide interaction between student-student and student-school, and increase the level of satisfaction with the lessons.

In an experimental study by Baig (2011), online learning environment supported by Web 2.0 tools and face-to-face physics lessons were compared. The study group consists of tenth grade students. As a result of the tests applied in the study, it was found that the online learning environment supported by the Web 2.0 tools used in the physics lesson increased the success of the tenth grade students.

When the literature is examined, although there are many studies on the use of web 2.0 tools in different units and subjects in science, there are very few studies on the unit "Reproduction, Growth and Development in Living Things" (Hardy et al., 2008; Andersen & Matkins, 2011; Weller, 2013). ; Habibi et al., 2019). In this direction, the research problem of the research is "How is the effect of online education applications supported by Web 2.0 tools on students' achievement in the unit of Reproduction, Growth and Development in Living Things?" determined as.

In order to fill this gap in the literature, this study, which examines the effects of online education applications supported by web 2.0 tools on the achievement of

7th grade students in the unit "Reproduction, Growth and Development in Living Things", is thought to be a guide for teachers and researchers.

Method

Model

The model of the study is mixed model. In this direction, a mixed method, in which qualitative and quantitative data can be collected and used together, was used (Gay et al., 2012). Mixed method; It is a research method that includes the use of qualitative and quantitative research methods in studies, the collection, analysis and interpretation of quantitative and qualitative data (Leech & Onwuegbuzie, 2009).

Sample and Population

The study group of the research consists of 14 students (8 girls, 6 boys) studying in the 7th grade. An easily accessible sample type was used to determine the study group of the research. In easily accessible sampling, the researcher selects a sufficient number of people as a sample from among the existing people (Stratton, 2021). Students who have the opportunity to attend online classes at a private school were determined for the study.

Data Collection Tools

Quantitative and qualitative data collection tools were used in the research. "Reproduction, Growth and Development Unit Achievement Test" developed by Aygün & Şimşekli (2019) as a quantitative data collection tool, and "Reproduction, Growth and Development Unit Worksheet in Living Things" was applied as a qualitative data collection tool. Developed by Aygün & Şimşekli (2019), the "Reproduction, Growth and Development Unit Achievement Test in Living Things" is an achievement test prepared to measure the academic success of 7th grade students in the unit "Reproduction, Growth and Development in Living Things". There are 23 multiple choice questions in the test. The test was administered to 93 people in the pilot application and the Cronbach Alpha reliability coefficient was calculated as 0.78. The test is valid and reliable. The achievement test was administered to the students before and after the application. The "Reproduction, Growth and Development Unit Worksheet" developed by the researcher by scanning the literature was prepared to measure the achievement of 7th grade students in the unit "Reproduction, Growth and Development in Living Things". The access test consists of 8 questions in total: matching, filling in the blanks and open-ended.

Expert opinions were used in the preparation of the rhubarb test. The access test was also administered to the students before and after the implementation.

Collection of Data and Analysis

In the analysis of the data obtained from the quantitative data collection tool in the research, the SPSS program was analyzed using the Wilcoxon signed-rank test, which is one of the non-parametric tests. The Wilcoxon signed-rank test allows comparison of two related measurements. Therefore, Wilcoxon signed-rank test was used to evaluate whether there is a significant difference between pre-test and post-test scores (Garcia et al., 2009). Content analysis was applied in the analysis of the data obtained from the qualitative data collection tool in the research. Content analysis is the conceptualization of the obtained data, organizing the concepts in a meaningful way, and determining the category and theme that explains the data accordingly (Hsieh & Shannon, 2005). The answers obtained from the students were analyzed by two researchers using open coding. The obtained data were analyzed and classified into themes, categories and codes.

Study Process

The study was conducted online through the Microsoft Teams platform, which is one of the web 2.0 tools in the science course. Microsoft Teams platform is a free-to-use chat-based teamwork platform. Virtual workspaces with chat such as group chat, private messages, meetings and calls are created on the platform (Shaw, 2020). Students accessed online courses from their existing computers, tablets and phones. Students met and used a different web 2.0 tool every week. In the study, the 7th grade science course "Reproduction, Growth and Development in Living Things" unit was supported with web 2.0 tools.

Figure 1. Weekly Implemented Web 2.0 Tools

Lesson plans are prepared according to the 5E education model. The weekly lesson plans are explained in detail below.

First week

The lesson plan for the first week is as follows:

Engage: A live lesson is started via Microsoft Teams and the current news called “Sharing a Surprise from the Octopus Mother” prepared with the Padlet application, one of the Web 2.0 tools, is shared with the students. Ask the students, “Do you have any siblings? If so, how many and how old? “How would you feel if you had 7 siblings?” Attention is drawn to the lesson by asking questions such as: Students are expected to click on the link and write their answers on the board on the padlet.

Explore: Images prepared with Canva, one of the Web 2.0 tools, are shared with students. “Which features do you think might be similar to the mother and which features of the father?”, “What do you think might be the reason for this similarity?” A discussion environment is created by asking questions. Students' ideas are taken.

Explanation: Students are shown the "Development of Embryo's" animation, which explains the development of the embryo. Afterwards, an introduction to human reproduction is made in the interactive Fenito Science Workshop book. The concepts and functions of the penis, testis, sperm, sperm duct and gland in the male reproductive system are explained by showing the diagram. The concepts and functions of the egg, ovary, fallopian tube, uterus (womb), vagina in the female reproductive system are explained by showing a diagram. It is explained that the fertilization event occurs with the union of the sperm and egg, which are the reproductive cells. The developmental characteristics of zygote, embryo, fetus and baby stages and the relationship between them are explained. Afterwards, the importance of hygiene for the health of the reproductive organs is emphasized.

Elaborate : Preparing with Padlet, one of the Web 2.0 tools, the birth week of the newborn, birth weight, height, developmental retardation, etc., in smoking and non-smoking mothers. A section from the article sample, in which it is compared in terms of features, is shared with the students. Ask the students, “What should a mother-to-be pay attention to in order to give birth to her baby in a healthy way?” and “What should a mother-to-be avoid in order to give birth to her baby in a healthy way?” A discussion environment is created by asking questions. Students are expected to click on the link and write their ideas on the board on the padlet.

Evaluation: Students are asked to participate in mini-evaluation questions about human reproductive cells, reproductive organs and their functions, prepared with Quizizz in Web 2.0 tools, by sharing them with the link. "The fertilization event takes place in the oviduct.", "The male reproductive cell is called the zygote.", "The male reproductive organ where the sperm is thrown out of the body is the penis." “An expectant mother should eat whatever she likes.”, “When the baby is 10 weeks old in the womb, its name is fetus.”, “Nylon ones should be preferred when buying underwear”, “Female reproductive cell is produced in the oviduct.” Ask them to mark true or false questions. Then, the lesson is concluded by discussing the correct answers to the sentences with the teacher along with their reasons.

Second Week

The lesson plan for the second week is as follows:

Engagement: The live lesson is started via Microsoft Teams, the link of the activity prepared using Nearpod, one of the Web 2.0 tools, is shared with the students and they are asked to log in to the virtual classroom. When all students in the class log in, the researcher starts the lesson of the virtual classroom. “Why do you think reproduction is important for living things?” Students are asked to answer the open-ended question by writing it down or dictating it by voice. In this process, after all students have stated their answers in writing, each student is expected to express their thoughts on the question.

Exploration: “What do you think the shape of the sperm and egg cell look like? Draw." Students are expected to answer the question by drawing on the virtual classroom page. The drawing slide is designed in such a way that students can adjust the brush thickness and brush colors to the desired settings, or have the option to add images, write text and delete them. After the students' drawings are finished, the researcher is expected to show everyone's drawing to the class and the characteristics of the sperm and egg cell are discussed by the students and the teacher.

Explanation: With the "Human Sperm vs Sperm Whale" video, an animation describing the structure, movement and similarity of the sperm cell with the sperm whale is watched. In the animation, students are entertainingly told about the movement of a sperm, the journey of a sperm whale in the water, and the comparison of a swimmer's swimming in a swimming pool by calculating the Reynolds number. In this way, students are provided to understand why sperm are microscopic in size

and the advantages of this situation. “Based on your observations, write down the properties of the sperm that enable it to move.” The students are asked to answer the question in written form.

Elaborate: “Imagine trying to design a sperm that is even more effective than it is now. What shape would it have?” The page with the question is passed and the students are asked to draw. When students have finished their drawings, they are asked to examine the visual of abnormal sperm cell structures. As a result of their examination, the students said, “As you can see in the figure, there are many different types of sperm abnormalities. Choose one of them. How do you think the abnormal sperm shape you choose affects fertilization?” are asked to answer the question. Students are expected to write their thoughts in the answer box. After the answers received, the teacher and students are expected to discuss the question.

Evaluation: After the activity with Nearpod, one of the Web 2.0 tools, is over, the teacher is expected to make a general summary of Human Reproduction, Growth and Development. Afterwards, the Mini Quiz event is shared with the students via the link with Kahoot, one of the web 2.0 tools. After all students log in to the link, the competition is started and the prepared questions are expected to be answered. The correct answers of the wrong questions are discussed and the lesson ends.

Third Week

The lesson plan for the third week is as follows:

Engagement: The live lesson is started via Microsoft Teams, the link of the activity prepared using Nearpod, one of the Web 2.0 tools, is shared with the students and they are asked to log in to the virtual classroom. When all students in the class log in, the researcher starts the lesson of the virtual classroom.

Exploration: On the first page of the virtual classroom activity, “What do you think is the importance of plants for living things? What could be the benefits they provide to humans and other living things? Students are asked to answer the open-ended question by writing. After the students have stated their answers in written form, a discussion is held with the teacher by sharing them verbally as well. Then “Close your eyes and imagine a flower. What do you think the shape of that flower is? Can you draw the flower to show its parts?” Students are expected to answer the question by drawing on the virtual classroom page. The drawing slide is designed in such a way that students can adjust the brush thickness and brush colors to the

desired settings, or have the option to add images, write text and delete them. After the students' drawings are finished, the researcher shows everyone's drawing to the class and the parts of the flowering plant are discussed over the students' drawings.

Explanation : “Got seeds? Just add bleach, acid and sandpaper” video and the video explaining different plant growing methods are watched. The video describes the process of growing plants using bleach, acid and sandpaper. Afterwards, the students were asked, “Based on your observations, in what situations do you think we will have to use the methods shown in the video? Do you think there is a need for these plant growing practices in the city we live in? Why?" They are expected to answer the question. Then, students are asked to state their opinions about the reasons for needing different plant growing methods and a discussion is made.

Elaborate: “Can you draw the stages of reproduction, growth and development of a plant? Show your ingenuity :)” question is asked and students are asked to draw. After the students' drawings are finished, the researcher is expected to show everyone's drawing to the class and discuss the drawings. Afterwards, the students are presented with a visual of different-looking flowers and they are asked to examine the flowers. After they finished their review, “Imagine a flower that is more remarkable than it is now. What kind of design do you think it would have and what features would it have?” The question is asked and students are asked to draw flower shapes that they think will attract attention. After the drawings are finished, the remarkable features of the drawn flowers are discussed with the class.

Evaluation: The link of the Wordwall activity, one of the Web 2.0 tools, is shared with the students. Students are expected to mark the correct option in the questions in the activity. After the activity is completed, a brief summary of the plant reproduction, growth and development is made with the teacher and the lesson ends.

Fourth Week (1st lesson)

The lesson plan for the fourth week (1st lesson) is as follows:

Engage: A live lesson is started via Microsoft Teams and the link of the activity called “Nature and Human” prepared with the Padlet application, one of the Web 2.0 tools, is shared with the students and they are asked to participate.

Exploration: Students are asked to examine the plot prepared with Storyboard That, one of the web 2.0 tools, and transferred to Padle, and they are expected to write the message that the plot wants to tell under the image. Then, the video is

watched by the class, which covers the great forest fire in Australia and how trees and animals were affected by the fire in the interview with the people living in the surrounding area. Students are asked to write their opinions on the cause of the fire and its effects on living things on the padlet.

Explanation: An introduction to the subject of Reproduction, Growth and Development in Plants is made from the book Interactive Fenito My Science Workshop. The concepts of sexual reproduction and asexual reproduction are explained. Four types of asexual reproduction are described, namely by division, budding, regeneration, and vegetatively. Examples of organisms that reproduce by asexual reproduction are given. Parts of the flowering plant, male and female reproductive organs are explained. The characteristics of the parts of the flowering plant are explained through visuals. Formation stages of sexually reproducing flowers; pollination, fertilization, zygote, embryo, seed and fruit are explained.

Elaborate: The requirements for germination of the seed under suitable conditions are discussed. The requirements for the healthy growth of the plant are explained. Interactive Fenito Science Workshop is expected to classify inorganic substances required in experiments for plant growth as dependent, independent and control variables.

Evaluation: The link of the Wordwall activity, one of the Web 2.0 tools, is shared with the students. Students are expected to mark the correct option in the questions in the activity. After the activity is completed, a brief summary of the subject is made with the teacher and the lesson ends.

Fourth Week (2nd lesson)

The lesson plan for the fourth week (2nd lesson) is as follows:

Engage: A live lesson is started via Microsoft Teams and an introduction to the subject of Reproduction, Growth and Development in Animals is made.

Exploration: “We learned about reproduction in humans and plants. So how do you think animals reproduce?" and “Have you ever had an animal in your home or garden? If you fed it, what did you do to take care of it?" Ask students to answer questions. A discussion environment is created based on the answers given.

Explanation: Reproduction, Growth and Development in Animals page opens from the book Interactive Fenito My Science Workshop. Vertebrates are said to reproduce by sexual reproduction. It is explained that animal reproductive cells and

human reproductive cells are the same, therefore humans are also included in the member of the animal kingdom. The development of the zygote formed by reproduction is explained. Afterwards, it is explained how growth and development differ in vertebrate animals. The concept of metamorphosis and the living beings that undergo metamorphosis are explained. The metamorphosis stages of some animals such as butterflies and frogs are explained.

Elaborate: The link of the Bubbl Us activity, one of the Web 2.0 tools, is shared with the teacher and the teacher shares the screen with the class. The teacher prepares a mind map for the unit Reproduction, Growth and Development in Living Things with the whole class. It is expected that the unit concepts that should be in the mind map are given by the students. Verbally expressed concepts are boxed by the teacher through Bubbl us. Misconceptions are detected by associating the concepts with each other in a sentence. A general repetition of the Reproduction, Growth and Development unit is made by making the necessary corrections.

Evaluation: With Kahoot, one of the Web 2.0 tools, the Mini Quiz Final event is shared with the students via the link. After all students log in to the link, the competition is started and the prepared questions are expected to be answered. The correct answers of the wrong questions are discussed and the lesson ends.

Findings

The quantitative and qualitative findings obtained from the study are given under separate headings.

Quantitative Findings

Quantitative findings analyzed with the SPSS program are given in Table 1 and Table 2.

Table 1.

Descriptive Statistics of Student Access

Group	N	X	S
Pre-test	14	9,1429	3,77964
Post-test	14	16,6429	4,43079

Table 2.

Comparison of Study Group Access Test Pretest-Posttest Scores with Wilcoxon Signed Ranks Test

Ranks	N	Rank	Rank Sum	Z	p

		Average			
Negative Rank	1	1,00	1,00	-3,112	,002
Pozitive Rank	12	7,50	90,00		
Equally Rank	1				

According to Table 2, as a result of the analysis of the data in the study, a positive (Z=-3.112) and significant (p=.002<.05) result was obtained in terms of the achievements of the study group in the unit of reproduction, growth and development in living things.

Qualitative Findings

The qualitative findings analyzed by content analysis are as follows:

Table 3.

Students' Answers to the Question of "Features of male and female reproductive cells are given below. Write the given features under the cell you think they belong to"

			Frequency	
Theme	**Category**	**Codes**	**Before**	**After**
Cell Properties	Sperm Cell	Male reproductive cell	7	14
		It consists of three parts, head, middle and tail	13	14
		Small and mobile	9	13
		Producing a large number	6	14
		Composed of cell membrane, cytoplasm and nucleus	2	2
		Big and immobile	4	1
		Producing in small numbers	6	-
		Having a female reproductive cell	4	-
	Ovule cell	Female reproductive cell	6	14
		Producing in small numbers	5	14
		Big and immobile	8	13
		Consist of cell membrane, cytoplasm and nucleus	10	12
		Small and mobile	1	1
		Producing a large number	6	-
		Male reproductive cell	4	-

According to Table 3, the most common answer given before the implementation in the "Sperm Cell" category under the "Cell Properties" theme was the code " It consists of three parts, head, middle and tail" and the most common answer given after the implementation was "Male reproductive cell". It was seen that the most common answer given before the implementation in the "Ovule Cell" category was the code "Consist of cell membrane, cytoplasm and nucleus", and the most common answer given after the implementation was the code "Female reproductive cell". Considering the frequencies before and after the implementation, it was seen that the students gave more accurate codes and more frequency output with a significant difference after the application. It was determined that the students mixed their properties with sperm and egg cells before the implementation. After the implementation, it was determined that the students learned the properties of sperm and ovule cells correctly.

Table 4.

Students' Answers to the Question of "Male and female reproductive organs are given below. Accordingly, match the features given below with the structures in the organs."

			Frequency	
Theme	**Category**	**Codes**	**Before**	**After**
Features of Reproductive Organs	Sperm Duct	Where sperm are transported from the testicles to the penis	5	11
		Where urine and semen are expelled	1	1
		The place where the secretion that allows the sperm to move freely is produced	3	-
		Where sperm cells are formed	2	-
		Where the fertilized egg implants and develops until birth	1	-
		I do not know	2	-
	Gland	The place where the secretion that allows the sperm to move freely is produced	5	14
		Where sperm cells are formed	3	1
		Where urine and semen are expelled	2	-

	Where sperm are transported from the testicles to the penis	1	-
	I do not know	1	-
Penis	Where urine and semen are expelled	8	13
	Where sperm are transported from the testicles to the penis	3	2
	The place where the offspring, which has completed its development, leaves the mother's body at birth	2	-
	Where sperm cells are formed	1	-
Testis	Where sperm cells are formed	7	13
	Where sperm are transported from the testicles to the penis	2	1
	Where fertilization takes place	3	-
	The place where the secretion that allows the sperm to move freely is produced	2	-
Oviduct	Where fertilization takes place	3	10
	Where the fertilized egg implants and develops until birth	2	1
	Where the ovule cell is produced	4	-
	Where sperm are transported from the testicles to the penis	1	-
	The place where the secretion that allows the sperm to move freely is produced	1	-
	I do not know	2	
Ovarian	Where the ovule cell is produced	9	14
	Where fertilization takes place	-	2
	Where the fertilized ovule implants and develops until birth	1	1
	The place where the secretion that allows the sperm to move freely is produced	2	-
	Where sperm are transported from the testicles to the penis	1	-
	The place where the offspring, which has completed its	1	-

	development, leaves the mother's body at birth		
Uterine	Where the fertilized ovule implants and develops until birth	4	12
	Where fertilization takes place	3	2
	The place where the offspring, which has completed its development, leaves the mother's body at birth	5	-
	I do not know	2	-
Vagina	The place where the offspring, which has completed its development, leaves the mother's body at birth	8	14
	Where the fertilized ovule implants and develops until birth	3	-
	Where fertilization takes place	3	-

According to Table 4, the most common answer given before and after the implementation in the "Sperm Duct" category under the theme of "Features of the Reproductive Organs" was the code " Where sperm are transported from the testicles to the penis". In the "Gland" category, it was seen that the most common answer given before and after the implementation was the code " The place where the secretion that allows the sperm to move freely is produced". It was seen that the most common answer given before and after the implementation in the "Penis" category was the code " Where urine and semen are expelled". It was seen that the most common answer given before and after the implementation in the "Testis" category was the code " Where sperm cells are formed". It was seen that the most common answer given before the implementation in the "Oviduct" category was the "Where the ovule cell is produced" code, and the most common answer given after the implementation was the " Where fertilization takes place" code. It was seen that the most common answer given before and after the implementation in the "Ovarian" category was the code " Where the ovule cell is produced". It was seen that the most common answer given before the implementation in the “Uterine" category was the code "The place where the offspring, which has completed its development, leaves the mother's body at birth", and the most common answer given after the application was the code " Where the fertilized ovule implants and develops until birth". It was

seen that the most common answer given before and after the implementation in the "vagina" category was the code " The place where the offspring, which has completed its development, leaves the mother's body at birth". It was determined that there was an increase in the frequency numbers of the answers given by the students before and after the application, mostly in the correct code. It was determined that the students had misconceptions about the reproductive organs before the application, and that their misconceptions were resolved after the implementation.

Tablo 5.

Students' Answers to the Question of "The stages of formation of an individual are given below. Write the properties of the numbered structures in the spaces given."

			Frequency	
Theme	**Category**	**Codes**	**Before**	**After**
Stages of Formation of a Human	Female reproductive cell	Ovule cell	3	13
		Ovarian	6	1
		I do not know	5	-
	Male reproductive cell	Sperm	9	14
		I do not know	5	-
	The fusion of sperm and egg	Fertilization	5	14
		I do not know	9	-
	Structure formed by the union of sperm and egg	Zygote	2	13
		Embryo	-	1
		Fertilization	1	-
		I forgot	1	-
		I do not know	10	-
	The structure formed by the zygote through successive mitotic divisions	Embryo	5	13
		Zygote	-	1
		Fertilization	1	-
		I do not know	8	-
	The structure formed by the growth and development of the embryo	Fetus	6	14
		Embryo	1	-
		I do not know	7	-
	The State of the Fetus that Completed Its Development at the World	Baby	8	14
		I do not know	6	-

According to Table 5, the most common answer as the "Ovarian" code given before the implementation was in the "Female Reproductive Cell" category under the theme "Stages of Formation of a Human", and the most common answer given after

the implementation was the "Ovule cell" code. It was seen that the most common answer given before and after the implementation in the "Male Reproductive Cell" category was the "Sperm" code. It was seen that the most common answer as given before the implementation in the category of was the code "I don't know", and the most common answer given after the implementation was the code "Fertilization" in the "The fusion of sperm and egg" category. In the category of "Structure formed by the union of sperm and egg", the most common answer given before the implementation was the code "I don't know", and the most common answer given after the implementation was the code "Zygote". It was seen that the most common answer given before the implementation was the code "I don't know" in the category of "The structure formed by the zygote through successive mitotic divisions ", and the most common answer given after the implementation was the "Embryo" code. In the category of "The structure formed by the growth and development of the embryo", it was seen that the most common answer given before the implementation was the code "I don't know", and the most common answer given after the implementation was the "Fetus" code. It was seen that the most common answer given before and after the implementation in the category of " The State of the Fetus that Completed Its Development at the World" was the "Baby" code. It was determined that some students confused the concepts of egg and ovary before the implementation, and this conceptual confusion was corrected after the application. After the application, it was determined that a student confused the concepts of zygote and embryo.

Table 6.

Students' Answers to the Question of "Write in the blanks which type of asexual reproduction the following organisms perform."

			Frequency	
Theme	**Category**	**Codes**	**Before**	**After**
Types of asexual reproduction	Paramecium	By dividing	3	13
		I do not know	11	1
	Rose	Vegetative	4	12
		I do not know	10	2
	Earthworm	Regeneration	3	12
		By dividing	1	2
		I do not know	10	-
	Strawberry	Vegetative	3	11

	Budding	1	-
	I do not know	10	3
Cap mushroom	Budding	2	10
	Vegetative	1	1
	Spore	1	-
	I do not know	10	3
Starfish	Regeneration	3	12
	By dividing	-	1
	I do not know	11	1
Jellyfish	Budding	3	10
	By dividing	1	-
	I do not know	10	4
Amoeba	By dividing	4	12
	I do not know	10	2
Coral	Budding	2	11
	Vejetatif	1	-
	By dividing	1	1
	I do not know	10	2
Violet	Vegetative	4	13
	I do not know	10	1
Moss	Regeneration	-	6
	Spore	1	2
	Germination	1	-
	Vegetative	2	-
	I do not know	10	6
Oglena	By dividing	3	11
	Budding	1	-
	I do not know	10	3

According to Table 6, the most common answer given before the implementation was "I don't know" in the "Paramyceum" category under the theme of "Types of asexual reproduction", and the most common answer given after the implementation was "By dividing". It was seen that the most common answer given before the implementation in the "Rose" category was the code "I don't know", and the most common answer given after the implementation was the "Vegetative" code. It was seen that the most common answer given before the implementation in the "Earthworm" category was the code "I don't know", and the most common answer given after the implementation was the “Regeneration” code. In the "Strawberry" category, the most common answer given before the implementation was the "I don't

know" code, and the most common answer given after the implementation was the "Vegetative" code. It was seen that the most common answer given before the implementation in the category of "Cap mushroom" was the code "I don't know", and the most common answer given after the implementation was the code "Budding". It was seen that the most common answer given before the implementation in the "Starfish" category was the code "I don't know" and the most common answer given after the implementation was the "Renewal" code. It was seen that the most common answer given before the application in the "Jellyfish" category was the code "I don't know", and the most common answer given after the implementation was the "Budding" code. In the "Amoeba" category, it was seen that the most common answer given before the implementation was the code "I don't know", and the most common answer given after the implementation was the code "By dividing". In the "Coral" category, the most common answer given before the implementation was the "I don't know" code, and the most common answer after the implementation was the "Budding" code. It was seen that the most common answer given before the application in the "Violet" category was the code "I don't know", and the most common answer given after the implementation was the "Vegetative" code. It was seen that the most common answer given before the implementation in the "Moss" category was the code "I don't know", and the most common answers given after the implementation were the " Regeneration" and "I don't know" codes. It was seen that the most common answer given before the implementation in the "Oglena" category was the code "I don't know", and the most common answer given after the implementation was the code "By dividing".

Table 7.

Students' Answers to the Question of "The parts of a flower are given below. Write the name and function of the organ in the place indicated by the arrow."

Theme	Category	Codes	Before	After
Recognizing parts of a flower through visual	Recognition of the cusps	tooth crest	2	10
		Mound	5	-
		dental tube	-	1
		I do not know	7	3
	The seed outline/ recognizing the ovary	Ovarian	1	11
		seed draft	2	1
		egg cell	2	-

	I do not know	9	2
Identifying the stigma	dental tube	2	12
	female organ	2	2
	Ovarian	1	-
	female reproductive cell	1	-
	I do not know	8	-
Recognition of the male organ	Male organ	5	9
	Başcik	-	4
	Pollen	1	1
	I do not know	8	-
Petal Recognition	petal	4	14
	Leaf	2	-
	I do not know	8	-
sepal recognition	sepals	4	14
	Leaf	1	-
	I do not know	9	-
Recognizing the flower bed	flower tray	4	13
	Handle	1	-
	I do not know	9	1
Recognizing the flower stem	flower stalk	7	14
	I do not know	7	-

According to Table 7, it was seen that the most common answer given before the application was "I don't know" in the category of "Recognizing the Tooth Crest" under the theme "Recognizing the parts of the flower through visuals", and the most common answer given after the application was the "Tooth Crest" code. It was seen that the most common answer given before the application in the category of "recognition of the seed outline/ovary" was "I don't know", and the most common answer given after the application was the "Ovary" code. It was seen that the most common answer given before the application in the "Recognition of the Dentistry Tube" category was the code "I don't know", and the most common answer given after the application was the "Denticulum tube" code. It was seen that the most common answer given before the application in the "male organ recognition" category was the code "I don't know", and the most common answer given after the application was the "male organ" code. In the "petal recognition" category, the most common answer given before the application was the "I don't know" code, and the

most common answer given after the application was the "petal" code. It was seen that the most common answer given before the application in the "Seal recognition" category was the code "I don't know", and the most common answer given after the application was the "Seal" code. In the category of "Recognizing the flower tray", it was seen that the most common answer given before the application was the code "I don't know", and the most common answer given after the application was the code "Flower tray". It was seen that the most common answers given before the application in the category of "Recognizing the flower stem" were "Flower stem" and "I don't know" codes, and the most common answer given after the application was the "Flower stem" code.

Table 8.

Students' Answers to the Question of "Write the metamorphosis stages of the butterfly and the frog in the "Your Answer" section below, respectively."

Theme	Category	Codes	Before	After
Visual Recognition of Butterfly Metamorphosis	Egg stage	Egg	6	14
		I do not know	8	-
	Caterpillar / larval stage	Caterpillar	3	10
		Larval	2	4
		I do not know	9	-
	Pupal stage	Pupal	3	11
		Cocoon	2	3
		I do not know	9	-
	Butterfly phase	Butterfly	5	14
		I do not know	9	-
Visual Recognition of Frog Metamorphosis	Egg stage	Egg	5	14
		I do not know	9	-
	Tadpole stage	Tadpole	4	9
		Caterpillar	2	5
		I do not know	8	-
	Young frog stage	Young frog	2	8
		Tadpole	3	6
		I do not know	9	-
	Adult frog stage	Adult frog	2	13
		Baby frog	3	1
		I do not know	9	-

According to Table 8, the most common answer given before the implementation was "I don't know" in the "Egg Stage" category under the theme of "

Visual Recognition of Butterfly Metamorphosis", and the most common answer given after the implementation was the "Egg" code. In the category of "Caterpillar / larval stage", the most common answer given before the implementation was the code "I don't know", and the most common answer given after the implementation was the code "Caterpillar". It was seen that the most common answer given before the application in the "Pupal Stage" category was "I don't know", and the most common answer given after the application was the "Pupa" code. In the "Butterfly Stage" category, the most common answer given before the implementation was the "I do not know" code, and the most common answer given after the implementation was the "Butterfly" code. It was seen that the most common answer given before the implementation was the code "I don't know" in the category of "Egg Stage" under the theme of " Visual Recognition of Frog Metamorphosis", and the most common answer given after the implementation was the "Egg" code. It was seen that the most common answer given before the implementation in the category of "tadpole stage" was the code "I don't know", and the most common answer given after the application was the "tadpole" code. It was seen that the most common answer given before the implementation in the "Young Frog Stage" category was "I don't know", and the most common answer given after the implementation was the "Young frog" code.

It was seen that the most common answer given before the implementation in the "Adult frog stage" category was "I don't know", and the most common answer given after the implementation was the "Adult frog" code.

Table 9.

Students' Answers to the Question of "Onur prepared the following materials for growing zucchini at home. In the process of growing honor gourd, what should he pay attention to in terms of the materials he uses and the environmental conditions? What else does the squash need to grow healthily?"

			Frequency	
Theme	**Category**	**Codes**	**Before**	**After**
Growing plant	Environmental conditions	Water	9	7
		Suitable temperature	-	7
		Oxygen / Air	2	7
		Moisture	2	4
		Light	-	3

		Sun	7	2
		Carbon dioxide	1	1
		Pot change	1	-
		Seed	1	-
		Medicine	1	-
		Fertilizer	1	-
		Heat	1	-
	Other	I do not know	4	-

According to Table 9, under the theme of "Growing Plant", the most common answer given before the implementation in the "Environmental Conditions" category was the code "Water", and the most common answer given after the implementation "Water", "Suitable Temperature" and "Oxygen/Air" codes. It was determined that while the students only commented on the growth of the plant before the implementation, they made comments on the germination, growth and development of the plant after the implementation.

Table 10.

Students' Answers to the question of "What do you think should be considered in the care of different animals (cat, dog, chick, fish, lamb, chicken, cow...)?"

			Frequency	
Theme	**Category**	**Codes**	**Before**	**After**
Animal care	Things to do	Paying attention to the living space	-	8
		Paying attention to your diet	2	8
		Show love	3	5
		Keep clean	6	5
		Vaccinate regularly	2	4
		Give food	4	4
		Give clean water	3	4
		Hover	2	3
		Give freedom	1	2
		Taking care of when sick	2	1
		Toilet training	2	-
		Grow in the garden	1	-
		Paying attention to the shelter area	3	-
	Other	I do not know	4	-

According to Table 10, under the "Animal Care" theme, the most common answer given before the application in the "What to do" category was "Keeping it clean", and the

most common answer given after the application was "To pay attention to the living space." and “Taking care of his diet.” codes have been found.

Result and Discussion

As a result of the study, it was found that the students gave more correct code and frequency outputs with a significant difference after the application and correctly associated the unit concepts with each other. In addition, it was observed that the students had misconceptions about reproductive cells and their features, reproductive organs and their functions, stages of formation of living things, types of asexual reproduction, parts of flowers, stages of metamorphosis, plant and animal breeding, but their misconceptions were largely resolved after the application. With the results obtained, it was concluded that there was a positive change in the students' pre- and post-application achievements within the scope of the "Reproduction, Growth and Development in Living Things" unit. Accordingly, it was seen that the quantitative and qualitative findings supported each other.

Similarly, Azid et al. (2020), it was found that the use of Web 2.0 tools increased students' mathematics achievement. In a study conducted by Uysal & Çaycı (2020), it was found that Web 2.0 animation tools had a positive effect on the academic achievement of 4th grade students. Jena et al. (2020), it has been found that the use of Web 2.0 tools has a positive effect on the learning performance of secondary school students. Mohammed et al. (2020) with undergraduate students, it was found that there was a significant difference in the achievements of the experimental group, in which Web 2.0 tools were applied, compared to the control group, in which traditional instruction was applied.

Abdoli-Sejzi et al. (2015), it was found that there is a positive relationship between the use of Web 2.0 technologies and student success in the virtual university. In another study by Baig (2011), it was found that the online learning environment supported by Web 2.0 tools used in physics lessons increased the success of tenth grade students. Other studies also emphasize that Web 2.0 technologies have a significant effect on student achievement (Malhiwsky, 2010; Konstantinidis et al., 2013).

Recommendations

In this study, the effect of online education applications supported by Web 2.0 tools on the achievement of 7th grade students in the unit "Reproduction, Growth and Development in Living Things" was examined. As a result of the study, it has been reached

that online education applications supported by web 2.0 tools increase the access of students. Accordingly, web 2.0 tools can be applied and useful in other branches and subjects in order to increase the accessibility of secondary school students. In this study, online training activities were carried out using the web 2.0 tools Canva, Padlet, Quizizz, Nearpod, Wordwall, Kahoot, Storyboard That and Bubbl Us. Different web 2.0 tools can be used and useful according to the needs of the course, the teacher and the students. The duration of this study is limited to a total of 6 weeks (24 course hours) with 4 weeks of practice and 2 weeks of testing. It may be more beneficial to practice for a longer period of time so that the study can be generalized.

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