

Astronomy with Web 2.0 Tools: Sun, Earth and Moon Unit

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Abstract

The aim of this research is to examine the effects of web 2.0 tools used in online astronomy education on the conceptual achievement of 5th grade secondary school students. For this purpose, the Sun, Earth and Moon unit was processed online using web 2.0 tools. The study was implemented in a public secondary school over a period of 6 weeks. Mixed research method, which combines qualitative and quantitative research methods, was used in the study. An easily accessible sample model was used to determine the study group. The sample of the study consists of 12 students (7 girls, 5 boys) in the 10-11 age group. The "Sun, Earth and Moon Achievement Test" developed by Sontay & Karamustafaoğlu (2020) was used as a quantitative data collection tool in the study. Qualitative data collection tool "Semi-Structured Telephone Interview on the Concepts of the Sun, Earth and Moon" was used. SPSS program was used in the analysis of quantitative data. Content analysis method was used in the analysis of qualitative data. As a result of the study, it was seen that online education supported by web 2.0 tools within the scope of the Sun, Earth and Moon unit had a positive effect on students' conceptual success.

Keywords: Sun, Earth and Moon, Web 2.0 Tools, Conceptual Achievement, Online Education

Introduction

Throughout history, the curiosity of people to find their position in space and to observe celestial bodies has been the starting point of astronomy. From past to present, the science of astronomy has been a popular and up-to-date science among the younger generation and the public. It can be thought that the science of astronomy is less related to our daily life than other sciences. However, astronomy is a highly inspiring discipline, linked to other disciplines and industry (Fies & Packham, 2022).

With the development of technology, astronomy science and astronomy education have also developed (Percy, 2010). The field of AstroInformatics, which has come to the fore as a new discipline; by bringing together astronomy and information/communication technologies, it opens new perspectives for astronomical discoveries and information. In this context, a new methodological change is needed such as new generation telescopes, space missions, teaching and information acquisition methods (Cavuoti, Brescia & Longo, 2012).

Review of Literature

In parallel with astronomy, developments in technology have also caused a change in the paradigm of teaching methods used in education. Previously, the training was only face-to-face; today, online education is widely used. Online education and learning is no longer peripheral or complementary; appears as the main component. As a result of this; new educational tools, learning areas, processes, results, new educational roles and formations have emerged. Today's children are born into technology and grow up with computers, mobile games and online environments and use this digital language as their mother tongue (Prensky, 2001). This new generation of students is very prone to accessing information via the internet and sharing information online (Kleiman, 2004).

Larreameindy-Joerns and Leinhardt (2006) presented two opposing views for online education in their study. According to some, online education is a great opportunity to remove the limitations of traditional education, while others are concerned that it may have negative consequences for the quality of education. However, it is seen that this negative view is not only specific to online education, but a general reaction to distance education.

With web technologies, online education has become more accessible, open and flexible. Thus, they are innovations that enable more and faster human communication in the digital information age and produce the information economy. Among these technologies, Web 2.0 technology is widely used in education (Harasim, 2000). Unlike Web 1.0 technologies, Web 2.0 tools do not simply offer one-way communication, such as reading a web page or viewing an image; Allows you to leave comments, interact with web content such as live text, audio or video discussions. These tools can be accessed from many technological devices and from anywhere in the world. It is also free and does not require much hardware (Weller, 2013). Web 2.0 technologies maximize learning through content creation and electronic interaction (Okoro et al., 2012). Web 2.0 activities can be used in classroom learning, designing and implementing classroom activities (Albion, 2008). Web 2.0 tools are easy-to-learn and easy-to-use applications that enrich the distance

education process in terms of interaction and quality. Web 2.0 can be defined as a set of basic tools that contribute to the development and enrichment of knowledge (O'Reilly, 2005). These tools are;

- Enabling them to be individuals who are shaped according to the needs of the 21st century and who can use and process information
- Increasing motivation by having fun while learning
- Technologically active and keeping fit
- Obtaining a tangible product as a result of work
- Ensuring permanence by appealing to more than one sense
- Increasing students' self-confidence and providing a positive attitude
- It has important features such as providing a dynamic educational environment (Pierce, 2018).

Elia (2007) presented a study on the transition of libraries from paper format to the web environment, and from there to the online encyclopedia, which is a web 2.0 tool. Within the scope of this study, he examined articles on online encyclopedias such as Encyclopaedia Britannica Online and Wikipedia. Co-authored articles and talk pages in these online libraries form a distinctive new computer-mediated discourse community. Barnes et al. (2008), Web 2.0 tools were used in the Swinburne Astronomy Online (SAO) program, which was developed in a study. In a study conducted by Weller (2013), the use of Web 2.0 in the professional learning of science teacher candidates was investigated.

The aim of this research is to examine the effect of online education supported by web 2.0 tools on the conceptual achievement of secondary school 5th grade students in the sun, earth and moon unit. The research problem of the study is as follows:

- Is there a significant difference in students' conceptual success before and after the application within the scope of the Sun, Earth and Moon unit?

The sub-problems of the study are as follows:

1. Is there a significant difference between the academic achievement test scores of the students before and after the implementation?
2. What is the students' conceptual understanding of the Sun, Earth and Moon concepts before and after the implementation?

Materials and Methods

Model of Research

In this study, qualitative and quantitative data collection tools were used together. The model of the study is mixed method study. Mixed methods research is an approach that combines both quantitative and qualitative methods in a single study to provide a broader and more complete vision of a topic or problem under consideration. By using mixed methods, it overcomes the limitations of quantitative and qualitative methodologies and enables the researcher to reach rich information that cannot be obtained by using each method alone (Almeida, 2018).

Study Group

The study group consists of 12 students (7 girls, 5 boys) studying in the 5th grade of a public school. An easily accessible sample type was used to determine the study group of the research. Easily accessible sampling is one of the non-random sampling methods and is a method frequently used in pilot studies such as this study. Easily accessible or convenient sampling; sample is included in the study, which is quick and easy to reach. It is the most frequently used strategy in qualitative research (Patton, 2005).

Data Collection Tools

Due to the mixed method used in the research, qualitative and quantitative data collection tools were used together. “Semi-Structured Telephone Interview on the Concepts of the Sun, Earth and Moon” was used as a qualitative data collection tool. In this direction, a semi-structured interview form was applied. The quantitative data collection tool “Sun, Earth and Moon Achievement Test” developed by Sontay & Karamustafaoglu (2020) was used. “Sun, Earth and Moon Achievement Test” is an achievement test designed to measure the academic success of 5th grade students in the Sun, Earth and Moon unit. The questions were prepared for the achievements of the Science Curriculum. The test consists of a total of 25 items with multiple choice and 4 options. The mean item difficulty index of the test was 0.53; mean item discrimination index was 0.54; The KR-20 internal

consistency coefficient is 0.83. The test is valid and reliable. In order to use the scales determined by the researcher during the application process of the test, the necessary permissions were obtained from the scale developers and the forms were transferred to the digital environment. Data were collected by delivering these scales in the digital environment via the link addresses shared with the students. The problem statement and related data collection tools are shown in Figure 1:

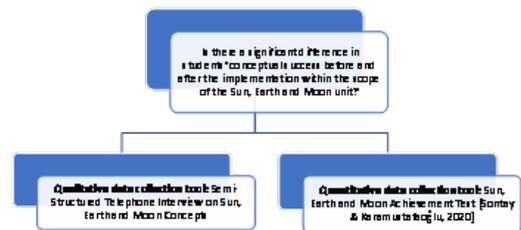


Figure 1 Problem Statement and Data Collection Tools

Data Collection Process

Within the scope of the study, Science Applications courses were conducted simultaneously online. Students participated in the classes in their home environment. The courses were conducted over the EBA or Zoom platform. In line with the study, different web 2.0 tools were used for each course. In this study, web 2.0 tools; EBA (Educational Information Network), Zoom, YouTube, Animaker, Hologram technology, Postermiywall, Mindmeister, Quizizz, Canva, Animatron, Padlet, Educandy, Genially, PBS Learning Media, Sky and Moon Phases Calendar, Popplet, Wordwall, Mycreativeshop, Artsteps, MEBAR, Mentimeter was used.

The activities in the lesson plans were developed with Web 2.0 tools within the scope of the Sun, Earth and Moon unit. While creating the activities, the literature was examined and two different expert opinions were taken. The application process took 4 weeks. The lesson plan prepared and the activities developed in the application were developed to cover the achievements of both by examining the 2018 Science and Science Applications curriculum.

Table 1 Data Collection Process and Tools

Weeks	Used tools	
	Knowledge Communication Tools	Web 2.0 tools
First week	Computer, tablet or phone	Eba, zoom, Animaker, YouTube, Hologram, Postermywall, Mindmeister, Quizizz
Second week	Computer, tablet or phone	Eba, zoom, Canva, Animatron, Padlet, Educandy
Third week	Computer, tablet or phone	Eba, zoom, Genially, PBS Learning Media, YouTube, Hologram, Popplet, Wordwall
Fourth week	Computer, tablet or phone	Eba, zoom, Mycreativeshop, Artsteps, MEBAR, Mentimeter

Data Analysis

As a data collection tool in the research, the quantitative data obtained from the pre-test and post-test applications of the “Sun, Earth and Moon Achievement Test” were analyzed using the SPSS program and wilcoxon analysis, one of the non-parametric tests. The Wilcoxon signed-rank test takes into account the direction of the differences between the pretest and the posttest, as well as the amount of differences.

As a data collection tool, content analysis method was used for the analysis of the qualitative data obtained through the “Semi-Structured Telephone Interview on the Concepts of the Sun, Earth and Moon”. Content analysis is a data analysis method that examines the general trends on the researched subject, reveals and defines the results of the research by systematically examining the data obtained. In content analysis, similar data are brought together within the framework of certain concepts and themes, and they are organized and interpreted (Creswell, 2016).

In the research, the data obtained by reflecting open-ended questions to the participants in semi-structured telephone interviews were organized by transferring them to the computer environment. The collected data were classified and tabulated as codes and frequencies. In this process, in order to increase the reliability of the study, the data were examined

by two researchers and the tables were finalized. Some of the students’ opinions are given under the tables as direct quotes, increasing the validity and reliability.

Results and Discussion

Findings related to the main problem of “Is there a significant difference in the conceptual achievements of students before and after the implementation within the scope of the Sun, Earth and Moon unit?” determined in the study, were collected and analyzed separately with qualitative and quantitative data collection tools and expressed under separate headings.

The quantitative findings obtained from the study are as follows:

Table 2 Comparison of Pretest-Posttest Mean and Standard Deviation

Group	N	X	S
Pre-test	12	11,5833	3,08835
Post-test	12	14,7500	5,61046

According to Table 2, the pretest mean score of the study group was $X=11.58$; its standard deviation is $S=3.09$. The post-test mean score of the study group was $X=14.75$; its standard deviation is $S=5.61$.

Table 3 Comparison of Pre-Test-Post-Test Scores with Wilcoxon Signed Ranks

Ranks	N	Rank Average	Rank Sum	Z	p
Negative Rank	1	1,50	1,50	-2,657	0,008
Positive Rank	9	5,94	53,50		
Equal Rank	2				

According to Table 3, as a result of the analysis of the data in the research, a positive ($Z=-2.657$) and significant ($p=.008 < .05$) result was obtained in terms of academic achievement.

The qualitative findings obtained from the study are given below in the form of categories, codes and frequencies in the tables:

Table 4 Sun’s Structure and Properties Theme

Category	Codes	Before	After
It’s size	The Radius of the Sun 695,500 km.	-	1
	The Sun is the Largest Celestial Object in the Solar System.	-	1
Gas structure	The Sun Is Composed Of Gases.	8	9
	The Sun Contains Hydrogen Gas in Its Structure.	1	3
	The sun contains Helium Gas in Solar Structure.	1	2
	The sun contains Oxygen Gas in the Structure of the Sun.	1	1
	The sun contains Carbon Gas in the Structure of the Sun.	-	1
	The sun contains Nitrogen Gas in Solar Structure.	-	1
Geometric shape	The sun is spherical.	4	8
Layered structure	The Sun Has a Layered Structure.	5	6
	The Sun Has a Stone Sphere Layer.	-	1
	The Sun Has a Color Sphere Layer.	-	1
	The Sun Has a Light Sphere Layer.	-	1
	The Sun Has a Core Layer.	-	3
Its temperature	Explosions Occur in the Sun.	1	4
	In the Sun, the temperature decreases from the inside out.	1	5
	There are sunspots on the surface of the sun.	1	7
Its type	The Sun is a Medium Size Star.	3	2
	The Sun is a Star.	-	1
	The Sun is the Closest Star to Earth.	1	-
Contribution to the world	Solar Energy Source.	-	1
	The Sun is the Source of Light.	6	8
	The sun is the source of heat.	5	7
	The Sun is the Life Source of our Earth.	1	2
On the life	There Is No Life on the Sun.	-	1
	There Is No Water Source on the Sun.	-	1
Observation	It is harmful to look at the sun with the naked eye.	-	1
Distance to Earth	The distance from the Sun to the Earth is 150 million km.	-	3

According to Table 4, considering the frequencies before and after the application, it was seen that the students gave more codes and frequency outputs on the theme of “The Structure and Properties of the Sun” after the application. While no code output was received from the students in the “Size” and “Distance” categories of the sun before the application, codes were obtained in these categories after the application and the codes contain scientifically correct information. After

the application, the students drew attention to the sunspots and made a statement about the sunspots. However, in students; The misconceptions identified in the semi-structured telephone interview before the application were not observed in the semi-structured telephone interview after the application.

Examples of student responses about “The Structure and Properties of the Sun” before the application are given below.

- S9: The Sun reflects its light to the Moon at night. (Misconception)
- S11: The Sun has no atmosphere. (Misconception)
- After the application, examples of student responses about “The Structure and Properties of the Sun” are given below.
- S9: The Sun is like a big ball of fire and the temperature increases as you go deeper from the Sun’s surface.
- S2: The Sun is so hot that spacecraft that get too close to it may melt.
- S10: There are regions on the sun called sunspots. When we observe the Sun, sunspots always shift in the same direction. This shows us that the Sun is rotating.
- S12: There are regions on the Sun’s surface that

are colder than other parts. These parts are called sunspots because they are darker in color.

Table 5 Sun’s Rotation Theme

Category	Codes	Before	After
Rotation movement	The Sun Rotates Around Its Axis.	11	12
Direction of rotation	The Sun Rotates Counter clockwise.	4	11
	The Sun Turns from West to East.	-	1

Looking at Table 5, more code and frequency outputs are seen after the application than before the application in the answers given by the students about the “Rotational Movement of the Sun” theme.

Table 6 Moon’s Structure and Properties Theme

Category	Codes	Before	After
Its size	The Radius of the Moon is 3475 Km.	-	1
	The Moon is Smaller than the Sun and Earth.	-	1
Its geometric shape	The moon is spherical.	3	7
Surface structure	There Are Craters On The Moon.	3	10
	There are Lunar Seas and Moon Mountains on the Moon’s Surface.	1	2
	The Moon’s Surface Is Covered With Dust.	2	6
Its atmosphere	The Moon's Atmosphere Is Thin To Nearly No.	4	9
	Meteor Showers on the Moon.	-	8
	The Day and Night Temperature Difference on the Moon is Too Big.	1	7
	Precipitation and Weather Events Are Not Observed on the Moon.	-	1
	Astronaut Footprints on the Moon’s Surface May Remain Undisturbed.	-	2
	Gravity on the Moon is Less than on Earth.	-	4
Life on the moon	There is no life on the moon.	-	3
	There is no oxygen on the moon.	1	1
	There is no water or food on the moon.	-	1
General structure	The moon is solid.	1	2
	The moon has a layered structure.	-	4
	The moon is not a natural light source.	1	3
	The Moon reflects the light it receives from the Sun.	1	5
	Moon is Earth’s satellite.	1	4
Observation	The moon has phases.	-	1

When we look at Table 6, the students had more code and frequency outputs on the theme of “Moon

Structure and Features” after the application, and in addition, the features such as weather events on

the Moon, meteor showers, temperature difference, surface structure of the moon were compared with each other. It can be seen from the sample responses of the students they associate with after the implementation.

After the application, examples of student responses related to the theme of “The Structure and Properties of the Moon” are given below.

- S1-S3-S10-S12: Craters on the lunar surface are formed as a result of meteor showers.
- S2-S5-S7-S9: As a result of the impact of meteorites, pits called craters are formed on the Moon’s surface.

- S10: There are lunar mountains and lunar seas on the lunar surface. The lunar mountains appear brighter, and the lunar seas appear darker.
- S10-S5: Since the temperature difference between day and night on the Moon is very large, the stones on the Moon crumble into dust. This is why the surface of the Moon is covered with dust.
- S10: Since there is no precipitation and weather events on the Moon, the footprints of astronauts who come to the Moon remain intact.
- S1: Since the gravity is less on the Moon than on the Earth, we are lighter.

Table 7 Moon Movements Theme

Category	Codes	Before	After
Rotation of the moon	The Moon Rotates Around Its Axis.	10	12
	The Moon Rotates Counterclockwise.	3	8
	The Moon Revolves Around the Earth. (Misconception)	4	-
	The Moon revolves around the Sun with the Earth. (Misconception)	4	-
Moon's entanglement	The Moon Goes Around the Earth.	7	12
	The Moon revolves around the Sun along with the Earth.	5	11
Movement times	The Moon's Rotation Period is 27 Days.	-	3
	The period of time for the Moon to orbit the Earth is 27 days.	-	2
	The Moon’s Period of Revolving Around the Earth is 24 Days. (Misconception)	1	-
	The Moon’s Period of Revolving Around the Earth is 1 Month.	-	3
	The time it takes for the moon to revolve around the earth is the same as for the moon to revolve around itself.	-	4
Consequences of the moon's movements	The Moon's Phases Are Formed As A Result Of The Moon's Movements.	4	10
	The Moon has 4 main phases and 4 intermediate phases.	-	4
	The Moon has 4 main phases.	1	-
	New month	-	7
	First Quarter	-	6
	full moon	1	8
	Last Quarter	1	6
	Bulging Moon	-	8
	Crescent	-	8
	Day and Night Occur as a Result of the Moon’s Movements. (Misconception)	2	-

Looking at Table 7, it is seen that the students have significantly more code and frequency outputs on the theme of “Moon Movements” after the application than before the application. However, in students; The misconceptions identified in the semi-structured

telephone interview before the application were not observed in the semi-structured telephone interview after the application. Ask students who have misconceptions about the rotation and entanglement movement, ‘What do you think is rotation? When

they were asked what is entanglement?', they stated that they did not know the difference between turning and entanglement, and the reasons for their mistake were understood. In the "Results of the Moon's Movements" category, the difference in code and frequency before and after the application is quite evident, and in the "Movement Times" category, although a correct code cannot be given before the application, the correct code outputs are seen after

the application.

One of the examples of the students' responses to the theme of "Moon's Movements" after the application is given below.

S11: Since the Moon does not have its own light, the side that sees the Sun appears bright, and the side that does not see the Sun appears dark. Thus, the phases of the Moon are formed.

Table 8 Earth Movements Theme

Category	Codes	Before	After
Earth's rotational motion	The earth rotates on its axis.	6	10
	The Earth's Rotation Time is 24 Hours.	-	8
	Day and Night Occur as a Result of the Earth's Rotation.	1	1
	The Earth Revolves Around The Sun. (Misconception)	2	-
Earth's rotation movement	The Earth Revolves Around The Sun.	4	10
	The Earth's orbit around the sun is 365 days and 6 hours.	1	10
	Seasons occur as a result of the Earth's revolution around the sun.	-	1
Earth's rotation direction	Earth Rotates Counterclockwise.	4	8

Looking at Table 8, it is seen that the students have significantly more code and frequency outputs on the theme of "Motions of the Earth" after the application than before the application. However, in students; The misconceptions identified in the semi-structured telephone interview before the application were not observed in the semi-structured telephone interview after the application.

Examples of student responses on the theme of "Motions of the Earth" before the application are given below:

- S5: Solar and lunar eclipses occur as a result of the movements of the Sun, Earth and Moon.
- S6: The Moon is a satellite of the Earth, but the Earth is not a satellite of the Sun.

Examples of student responses on the theme of "Motions of the Earth" after the application are given below.

- S5: Solar and lunar eclipses occur as a result of the movements of the Sun, Earth and Moon. Lunar eclipse if the Earth coincides between the Sun and the Moon, if the Moon falls between the Sun and the Earth, there is a solar eclipse.
- S8: The Sun, Earth and Moon rotate in a pattern.
- S10-S12: The period of the Moon's orbit around the Earth is the same as the period of its rotation.

That's why we always see the same side of the Moon.

Sun, Earth and Moon Achievement Test (Sontay & Karamustafaoğlu, 2020), which is a quantitative data collection tool, the pre-test and post-test data of the wilcoxon signed ranks test performed with the SPSS program, according to the academic achievement test statistic, the result was positive ($Z=-2,657$). and significant ($p=.008<.05$). As a result of the analysis made using the content analysis of the pre-test and post-test data of the 'Semi-Structured Telephone Call for the Concepts of the Sun, Earth and the Moon', which is a qualitative data collection tool, it was found that the students had more code and frequency outputs after the application compared to the pre-application. It is seen that they describe more about the subject, associate the concepts with each other and connect the phenomena to the cause. However, in students; The misconceptions identified in the semi-structured telephone interview before the application were not observed in the semi-structured telephone interview after the application. Similarly, in a study investigating the potential of web 2.0 technologies in distance learning, emerging problems and the effectiveness of web 2.0 tools, noticeably positive results of web 2.0 technologies on students'

academic achievement were revealed (Gilani, 2012). In a study by Bin-jomman and Al-Khattabi (2018), the effect of using Web 2.0 technologies in education on the motivation of undergraduate students was examined. In the study, it was found that the experimental group had a higher motivation than the control group.

Conclusion

In the research, the effect of online education supported by web 2.0 tools on the conceptual achievement of secondary school 5th grade students in the Sun, Earth and Moon unit was examined. In the study, the data were collected with both quantitative and qualitative data collection tools and analyzed separately.

In the light of these results, it was found that there was a significant difference in the conceptual success of the students before and after the application within the scope of the Sun, Earth and Moon unit. As a result of the research; the quantitative data collected with the Sun, Earth and Moon Achievement Test (Sontay & Karamustafaoglu, 2020) data collection tool before and after the application, and the qualitative data collected with the ‘Semi-Structured Phone Call for the Concepts of the Sun, Earth and Moon’ data collection tool were analyzed separately. It is seen that the data support each other. In the study, Web 2.0 tools were used in astronomy education and its effect on the conceptual achievement of secondary school students was examined. In the study, it was found that astronomy education, which was processed with Web 2.0 tools, had a positive effect on students’ conceptual success. Based on the result obtained in the study; In teaching astronomical concepts, the use of web 2.0 tools that present interesting content for students, are easy to use, and allow students to interact with the content and observe, increases success (Ricci, Nicastro & Pio, 2013).

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