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The Effect of Using Digital Concept Cartoons in Science Lesson on Students' Achievement#

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ABSTRACT In the digital age we live in, electronic teaching materials can effectively increase students' participation in the learning and teaching process. In addition, it is known that using visual materials in science education has a positive effect on learning in this direction. The study aims to determine the effect of digital concept cartoons in the sixth-grade science course on the academic achievement of students and the retention of what is learned in the lesson and to determine the students' views on the concept cartoons applied in the lesson. This research was carried out with sequential mixed design, one of the mixed designs in which quantitative and qualitative research methods are used. The quantitative dimension of the study was conducted with a random experimental design with the pretest-posttest control group, and the qualitative dimension was carried out with a case study design to support the quantitative data and make an in-depth analysis of the data. A significant difference in favor of the experimental group was found between the post-test and retention test mean scores of the experimental and control group students participating in the study. Based on these findings, it can be said that the use of digital concept cartoons in the sixth-grade science course "reproduction, growth, and development in plants and animals" unit is effective in ensuring academic achievement and the retention of what is learned in the lesson. This finding of the study is parallel with qualitative findings.

Keywords Instructional Technologies, Electronic Learning Materials, Concept Cartoons

1. INTRODUCTION

Approaches and methods based on the active participation of students in the process of science teaching have taken their place in the curricula of countries. Based on students' learning by doing, experiencing, and establishing relationships between their prior knowledge and new knowledge, these education programs aim to raise individuals who research and produce knowledge. Therefore, constructivism has been an essential orientation for research and applications in science teaching (Geelan, 1997). In the constructivist approach, the student should actively participate in the learning process to be an active learner and structure knowledge (Kroasbergen & Van Luit, 2005). For this reason, it is important to use visual tools that are thought to enable students to actively participate in the process in science lessons arranged according to the constructivist approach.

In the constructivist approach, learning is considered a subjective process. From this perspective, learning-teaching strategies and materials to be used in the teaching process are very important in increasing the quality of learning (Çepni, 2010). For example, concept cartoons are shown among highly effective teaching materials that can increase the quality of learning products (Chin & Teou, 2009).

1.1 Concept Cartoons

Concept cartoons are recommended as tools that can be used in science teaching in terms of both preparing a teaching environment suitable for the constructivist approach and minimizing the problems related to the classroom environment (Naylor & Mc Murdo, 1990; Keogh & Naylor, 1997; Keogh, Naylor, & Wilson, 1998). Concept cartoons, which were first put forward in 1992 by Brenda Keogh and Stuart Naylor to develop an innovative teaching strategy, are drawings in the form of cartoons that include daily events containing scientific elements and in which different opinions about these daily events are

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presented by the characters (Keogh & Naylor, 1999b). In other words, concept cartoons; are drawings designed as a stimulus to generate scientific ideas, spark discussion, attract attention, and ask questions (Keogh, Naylor, de Boo, & Feasey, 2001). The constructivist learning approach, which argues that the knowledge is interpreted and created by the individual, is the basis of it (Morris, Merritt, Fairclough, Birrell, & Howitt, 2007).

Concept cartoons show different characteristics compared to regular cartoons. While cartoons are used to make individuals laugh, concept cartoons entertain students and question their knowledge (Keogh & Naylor, 1999b). Thanks to concept cartoons, scientific thoughts are adapted to daily life in order for students to establish a connection between daily life and science (Keogh et al., 1998). Therefore, the focus of each concept caricature is the daily life events related to the learners' own experiences (Naylor & Keogh, 1999). According to Dabell (2008), the way to follow while applying concept cartoons can be listed as follows:

- Students are directed to the confusion of concepts with the help of cartoons.
- A suitable environment is provided for students to express their personal views on the topic in a discussion environment.
- Students are encouraged to have small group discussions.
- A common result is tried to be reached.
- It is ensured that the common ideas reached are shared with the class.
- Outcome ideas of small groups are discussed with all class members.
- How the students' ideas have changed is evaluated.
- Reinforcement and application are made to ensure that the right ideas are permanent.

1.2 Benefits of Using Concept Cartoons in Education

Concept cartoons; It is effective in visualizing the subject in science teaching, encouraging students to discuss and ensuring active participation in the lesson, enabling students to compare their thoughts with each other, seeking reasons on which students can base their ideas, and justifying their ideas (Morris et al., 2007). In addition, presenting the concepts as drawings in cartoons attracts the students' attention and increases their interest in the concepts.

These tools can be used as a starting point to reveal students' thoughts and encourage students to discuss. According to Kinchin (2004), concept cartoons are helpful tools for focusing and participating in class discussions. In addition, concept cartoons used in the discussion environment help reveal characteristics such as how students show their behaviors and express their opinions in science classrooms (Coll, France, & Taylor, 2005).

The characters in the concept cartoons reveal different views. They show that there can be different perspectives about an event and make this event a problem for learners (Keogh & Naylor, 1999b). In addition, concept cartoons offer learners alternative views, new and different perspectives that they did not think of before in many cases (Keogh & Naylor, 1999a). Each student interprets the situation given in the concept cartoons by associating it with the current information (Keogh & Naylor, 2000). Therefore, it can be said that concept cartoons enable students to use their existing knowledge, create new perspectives, and see every alternative idea in concept cartoons as acceptable.

Giving students both correct and incorrect statements about an event in concept cartoons enables a cognitive conflict to occur in mind (Naylor & Keogh, 1999). It may not be possible to represent the daily event under investigation in actual conditions accurately. Many environmental conditions can cause students not to see the event correctly. For this reason, it is stated that concept cartoons will change the conditions and offer a better opportunity to observe different situations (Stephenson & Warwick, 2002).

Concepts that are mental tools enable individuals to think and communicate meaningfully; it plays a vital role in ensuring that the individual understands his / her environment and events correctly (Mulhan, 2007). Concept cartoons can also help students to identify their prior knowledge and to realize their misconceptions. However, since concept cartoons do not directly give the correct answer to students, students' existing misconceptions can be changed with the help of discussion and a cognitive balancing process (Martinez, 2004). For this reason, concept cartoons function as a stimulus that leads to the change and development of students' thoughts and helps students to question their thoughts, increase their interest and motivation (Keogh & Naylor, 1996).

Technology-based knowledge and skills that individuals should have in the 21st century are much different than in the past. Therefore, developments in technology must be reflected in the educational environments of the new generation. The use of technology and digital materials in teaching can be an effective way to meet the needs of today's students. Through the preparation of concept cartoons in an electronic environment, digital concept cartoons, which are the subject of this study, emerge.

1.3 Purpose and Importance of the Research

As Naylor, Downing, and Keogh (2001) stated in their studies; Concept cartoons can be used as a stimulus in science lessons where students can conduct applied research to solve different opinions that arise from their discussions. In the literature, there are studies (Chin, 2001; Keogh et al., 2001; Klavir & Gorodetsky, 2001; Stephenson & Warwick, 2002; Dabell, 2004; Parkinson, 2004; Balım, İnel, & Evrekli, 2008; Akamca & Hamurcu, 2009; Chin & Teou, 2009; İnel, Balım, & Evrekli, 2009; Naylor & Keogh, 2009; Sexton, Gervesoni, & Brandenburg, 2009; Cengizhan, 2011; Evrekli, İnel & Balım, 2011; İnel &

Balım, 2011; Atasoy, Tekbıyık, & Gülay, 2013; Tokcan & Alkan, 2013; Çinici et. al., 2014; Demirel & Aslan, 2014; Topcubaşı & Polat, 2014; Akbaş & Toros, 2016; Gümüş, Kavanoz, & Yılmaz, 2017; Yaşar, 2017; Özdemir, Yildiz-Durak, Karaoğlan Yılmaz, & Yılmaz, 2018; Şahin, 2018; Cerrah Özsevgeç, Yurtbakan, & Uludüz, 2019; Demirci, 2019) that reveal that concept cartoons are essential tools in ensuring active participation of students in the lesson, in revealing and increasing their conceptual understanding, in determining and eliminating misconceptions, in revealing alternative concepts and individual thinking styles, in developing academic achievement , inquisitive learning skills and affective characteristics.

According to the science curriculum, which has a constructivist structure, it is necessary to create classroom environments that will allow students to think creatively and critically, be open to communication and participatory, and investigate and question. Therefore, one of the critical purposes of science lessons is to allow students to examine daily life examples to construct concepts scientifically in their minds while teaching in active environments (Ministry of Education, 2005). In this context, it is crucial to benefit from visual tools such as concept cartoons that enable students to participate in the process actively and support them to reach solutions by questioning the problems they encounter in daily life in science lessons arranged according to the constructivist theory. It is predicted that the use of concept cartoons in the science course will be effective in ensuring that students who are intensely confronted with concepts gain a positive attitude towards the lesson, making the lesson more enjoyable and learning more permanent.

In addition to these, the use of technology in classroom activities gains importance daily and brings a new digital dimension to teaching. It is known that the education to be given to students who need to keep up with the rapid development and change of information and communication technologies by using these technologies in lessons contributes to them from different angles. Therefore, it is vital to carry out studies on the use of digital concept cartoons, which are different teaching materials that attract students' attention, in science lessons. It is thought that this study will contribute to the field in terms of being an example for the researches that can be done in this field in learning environments today, where technology integration in education is supported. In addition to this, the research contribution to science is considered necessary due to quantitative and qualitative data collection methods together in the study, providing data diversity and enriching the research process. In this direction, the study aims to determine the effect of digital concept cartoons in the sixth-grade science course on the academic achievement of students and the retention of what is learned in the lesson and to determine the students' views on the concept cartoons applied in the lesson.

2. METHOD

This section includes information on the research design, study group, data collection tools, data collection process, and data analysis.

2.1 Research Design

This research was carried out with sequential mixed design, one of the mixed designs in which quantitative and qualitative research methods are used. Sequential mixed designs mean mixed-method patterns in which successive study stages occur within a specific time sequence (qualitative, quantitative, or vice versa) (Teddlie & Tashakkori, 2009: 172). The quantitative dimension of the study was conducted with a randomized pretest-posttest control group experimental design. Firstly, in this design, two groups are formed by random assignment from the previously determined sample pool. One of the groups is determined randomly as the experimental group and the other as the control group. Then, the measurements of the subjects in the two groups about the dependent variable are taken. In the application process, the experimental procedure whose effect is tested is given to the experimental group but not to the control group. Finally, the measurements of the subjects in the groups for the dependent variable are tested using the same tool or peer form (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2012). A pre-test in the model enables us to know the groups' pre-experiment similarity levels and arrange the post-test results accordingly.

Furthermore, the opportunity to work with the experimental and control groups in this design contributes to determining the actual effect of the experimental process. These two advantages make the pattern a solid experimental design. The qualitative dimension was carried out with a case study design to support the quantitative data and analyze the data. In the case study, the factors (environment, individuals, events, processes, etc.) related to a situation are investigated in a holistic approach and focuses on how they affect the relevant situation and how they are affected by the relevant situation (Yıldırım & Şimşek, 2018).

2.2 Study Group

The study group of the research consisted of 42 students studying in the 6th grade of a secondary school in Karaman city in Turkey in the 2017-2018 academic year. At the beginning of the 2017-2018 academic year, 6th-grade students were divided into four classes by random method. Before the research, one of these four classes was randomly determined as the experimental and control groups. Both groups consisted of 21 students, and the average age was 11. While 10 of the students in the experimental group were girls and 11 were boys, 9 of the students in the control group were girls, and 12 were boys. In order to determine whether the experimental and control group students participating in the study are equivalent in terms of academic achievement on "reproduction, growth, and

Table 1 t-Test results of the students' pre-test scores according to the group

Group	n	$\bar{x}$	S	sd	t	p
Experiment	21	8.38	3.06	40	-1.407	0.167
Control	21	9.76	3.30			

$p \leq 0.05$

development in plants and animals" unit of the science lesson before the practical application, an Independent Samples t-Test was applied on the pre-test scores. The results are given in Table 1.

When Table 1 is examined, there is no significant difference between the experimental and control group students ($p \leq 0.05$). Based on this finding, it can be said that the experimental and control group students are equivalent in terms of academic achievement on the sixth-grade science lesson unit of "reproduction, growth, and development in plants and animals".

2.3 Data Collection Tools

Academic Achievement Test

A multiple-choice achievement test consisting of 27 questions was prepared by the researchers to be applied as a pre-test and a post-test in the study. Relevant course and question books were used while determining the questions to be included in the academic achievement test. After the determined questions were corrected in the context of the opinions of the field and language experts, the achievement test was applied to 136 students studying in another secondary school in the same province for a reliability study. After the pilot application, five items were removed from the test due to low discrimination (rjx) values, and the test was finalized. According to Bloom's taxonomy, the questions in the final test belonged to the level of knowledge, comprehension, and application. The reliability of the final test consisting of 22 questions was calculated with the KR-20 method, and the reliability coefficient was found to be 0.87. Therefore, looking at this value, it is possible to say that the achievement test is reliable.

Student Interview Form

The researchers developed a semi-structured interview form to determine the experimental group students' views on digital concept cartoons applied in science lessons. This interview form was finalized by benefiting from the opinions of the experts. To give examples of the questions in the interview form can be specified as; "*At which stage did you have the most difficulty while preparing/presenting digital concept cartoons? Why?*", "*What were the phases you enjoyed most during the implementation process? Why?*", "*Did this method you use contribute to learning the subject? If you think it contributed, what kind of contribution did it make?*", "*How do you think the effect of the application process on the classroom environment and friendship relations?*", "*How did this practice affect your interest in a science lesson?*"

2.4 Implementation Process and Data Collection

The experimental application was carried out for six weeks in the sixth-grade science lesson "reproduction, growth, and development in plants and animals" unit. During this period, digital concept cartoons were applied in the experimental group, while the current program was continued to be implemented in the control group. At the beginning of the application process in the experimental group, students were informed about concept cartoons, and digital concept cartoons were introduced. Students were directed to the confusion of concepts through concept cartoons in the first stages of teaching based on concept cartoons. A suitable environment was created for them to express their personal opinions and participate in the discussion. In addition, students were encouraged to investigate the accuracy of different thinking styles in the cartoon and reinterpret the cartoon's ideas in light of the research findings. Subsequently, a typical result was tried to be reached. These common ideas were shared with the class, how the students' ideas changed were evaluated, and reinforcement and implementation were made to ensure that the right ideas reached were permanent. As the experimental process progressed, the activity of the students increased, and they created their digital concept cartoons, and they conducted research and discussions through these cartoons.

Therefore, digital concept cartoons were used as ready-made materials for the course at the beginning of the experimental process; in the following weeks, it can be said that the students prepared it. That is, it was a student product during the lesson. While these operations were carried out in the experimental group, the current program was continued to be executed simultaneously in the control group. Accordingly, the lesson in the control group was taught by the teacher with the method of the lecture as before. While the experimental process (application of digital concept cartoons), whose effect was tested in the application process in the study, was given only to the experimental group, there were no interventions in the control group. All these things are thought to contribute to the determination of the actual effect of the experimental process. The course teacher and the students used two different online software during the digital concept cartoon application process. The same academic achievement test was applied to both groups as a post-test after the experimental application and as a retention test 3 weeks after the experimental process. At the end of the experimental process, one-by-one interviews were done with the students by the researchers in order to get the opinions of the experimental group students on the digital concept cartoons.

2.5 Data Analysis

Descriptive statistical techniques and unrelated samples t-test were used in the analysis of the quantitative data of the study. Descriptive analysis technique was used to

analyze the qualitative data collected through the interview form in the study. The data obtained from the students' learning diaries were arranged and interpreted according to the themes determined at the beginning of the research process.

The following validity and reliability measures were applied in the quantitative and qualitative dimensions of the study.

1. In the study, in which quantitative and qualitative data collection methods were used together, the researchers became a natural part of the research process by spending time in the field both during the experimental process and the interview process and by doing direct interviews with the participants. Therefore, in this study, the researchers were in a participatory role. In addition, their proximity to the participants increased the validity (Creswell, 2013).

2. The processes followed in preparing the achievement test and the interview form used in the research are explained under data collection tools.

3. The research process has been enriched with qualitative and quantitative data collection techniques. In addition, different data collection techniques were used together to increase the credibility of the research.

4. The study's qualitative findings were clearly stated, and participant confirmation was obtained for the data collected by one by one interviews with the students. The findings obtained from the interviews were presented through direct quotations to increase the transmissibility, and the researcher's opinions were reflected in the interpretation phase after the data were collected and analyzed.

5. The experts examined the analysis results of the collected data.

3. FINDINGS

3.1 Quantitative Findings of the Study

In order to compare the post-test scores of the students according to the group, Independent Samples t-Test was performed, and the results are given in Table 2.

When Table 2 is examined, a significant difference is observed between the post-test scores of the students in the experimental and control groups in favor of the experimental group ($p \leq 0.05$). Based on this finding, it can be said that the use of digital concept cartoons in the sixth-grade science course "reproduction, growth, and development in plants and animals" unit has a positive effect on academic achievement.

Table 2 t-Test results of the students' post-test scores according to the group

Group	n	$\bar{x}$	S	sd	t	p
Experiment	21	19.19	1.78	40	9.863	0.000
Control	21	14.05	1.60			

$p \leq 0.05$

Table 3 t-Test results of the students' retention test scores according to the group

Group	n	$\bar{x}$	S	sd	t	p
Experiment	21	13.14	1.85	40	3.488	0.001
Control	21	11.05	2.04			

$p \leq 0.05$

In order to compare the permanence test scores of the students according to the group, Independent Samples t-Test was performed, and the results are given in Table 3.

When Table 3 is examined, it is seen that there is a significant difference between the retention test scores of the experimental and control group students in favor of the experimental group ($p \leq 0.05$). Based on this finding, it can be said that the use of digital concept cartoons in the sixth-grade science lesson "reproduction, growth, and development in plants and animals" unit is effective in ensuring the permanence of what has been learned.

3.2 Qualitative Findings of the Study

The findings obtained from the interviews with the students participating in the study are presented in Table 4. These findings were expressed under the titles of "general opinions", "pleasant stages", "difficult stages", "positive opinions," and "suggestions" according to student responses.

As stated in Table 4, considering the participant student views in the research under general opinions, their enjoyable, entertaining, and instructive expressions came to the fore. To exemplify some student quotations regarding this situation:

Table 4 Findings from interviews with students

General opinions	Enjoyable, fun, educational
Pleasant stages	Generating ideas, discussing
Difficult stages	Adding background, character, and speech bubble, entering to program, and saving the study
Positive opinions	Quick thinking and quick responses
	Taking notes, summarizing, doing homework
	Topic repetition and understanding the topic
	Willingness to attend class, motivation, concentration, energy
	Helping and solidarity
	Benefiting from different ideas, meeting on common ground
Suggestions	Application in other lessons
	Development of the mobile application
	Providing the ability to create your character and record sound

Nil: Did you know that when living things produce individuals similar to themselves, it is called "reproduction"?
Omar: Of course, it is also called "reproduction". All living things can reproduce, but reproduction is not necessary for the living thing to survive.

Figure 1 Reproductive

A: Reproduction in living things is of two types, "sexual" and "asexual".
B: Asexual reproduction too; There are five types: "division", "budding", "regeneration", "vegetative", and "spore reproduction".

Figure 2 Sexual and asexual reproduction

S1: "*In the past, it was a bit boring to listen and write in science classes all the time, but thanks to this application, I attended the class with fun.*"

S5: "*It was both fun and instructive for us to process this unit like this.*"

S6: "*I think it is very fun and something I did myself, so I liked it.*"

S8: "*I think it was a very good event. Because in this way, I learned the subject of 'reproduction in plants and animals very well.*"

S10: "*Our teacher was lecturing and solving tests in other lessons. The lesson could be boring from time to time. But the lessons we taught through digital concept cartoons were much more enjoyable.*"

S21: "*It was fun because when I design something, I enjoy it very much.*"

S22: "*We always use books and notebooks in other lessons. It was fun to use technology in this lesson.*"

Considering the participant student views in the research under the title of pleasant stages, generating ideas and discussing expressions came to the fore. To exemplify some student quotations regarding this situation:

S1: "*I enjoyed adding text to cartoons the most. Because I liked thinking, finding, and answering the question.*"

S3: "*It was an enjoyable stage to generate and discuss ideas.*"

S8: "*Setting a background was enjoyable for me.*"

Considering the participant student views in the research under the title of difficult stages; adding background, character and speech bubble; entering to program and saving the study expressions came to the fore. To exemplify some student quotations regarding this situation:

S1: "*I had a hard time adding characters. Because there were so many characters that it was difficult for me to choose.*"

S2: "*I had difficulty entering the application. Because he often gave errors.*"

S3: "*Continuous shifting of the background made it difficult for me to work.*"

S11: "*I had difficulty making the speech bubbles. It was very difficult to fit the text and ensure it did not slip.*"

S13: "*I had the most difficulty in the recording. This is because the program was in a foreign language.*"

S15: "*I had difficulty in speaking my ideas. Because I was so excited.*"

S22: "*I had difficulty making the characters talk.*"

C: The new creatures that have emerged have the same features as the ancestor.
D: It does not cause diversity in living things.
C: It happens with the proliferation of the cell.
D: It happens quickly and is seen in primitive organisms.
C: In other words, it is seen in unicellular, fungi, some plants, and animals.

Figure 3 Asexual reproduction

E: How about talking about asexual reproduction types of reproduction by division?
F: Splitting single-celled organisms into two means "reproduction by dividing".
E: A creature that has reached sufficient maturity is divided into two halves.
F: Living things formed by the division have the same features as each other.
E: Bacteria, paramecium, euglena multiply by dividing.

Figure 4 Division by multiplication

Considering the participant student views in the research under the title of positive opinions; quick thinking and quick responses; taking notes, summarizing, doing homework; topic repetition and understanding the topic; willingness to attend class, motivation, concentration, energy; helping and solidarity; benefiting from different ideas, meeting on common ground expressions came to the fore. To exemplify some student quotations regarding this situation:

S1: "*Now I can think faster and answer questions faster.*"

S12: "*It made it easier for me to take notes, summarize and do my homework.*"

S14: "*I made my subject repetitions through concept cartoons.*"

S18: "*I think it contributed to my understanding.*"

S19: "*I think that seeing the different studies of my friends contributed to my learning.*"

S1: "*Science lessons are more fun now. My desire to participate has increased.*"

S14: "*Thanks to digital concept cartoons, I entered science lessons more motivated and energetic and concentrated better.*"

S1: "*I think it taught us all that we can help each other and ask each other on matters we do not know.*"

S10: "*We talked with our friends about the cartoons we created even between classes.*"

S11: "*I think it was good because we all asked each other more things.*"

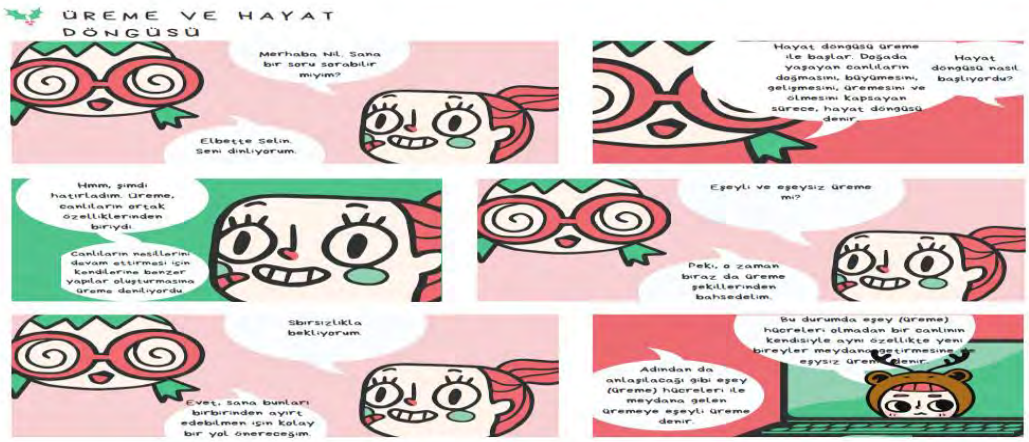
S13: "*I think we learned to meet at a common point.*"

S14: "*We also had the opportunity to listen to each other's ideas and benefit from them.*"

S19: "*In-class solidarity increased thanks to asking our friends what we could not understand.*"

G: Let us talk a little bit about budding.
H: Of course. First of all, a protrusion forms on the main creature's body.
G: The resulting protrusion develops over time and separates from the main creature.
H: I have also heard that sometimes they do not break up. They can also live in colonies.
G: Bu yaratıklar ne biliyor musun?
H: Creatures such as brewer's yeast, hydra, jellyfish, sponge, coral.

Figure 5 Budding



Selin: Hello Nil. Can I ask you a question?
Nil: Of course, Selin. I am listening to you.
Selin: How does the life cycle begin?
Nil: The life cycle begins with reproduction. The process involving the birth, growth, development, reproduction, and death of living creatures in nature is called the life cycle.
Selin: Hmm, now I remember. Reproduction is one of the common features of living things. Creating structures similar to living things in order to continue their generation is called reproduction.
Nil: Well, then let us talk a little bit about breeding patterns.
Selin: Sexual and asexual reproduction?
Nil: Yes, I will suggest you an easy way to distinguish between them.
Selin: Waiting impatiently.
Nil: As the name suggests, reproduction that occurs with sex (reproductive) cells is called sexual reproduction.
Selin: In this case, creating new individuals with the same characteristics as a living thing without sex (reproductive) cells is called asexual reproduction.

Figure 6 Reproduction and life cycle

Considering the participant student views in the research under the title of suggestions; application in other lessons, development of the mobile application, providing the ability to create our character a nd record sound expressions came to the fore. To exemplify some student quotations regarding this situation:

S1: "*I would like to apply it in other lessons as well because it is an application that will make us like the lessons we do not like.*"

S3: "*It is a fun and easy method. I think it should be used in every lesson at least once a week.*"

J: Come, let us play a game with you.
K: What kind of game?
J: Let me tell you the characteristics of a reproductive cell, and guess which reproductive cell it is.
K: Well, let us try it.
J: Large, abundant cytoplasm, immobile, in ovaries and is produced in small numbers.
K: I got it! The female reproductive cell, namely the egg.
J: Congratulations, correct answer. Well, there comes another question... It is mobile thanks to its tail. It is produced in the testicles and in large numbers. It is small and has little cytoplasm.
K: I think I can do that too. Male reproductive cell, or sperm.
J: Bravo! Again correct answer. You are great.

Figure 7 Female and male reproductive cells

Tekir: Hello Tekir, do you know what comes to my mind? Do you think the stages of people's pre-bırth development are like ours?
Bekir: I will share what I know with you. Reproductive cells are formed as a result of meiosis of the reproductive mother. The structure formed due to the fertilization of the female reproductive cell... What was the say? Fetus? Embryo? I found I found. Zygote.
Tekir: Then what?
Bekir: Then embryo occurs when the fertilized egg undergoes repeated mitosis.
Tekir: Then this structure continues to develop, and will a baby after the second month?
Bekir: No, it takes the name of the fetus. However, after about forty weeks, the baby is born.

Figure 8 Zygote-Embryo-Fetus-Baby

S5: "*This application can only be opened on computer and smartboard. It should be developed to be opened on tablets and phones.*"

S10: "*Nice, but it can be a little more fun. In fact, I think we can create characters ourselves, and we can record and make those characters speak.*"

Squirrel: Hello, dear frog, I have a question about your growing-up process.
Frog: As always, you are so curious, dear squirrel. Let us ask.
Squirrel: There was a different stage in your life cycle. What was his name?
Frog: Are you saying that we undergo structural changes after hatching and become similar to the main creature?
Squirrel: Yeah yeah. Exactly I am asking it.
Frog: It is called metamorphosis.
Squirrel: So, are there any creatures that undergo metamorphosis other than you?
Frog: Of course, arthropods, sponges, corals, butterflies also undergo metamorphosis.

Figure 9 Metamorphosis

3.3 Digital Concept Cartoon Example

The examples of digital concept cartoons developed by students within the scope of the experimental application and their translations from Turkish into English are presented.

When the cartoon in Figure 1 is examined, there are explanations and essential features of two concepts that are synonymous with each other.

In Figure 2, reproduction in living things was divided into two categories, and the types of asexual reproduction were mentioned.

The characters in Figure 3 talk about the characteristics of asexual reproduction, how it happens, and in which creatures it occurs.

The cartoon in Figure 4 shows the definition of the concept of "reproduction by division", its features, how it occurs, and in which creatures it is seen can be seen.

In Figure 5; the definition of the concept of "budding", one of the asexual reproduction varieties, its features, how it takes place, and in which creatures it is seen can be seen.

When Figure 6 is examined, it is seen that "reproduction", "life cycle", "sexual reproduction", "asexual reproduction", and the similarities and differences between these concepts are discussed, and misconceptions are tried to be prevented by this way.

In Figure 7, the characters talk about two separate concepts and their properties over a game.

In Figure 8, the characters describe the concepts of zygote-embryo-fetus-baby in order of formation.

When Figure 9 is examined, the characters discuss the metamorphosis process of frogs and other creatures and how this process develops.

4. RESULT AND DISCUSSION

A significant difference in favor of the experimental group was found between the post-test and retention test mean scores of the experimental and control group students participating in the study. Based on these findings, it can be said that the use of digital concept cartoons in the sixth-grade science course "reproduction, growth, and development in plants and animals" unit is effective in ensuring academic achievement and the retention of what is learned in the lesson. This finding of the study is parallel with qualitative findings.

The students participating in the research stated that they learned by having fun with digital concept cartoons. The application made understanding easier that they remembered better what they learned in this way, that they enjoyed a lot despite having difficulties at some stages while making the application. They stated that the application provided interest, curiosity, and motivation towards the lesson. It increased helping each other. The students also stated that the lessons they continued with this method were more enjoyable, exciting, and energetic than the others, provided more accessible and practical learning.

Therefore they wanted to use these and similar methods in different course units and other lessons. The findings showed the diversity of students' opinions.

In the research findings section, examples of digital concept cartoons prepared by students during the experimental application process are given.

1. When Cartoon 1 is examined, which is about "Reproductive", there are explanations and essential features of two concepts that are synonymous with each other. The aim here is to introduce these concepts and their properties.

2. In Cartoon 2, which is about "Sexual and asexual reproduction,"; Reproduction in living things was divided into two categories, and the types of asexual reproduction were mentioned. Here, the classification of the concept of asexual reproduction is emphasized.

3. The characters in Cartoon 3, which is about "Asexual reproduction,"; talk about the characteristics of asexual reproduction, how it happens, and in which creatures it occurs. The aim here is to provide basic information on the subject of asexual reproduction.

4. When Cartoon 4 is examined, which is about "Division by multiplication,"; The definition of the concept of "reproduction by division", its features, how it occurs, and in which creatures it is seen can be seen. Here, general information on the subject of reproduction is given by dividing.

5. In Cartoon 5, which is about "Budding,"; The definition of the budding concept, one of the asexual reproduction varieties, its features, how it takes place, and in which creatures it is seen can be seen. The aim here is to give general information about budding.

6. When Cartoon 6, which is about "Reproduction and life cycle," is examined, it is seen that "reproduction", "life cycle", "sexual reproduction", "asexual reproduction", and the similarities and differences between these concepts are discussed. Thus, misconceptions are tried to be prevented by this way.

7. In Cartoon 7, which is about "female and male reproductive cells, " two concepts and features are mentioned by the characters based on a game.

8. Cartoon 8, which is about "Zygote-Embryo-Fetus-Baby", describes the concepts of zygote-embryo-fetus-baby in order of formation. In this way, the development of an infant is discussed chronologically and based on related concepts.

9. When Cartoon 9, which is about "Metamorphosis," is examined, the characters discuss the metamorphosis process of frogs and other creatures and how this process develops. In this way, the concept of metamorphosis and the steps of the process of metamorphosis were tried to be comprehended.

When all of the examples are analyzed, students use concept cartoons to define, classify, sort, and specify their characteristics. It has also been observed that synonymous concepts can be learned, and misconceptions can be eliminated in this way.

Concept cartoons have emerged to provide a practical and innovative approach in science teaching (Keogh & Naylor, 1996). Concept cartoons can be used as a stimulus to initiate discussion in science lessons (Keogh, Naylor, & Downing, 2003). It is thought that the use of concept cartoons in science lessons can create learning and information structuring environments where students can focus their attention on the lesson and discuss their views. Concept cartoons are effective both in determining and eliminating misconceptions. Concept cartoons are suggested as tools that can be used in science teaching in terms of both preparing the environment for the learning activities envisaged by the constructivist approach and minimizing the problems related to classroom organization (Naylor & Mc Murdo, 1990; Keogh & Naylor, 1997; Keogh et al., 1998).

Various factors affect the success of teaching based on concept cartoons. According to Keogh et al. (1998), concept cartoons should be presented in association with daily events to provide students with the desired motivation and successful teaching. Sentences should be as short, legible, and similar as possible. It is stated that concept cartoons prepared in this way will contribute to developing the student's problem solving, critical thinking, scientific thinking skills and help attract attention by making the subject more interesting (Keogh & Naylor, 1999b).

CONCLUSION

1. The positive effects of the use of concept cartoons in lessons on academic achievement, retention of what is learned in the lesson, attitude, and motivation have been proven by various studies. For this reason, it may be a good idea to include concept cartoons in textbooks frequently and to prepare concept cartoons as posters and hang them on classroom walls.

2. Concept cartoons can be helpful, especially in lessons and subjects where many concepts and concept confusion can be observed at a high rate.

3. Many tools such as concept maps, meaning analysis tables, concept puzzles, concept networks, v diagrams, descriptive branched tree, structured grid, conceptual change text are used in concept teaching. Nowadays, considering the importance of technology integration in education and the interest of children and young people in technology, benefiting from the digital applications of these materials may be necessary for terms of attracting students' attention, motivating them to the lesson, enabling them to learn by researching, discussing, and having fun.

4. This research was carried out with 21 experimental and 21 control group students for six weeks. More extended studies can be carried out with larger study groups. An academic achievement test developed by the

researcher was used to obtain quantitative data. By using an attitude scale, the attitudes of the experimental and control groups towards the lesson can be examined, or the change in attitudes of the students before and after the application can be investigated.

5. It is known that the more senses students participate in the learning process, the more efficiently and effectively they learn. In this sense, it may be essential to develop and implement similar multimedia tools in lessons. Examples of these materials are digital picture books, web presentations, animations, digital stories.

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