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# Evaluation of Animated Concept Cartoons on Fractions Developed Based on Teachers' and Students' Views**

[1*] Demet Baran Bulut, [2] Zeynep Karabayir, [3] Sevim Sevval Inel & [4] Burak Yildiz

[1]Recep Tayyip Erdogan University, Faculty of Education, Rize, Turkey
[2]Ministry of National Education, Bartın, Turkey
[3]Ministry of National Education, İstanbul, Turkey
[4]Atatürk University, Graduate School of Education, Erzurum, Turkey

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**Abstract**

This research aimed to develop animated concept cartoons for the subject of fractions and to evaluate their applicability based on teachers' and students' views. In this context, animated concept cartoons (ACC) have been developed that contain some of the acquisitions of "Fractions and Operations with Fractions" in the 5th and 6th grades of the mathematics curriculum. Before the concept cartoons were developed, a needs analysis was made for the students 'misconceptions about fractions by taking teachers' views. The scenarios of ACC for the misconceptions determined afterward were created by making use of the literature. These scenarios were prepared using visuals and voiceovers through an animation preparation application. The developed concept cartoons were applied in three different classes in three different schools, then teachers' and students' views were received about the concept cartoons.

## Introduction

According to the constructivist approach that has guided the Turkish education system since the 2005-2006 academic year, it is important to use visual tools that can involve students in the learning process and create a discussion environment for more meaningful learning since students need to be active in the process of constructing knowledge (Erdag, 2011). One of the tools that can be used in this process is concept cartoons (Balim, Inel & Evrekli, 2008; Ersoy, 2010). Concept cartoons (CC) are cartoon-style drawings depicting everyday situations to

* Correspondence to Demet Baran Bulut, Recep Tayyip Erdogan University, Faculty of Education, Rize, Turkey , Email: demet.baran@erdogan.edu.tr

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arouse curiosity, cause discussion, generalize scientific ideas, and stimulate questions (Keogh, Naylor & Wilson, 1998; Long & Marson, 2003). The use of CC dates back to 1992 and can be defined as texts written in dialogue form together with visual stimuli (Keogh & Naylor, 1999). In the CCs developed by Keogh and Naylor (1999), the ideas in the discussion environment about the topic taken from daily life are put forward by the cartoon characters, and the students are included in the discussion environment through the cartoon characters (as cited in Kabapinar, 2005). Due to this feature, CCs can be used as tools that allow students to reveal their thoughts, focus and participate in the discussion (Yildiz, 2008; Chin & Teou, 2009). Such tools allow students to think deeply about conflicting ideas and direct their thoughts to the cartoon characters in a way that does not cause tension in the community (Kinchin, 2001). In a CC, three or more cartoon characters put forward various ideas about implementing a daily event with the help of speech balloons (Stephenson & Warwick, 2002). While one of these ideas contains the correct information, the other characters present misconceptions about the subject. This feature states that CCs can be used as an effective teaching tool to realize students' misconceptions and eliminate them (Naylor & Keogh, 2000; Kabapinar, 2005).

CCs were created to develop innovative teaching and learning strategy that includes a constructivist approach to science teaching (Keogh & Naylor, 1999). Therefore, there are many CC applications for science teaching in the literature (Balim, Inel & Evrekli 2008; Coll, France & Taylor, 2005; Inel, Balim & Evrekli, 2009; Evrekli, 2010; Stephenson & Warwick, 2002; Sahin & Cepni, 2011; Demir, Uzoglu & Buyukkasap, 2012; Erdogan & Cerrah-Ozsevgeç, 2012; Karakus, 2019).

The use of CCs in mathematics, on the other hand, begins long after the applications in the field of science education. In studies on using concept cartoons in mathematics teaching abroad, concept cartoons have been considered a learning or assessment tool (Cho, Osborne & Sanders, 2015; Sepeng, 2013; Webb, 2015). As a result of the studies, it was determined that students developed positive attitudes towards mathematics through concept cartoons and became more willing to do homework containing concept cartoons.

Some studies conducted on CCs in mathematics education in our country are presented in this chapter. In his research, Erdag (2011) investigated the effect of concept cartoons in primary school 5th-grade mathematics teaching on academic success and permanence in the subject of decimal fractions. The study concluded that there was a significant difference in permanence and academic achievement in favor of the experimental group. In addition, it was supposed that the students in the experimental group developed a positive opinion about the mathematics class supported by conceptual cartoons. Another study aimed to determine the effects of concept cartoons on students' perceptions and self-efficacy levels in mathematics (Sengul, 2011). The study results revealed that concept cartoons significantly impact students' perceptions of their mathematical self-efficacy levels. In the study conducted by Guler, Cakmak & Kavak (2013), the learning was carried out by supporting the learning outcomes in the natural numbers sub-learning area with CCs. Then, analyzes were conducted by determining the effect of this applied process on the 6th-grade students' academic achievement in mathematics and their attitudes towards mathematics, and it was determined that there was no significant difference between the academic achievements of the experimental and control groups. It was also observed that there was no significant difference between the attitude scores of the students. It was thought that the short duration of the implementation and the fact that the semester holiday intervened during the performance may have been effective in this situation. On the other hand, Ugurel, Kesgin & Karahan (2013) studied "concept cartoons" as an alternative learning-teaching and assessment-evaluation tool that can be used functionally in mathematics education. In the study, eight concept cartoon examples developed by the authors and can be used at different levels of education are introduced, and some suggestions for the use of such cartoons are listed. According to these suggestions, CCs can be applied individually,

in groups, or on a whole class basis, depending on their purpose, in individual or small group work, it may be more beneficial to reproduce and distribute CCs in written and printed form, and, it is also possible to use CCs in an integrated manner with other alternative learning-teaching tools. The study conducted by Taskin-Gultekin (2013) aimed to determine the effectiveness of the learning environment enriched with concept cartoons in eliminating the misconceptions about some concepts (relationships between number sets, absolute value, root numbers) at the 9th-grade level in mathematics, how the created learning environment caused a change in the roles of teachers and students, and to identify the views of the students about this learning environment. As a result of the study, it has been understood that the learning environment enriched with concept cartoons is effective in the relations between number sets and eliminating the misconceptions about absolute value and radical numbers, that the created learning environment has changed positively in terms of constructivist approach in teacher and student behaviors, and, finally, that the students developed positive opinions about the lesson taught with concept cartoons.

Another study was carried out to identify the misconceptions about 8th-grade square root numbers and compare the concept cartoon with traditional teaching to eliminate the misconceptions (Kaplan, Altayli & Ozturk, 2014). As a result of the study, concept cartoons and traditional teaching effectively removed misconceptions. While conventional education only led to a positive change in comparing square root numbers, concept cartoons positively affected all learning outcomes. Goksu & Koksal (2016) aimed to examine the applicability of the subjects of lines, angles, and polygons in secondary school 7th-grade mathematics lessons in a constructivist learning environment supported by concept cartoons. This study revealed that concept cartoon supported learning improved students' problem-solving skills. As a result of the interviews, it was known that constructivist learning practices supported by concept cartoons contributed positively to the affective characteristics of the learners. On the other hand, it was seen that students developed positive opinions about group activities due to concept cartoon supported constructivist learning applications, their curiosity and interest in the lessons increased, their learning effort and desire improved, they were tolerant, and the development of their self-confidence was supported. As a result of his study titled "The effect of concept cartoons in teaching geometry on fifth-grade students' attitudes towards mathematics and their level of achievement," Sahin (2018) revealed that the geometry achievements of the experimental group students who used concept cartoons were higher than the geometry achievements of the control group students for whom traditional geometry was in use. Moreover, it was concluded that there was a positive and significant difference in the attitudes of the experimental group students towards geometry. Batdal-Karaduman & Elgun-Ceviz (2018), on the other hand, aimed to examine the effect of the use of concept cartoons on the achievement of 4th-grade primary school students in mathematics lessons. In the research, the subject of "weight measures" in the learning area of "exploring tone and measuring over time" in the 4th-grade mathematics program was taught using concept cartoons in the experimental group; however, in the control group, it was led by following to the curriculum. Findings show that teaching supported by concept cartoons is more effective than teaching based on the curriculum. Sancar & Koparan (2019) investigated the effect of concept cartoons in eliminating the misconceptions of secondary school students about polygons. At the end of the study, it was concluded that the use of concept cartoons created a significant difference in favor of the experimental group on students' mathematics achievement and attitudes towards mathematics lessons. In addition, students stated that they understood the subject better in learning environments where the conceptual change approach was used, their learning process was more permanent, they learned by doing and experiencing in some parts, they did group works and discussion activities with the worksheets, and the lessons were more fun and different.

Considering the studies conducted in Turkey, it has been determined that it is generally on academic achievement, attitude towards mathematics, self-efficacy, achievements in mathematics and geometry, eliminating misconceptions and developing concept cartoons. In addition, it is also stated that it is appropriate to use concept cartoons prepared in digital environments since they are more attractive, more straightforward to prepare in terms of visuality, and easy to make changes in the digital domain (Yenil, 2020). As a result of the studies, it has been understood that animated concept cartoons were not developed or used. In this context, it is thought that this study will contribute to the literature. Moreover, in Turkey, studies on fractions are limited. One of the abstract concepts secondary school students learn in mathematics is fractions. In the learning process, the formation and development of fractions take a long time. Therefore, there are a lot of misconceptions in this long process. In this context, this study examines the preparation and application of animated concept cartoons on fractions and evaluates their applicability in terms of teachers' and students' views. The study seeks answers to the following questions.

1. What are the teachers' views on the applicability of animated concept cartoons (ACC) developed on fractions?
2. What are the students' views on the applicability of animated concept cartoons (ACC) developed on fractions?

## Method

In this study, in which animated concept cartoons on fractions were aimed at teachers' and students' views, the case study method was used. The workflow chart carried out in the study is given below.

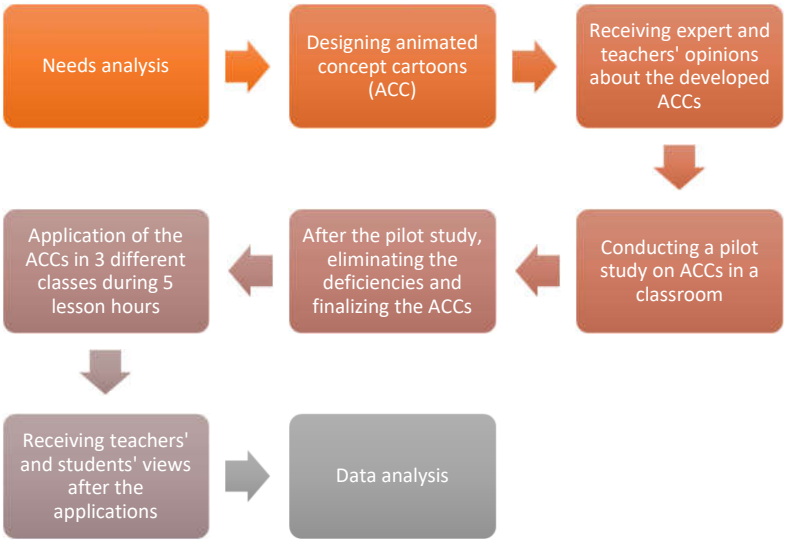


Figure 1. Flow chart of the studies carried out in the research

### Development of animated concept cartoons

A needs analysis was conducted before preparing the animated CCs on fractions. For this purpose, informal interviews were conducted with three mathematics teachers. In line with the feedback received, it was determined which learning outcomes the students had the most difficulty with and had misconceptions about fractions. Then, the contents and scenarios of the CCs to be prepared were created by conducting a literature review on misconceptions about fractions. The created contents were associated with the learning outcomes, and 10 CC drafts were prepared.

The prepared drafts were examined by three academics and three mathematics teachers who are experts in mathematics education, and views were received regarding the extent to

which the contents had a representative power in measuring the desired learning outcomes. Expert statements regarding the ability to represent the learning outcomes were generally positive. There is a CC called "Keep a Number in Your Mind." In this CC, the misconception about "dividing a number by zero" was taken from the literature, and CC was prepared in this context. Experts have agreed that the use of the mentioned CC is not appropriate due to the absence of the learning outcome on the content of the curriculum. Therefore, this CC was not used in the study. For this reason, it was decided to use a total of 9 ACCs within the scope of the study. In this context, the content validity of CCs has been provided. Information on the misconception, learning outcomes, and content used in the prepared animations are given in the Appendix.

Drafts with content validity were turned into animation videos using the Vyond animation program. Then, the researchers completed the dubbing process of the animation videos. An expert in computer and instructional technology education checked the developed ACCs, and It has been decided that they are suitable both in terms of visuality and vocalization.

The pilot study of ACCs was carried out with 25 students studying in the 6th-grade of a secondary school in Rize province. The pilot study was completed five days by applying two ACCs each day. During the pilot study, the students stated that there were some deficiencies in dubbing. For this reason, the videos were dubbed again. Thus, ACCs took their final form.

To receive teachers' and students' views on the developed ACCs, three mathematics teachers worked in three different secondary schools located at the center, a district, and a village in Rize province, and 60 students studying in the 6th-grade in which the selected teachers conduct mathematics lessons were specified. The original applications were carried out in five-lesson hours using two ACCs in each lesson hour in three different classes. Afterward, teachers' and students' views were taken. While the original application was being carried out, the ACCs were first shown to the students in each class; then, a discussion environment was created. In the discussion environments, attention was paid to revealing the views, mainly belonging to the students, about the misconception in the ACCs prepared. Students were asked questions about the related misconception in these environments, and they were allowed to make more in-depth comments on this issue. Moreover, the contents that can eliminate these misconceptions determined following the ACCs scenarios were presented to the students, and the reasons for the misconceptions were explained.

## Study group

The research was carried out with 60 6th-grade students studying in three different secondary schools located at the center, a district, and a village in Rize province, with different socioeconomic situations. Fifteen students, five from each secondary school, were randomly selected, and interview forms were applied to fifteen students and three mathematics teachers. While selecting the students, the ratio of girls and boys was considered. Teachers were coded as Teacher-1, Teacher-2, and Teacher-3, while the students were coded as Student-1, Student-2,..., Student-15.

## Data collection tool

In the study, the researchers prepared nine animated concept cartoons (see; Annex) for the pre-determined learning outcomes within the scope of fractions. In the Annex, information about the titles of the animations, the misconceptions used in the scenario of ACCs, and the learning outcomes they contain are given. The scenario of the ACC titled "Three Pieces of Cake" is shown below as an example for the developed CCs.

*Three Pieces of Cake:*

Misconception used in animation: Inability to determine the part and whole relationship in the subject of fractions.

Learning outcome: "M.5.1.3.6. The student calculates the specified proper fraction of a multiplicity and the whole of a given proper fraction by using unit fractions."

Scenario: Three brothers, whose mother bakes a cake, have a conversation about the fact that the pieces of the cake are not equal since it is sliced in different sizes.

Visual:


The dialogue in the ACC:

Ayşe: Come on, mom baked a cake.

Batu: It exactly has three pieces. So, each of us will eat one-third of the cake.

Ceylin: No, it is not one-third. Can't you see? The pieces are not equal.

Batu: What do you mean? Is it not enough to divide the cake into three pieces for us to eat in equal amounts?

Ayşe: It is not enough, of course. The cake should have been divided into three equal parts for each of us to eat a third of it. But this cake is sliced into different sizes. We cannot express it in fractions since it is not divided into equal parts.

To evaluate the applicability process of these cartoons, the researchers developed interview forms. Two separate interview forms were prepared for teachers and students in the study. However, the first four questions of these interview forms are the same. The first four questions of the interview form aim to evaluate the ACCs in terms of visuality, dubbing, scenario, and suitability for daily life. The other questions prepared for teachers desire to determine the characteristics of the ACCs regarding their potential to reveal and eliminate misconceptions, their suitability for mathematics teaching, and their relation to learning outcomes. Other questions asked to the students, on the other hand, aim to reveal whether the ACCs make the lesson interesting, views about the use of such materials in different classes and whether they are beneficial for the students in terms of the learning outcomes. To ensure the validity of the interview questions, the views of an expert academic were taken. Data were collected using these interview forms with three teachers and fifteen randomly selected students from sixty students in three different schools.

## Data analysis

The data obtained from the interview forms were analyzed by following the descriptive analysis method, one of the qualitative research analysis techniques. Frequency and percentage tables were created for the answers given. Moreover, direct quotations from the answers of the teachers and students are presented in the table for a better understanding of the answers. Thus, a conclusion was obtained regarding the applicability of the developed material.

## Results

In this study in which it is aimed to prepare animated concept cartoons on fractions and to evaluate these materials in terms of views' of teachers and students, various questions were directed to teachers and students; however, in this chapter, the same questions asked to teachers and students were evaluated together, while the views of the relevant people (teachers or students) were presented in cases where the questions differed.

In this chapter, the views of teachers and students about the visual elements of ACCs are given first.

Table 2
Teachers' and students' views about the visuals in ACCs

| Question | | Answer | | | | Description (General Thoughts) |
|---|---|---|---|---|---|---|
| 1. Are the animations visually appropriate? Please evaluate it. | Teacher's views | Yes | | No | | *"According to my opinion, they were quite appropriate. They were interesting. Students are interested in things like cartoons due to their age. Therefore, the animations were interesting, and the students watched them without getting bored. I think the visuals used are appropriate for both the scenario and the age level." (Teacher-3)* |
| | | f | % | f | % | |
| | | 3 | 100 | - | - | |
| | Students' views | Yes | | No | | *"Yes, they were appropriate. I cannot solve some of the questions about fractions. The visuals help me remember their solution currently.* |
| | | f | % | f | % | |
| | | 15 | 100 | - | - | |

When Table 1 is examined, it is clear that the ACCs are appropriate in terms of visuality according to the views of the teachers and students.

In the second question, teachers and students were asked to evaluate ACCs in dubbing. The findings are presented in the table below.

Table 3
Teachers' and students' views about the dubbing in ACCs

| Question | | Answer | | | | Description (General Thoughts) |
|---|---|---|---|---|---|---|
| 2. Are the animations appropriate in dubbing (volume, intonation, emphasis, etc.)? Please evaluate it. | Teachers' views | Yes | | No | | *Yes: Dubbing and intonation were good, but the speed was a little fast. There were repetitions in conversations (such as the word "akıllım," which is like "my smart boy" in English). It would be more natural if different jokes were made each time." (Teacher-1)* *Hayır: "Of course, you have limited sources. A professional dubbing could perhaps attract children's attention more because they could not understand the dubbing in some parts. There was a question about grandmother's water tank (water cut-off video). A little local dialect was in use for the dubbing. However, I think a more proper Turkish would be* |
| | | f | % | f | % | |
| | | 2 | 66.7 | 1 | 33.3 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | *better for dubbing. Because, although not every student, some students may make fun of it. Children may focus on the grandmother's voice rather than the question and imitate her voice. So, I think they can get away from your purpose by not focusing on the question." (Teacher-2)* |
| | Students' views | Yes | | No | | *Yes: "The volume was not enough at first, but then they got better." (Student-4)* |
| | | f | % | f | % | *No: "I could not hear some parts. The volume was too low. Therefore, I could not understand." (Student-1)* |
| | | 8 | 53.3 | 7 | 46.7 | |

From the findings in Table 2, it was determined that two of the teachers liked the dubbing performance. On the other hand, one teacher stated that the quality of the dubbing and the local dialect used for the dubbing might cause various problems during learning in students. 53.3% of the students expressed positive views about dubbing, while 46.7% stated that they could not understand the script text due to the low volume. This situation reveals the necessity of using more professional techniques while dubbing the animations used in concept cartoons. This situation can also be accepted as indicating the need to use a better sound system in the classroom while using the developed concept cartoons for teaching. Thus, it is thought that these solutions can eliminate the negative views from both teachers and students.

In the third question, the suitability of the scenario contents of ACCs in terms of teaching was investigated. In Table 4, the views of teachers and students about the suitability of ACCs in terms of scenarios are presented.

Table 4
Tachers' and students' views about the scenarios of ACCs

| Question | | Answer | | | | Description (General Thoughts) |
|---|---|---|---|---|---|---|
| | | Yes | | No | | |
| 3. Are the animations appropriate for the scenario? | Teachers' views | f | % | f | % | *Yes: "A very nice, understandable, and simple style was used in the scenarios. Without entering into details, a scenario was prepared by the subject intended to be given to the children. In this regard, I found it quite nice." (Teacher-2)* |
| | | 3 | 100 | - | - | |
| | | Yes | | No | | *Yes: The scenarios were good. My favorite part was the part about the pizza slice." (Student-3)* |
| | Students' views | f | % | f | % | |
| | | 15 | 100 | - | - | |

When Table 3 is examined, it has been determined that both teachers and students found the scenario contents of the developed ACCs suitable for teaching. Teacher-2 expressed his views on the simplicity and clarity of the scenario content, and student-3 stated that all scenarios were good. Thus, it has been determined that the scenario contents of ACCs are suitable for teaching fractions according to teachers' and students' views.

The answers of the teachers and students for the fourth question about associating ACCs with daily life are presented in Table 4.

Table 5
Teachers' and students' views about the association of ACCs with daily life

| Question | | Answer | | | | Description (General Thoughts) |
|---|---|---|---|---|---|---|
| 4. Do you think the association of animations with daily life was sufficient? | Teachers' views | Yes | | No | | *Yes: It was very nice that the examples we gave verbally in the lessons were animated. It was also very nice that the animations were associated with everyday life. It was very appropriate and friendly for the children to encounter these examples visually." (Teacher-3)* |
| | | f | % | f | % | |
| | | 3 | 100 | - | - | |
| | Students' views | Yes | | No | | *Yes: "I think it was sufficient. We also experience situations such as water cut off and we can follow such ways to account for the remaining water." (Student-7)* |
| | | f | % | f | % | |
| | | 15 | 100 | - | - | |

Considering the table above, all of the teachers and students expressed positive views about the association of ACCs with daily life. Thus, the feature of establishing a daily life association, which was one of the purposes of concept cartoons, has been accepted as provided in the developed teaching material.

Since teacher and student interview questions differ after this question, teachers' and students' views will be presented separately, starting from this section of the findings chapter.

In the fifth question asked to the teachers, it was questioned whether the ACCs revealed misconceptions or not.

Table 6
Teachers' views about the potential of ACCs to reveal misconceptions

| Question | | Answer | | | | Description (General Thoughts) |
|---|---|---|---|---|---|---|
| 5. Are animations in a structure that can reveal misconceptions? | Teacher's' views | Yes | | No | | *Yes: "Yes. While watching, I thought that I was also facing these problems with my students. I thought it frequently." (Teacher-3)* |
| | | f | % | f | % | |
| | | 3 | 100 | - | - | |

All of the teachers whose views about this issue believe that the developed ACCs are in a structure that can reveal misconceptions. Teacher-3 expressed his views about the matter as follows: *"Yes. While watching, I thought that I was also facing these problems with my students. Most of them made me feel that way. On the other hand, when we asked the students, it was seen that misconceptions were revealed. Therefore, they can be used for this purpose."*

The sixth question directed to the teachers aimed to reveal teachers' views about the potential of ACCs to eliminate misconceptions. In this context, the answers and explanations given by the teachers are presented in the table below.

Table 7
Teachers' views about the potential of ACCs to eliminate misconceptions

| Question | Answer | | | | Description (General Thoughts) |
|---|---|---|---|---|---|
| | | Yes | | No | |
| 6. Are animations in a structure that can eliminate misconceptions? | Teachers' views | f | % | f | % | *Yes: "I can give 9 points out of 10 in terms of elimination of misconceptions. You were better at identifying the misconceptions. Of course, the limited time may also affect it. So, while identifying the misconceptions before, you may only focus on eliminating them in the video." (Teacher-1)* |
| | | 3 | 100 | - | - | |

When the teachers were asked about the potential of ACCs to eliminate the misconceptions, all of the teachers expressed positive views on this situation. In other words, according to teachers, ACCs can be used as a practical learning tool in eliminating misconceptions in fractions. Teacher-1 shared the following view on this subject: *"I can give 9 points out of 10 in terms of elimination of misconceptions. You were better at identifying the misconceptions. Of course, the limited time may also affect it. The beginning of the video could have been about detecting the misconceptions, and the rest could be about eliminating them. However, orientation has crucial importance in this process."* Thus, in the light of the teachers' views, it was determined that the ACCs developed within the scope of this study were sufficient in eliminating the misconceptions.

The seventh question asked to the teachers is about the potential of ACCs to eliminate misconceptions. In this context, the answers and explanations given by the teachers are presented in the table below.

Table 8
Teachers' views about the potential of ACCs to represent learning outcomes

| Question | Answer | | | | Description (General Thoughts) |
|---|---|---|---|---|---|
| | | Yes | | No | |
| 7. Do you think it is appropriate to associate the subjects in animations with the learning outcomes in our curriculum? | Teachers' views | f | % | f | % | *Yes: "I think they are associated. Children today do not just learn what the teacher teaches, as in our time. They also like the interesting things they hear from their older brothers and sisters. In class, they can ask questions about things they learn. "Teacher! I heard that the division of a number by zero is infinity. How can it be possible?" If you skip the question without explaining, you cause different question marks in the child's mind. Thus, besides providing the required learning outcomes, we also must answer the questions, as I have stated. This is one of the issues we consider." (Teacher-1)* |
| | | 3 | 100 | - | - | |

All teachers used positive expressions in their views about the potential of the subjects in ACCs to represent the learning outcomes in the curriculum. As it can be understood from the explanation of Teacher-2, it can be said that the developed ACCs are suitable teaching materials for the learning outcomes in the secondary school mathematics curriculum.

The last question posed to the teachers is on their general views about the developed ACCs. The answers and explanations given by the teachers are presented in the table below.

Table 8
General views of teachers about ACCs

| Question | | Description (General Thoughts) |
|---|---|---|
| 8. What are your general opinions about the developed ACCs? | Teachers' views | *"I liked the animations. The misconceptions were nicely established. However, their eliminating feature was not as good as identifying. It may be more useful if the solution steps are slower in videos. As I said before, limited time is also effective in this situation. They will be identified even better with the papers to be collected from the students. Since you learned the students' thinking processes, it was easier to identify the misconceptions. In order words, you decide more easily whether it is a mistake or a lack of knowledge." (Teacher-1)*<br>*"It is quite suitable for fraction teaching. We find it difficult to visualize and concretize every subject. However, it was nice to present the subject of fractions to children as animation. One of my favorite videos was the video about keeping a number in mind. The case of dividing a number by zero is well expressed." (Teacher-2)*<br>*"Since there is no smartboard or projector in our school, we are a little far from technological development. We are currently using games for teaching. I think that the technology will increase the efficiency even more. Children are interested and having fun, and the videos provide instant feedback. I think it is perfect in that respect. When I am assigned to other schools in the future, I plan to have my students watch your videos if it is possible. They are perfect; great job!" (Teacher-3)* |

The general view of all teachers is that the ACCs are suitable teaching tools that can be used for teaching fractions. In addition, the general views received from the teachers about ACCs and their in-class application were determined as positive. Based on these views, the applicability of ACCs developed on fractions as a teaching tool was accepted as appropriate, according to the teachers' views.

The fifth question addressed to the students is how the products make the lesson interesting. The answers and explanations given to this question are presented in the table below.

Table 9
General views of students about ACCs

| Question | | Answer | | | | General Thoughts |
|---|---|---|---|---|---|---|
| | | Yes | | No | | |
| 5. Did the use of the ACCs make the lesson interesting? | Students' views | f | % | f | % | *Yes: "It can also be used for the lessons to be conducted in the future." (Student-5)*<br>*"It would be great if it were used in classes; I had a lot of fun." (Student-13)*<br>*"I think it should be used occasionally in math class. After* |
| | | 15 | 100 | - | - | |

| | |
|---|---|
| | *learning the subject, it can be used to reinforce. We both understand better and learn by having fun." (Student-15)* |

All of the students believe that the ACCs make the lesson interesting. Moreover, all of the students reported that they liked the application, the CCs contributed to their learning process, and they desired similar applications for mathematics subjects to be covered in the future. Thus, considering the students' views, it has been revealed that the ACCs are suitable learning tools, just like the teachers' views. For this reason, it has been accepted that the ACCs developed within the scope of this study are teaching tools that can be used in fraction teaching.

## Discussion and Conclusion

This study aims to develop animated concept cartoons (ACC) for fractions and evaluate their applicability in terms of teachers' and students' views.

In this regard, the ACCs prepared with experts' views in this study are materials that can be used on fractions according to the views of teachers and students. One of the first concepts secondary school students learn in mathematics is fractions. In the learning process, the formation and development of the concept of fractions take a long time. Therefore, there are a lot of misconceptions in this long process. In this regard, when the ACCs prepared in this study are used in lessons, the teachers' views have determined that it efficiently reveals and eliminates misconceptions. In similar studies, it has been seen that concept cartoons (CC) are effective in eliminating misconceptions (Kaplan, Altayli & Ozturk, 2014; Prescott & Mitchelmore, 2005; Yildiz, 2008). On the other hand, Ekici, Ekici & Aydin (2007), Kabapinar (2005), and Rule & Auge (2005) similarly stated in their studies that CCs are effective teaching tools in eliminating misconceptions.

Teachers determined that the ACCs prepared are suitable in visuals, scenario content, and day-to-day context. Notably, the views that the everyday context is well established indicate that the ACCs, which were developed in terms of the potential to eliminate the misconceptions that may arise about fractions, can be used as an effective tool. Chi (1992) stated that one of the main reasons for misconceptions is the inability to connect concepts and day-to-day life (as cited in Ozgen, 2013). In this regard, CCs associated with everyday life efficiently eliminate misconceptions; hence, the ACCs prepared in this study serve the same purpose.

According to the students, it has been stated that the ACCs make the lessons interesting and fun. It has also been determined that there is a tendency for students to increase their desire and motivation towards the class. Similarly, studies have concluded that the use of concept cartoons has a positive effect on student motivation (Inel, 2012; Yenil, 2020; Eroglu, 2010; Ugurel & Morali, 2006; Taskin-Gultekin, 2013).

Another quality that the teachers have expressed is that the ACCs are compatible teaching material for the learning outcome in the mathematics curriculum. This situation shows that in teaching fractions, ACCs are suitable as a teaching tool that can be used in mathematics lessons and can transfer the outcome.

## Suggestions

One of the deficiencies in the concept cartoons prepared in this study is dubbing. Therefore, it can be suggested that the dubbings be performed more professionally in other ACCs to be developed. In addition, especially when this material is desired to be used in crowded classrooms, it should be supported with qualified sound system tools when the teaching process is carried out. Otherwise, it has been determined that students will have difficulty understanding some parts of the script.

It has been determined by the teachers' views that the developed ACCs are compatible with the acquisitions in the secondary school curriculum and that these acquisitions are effective in teaching. In this regard, it can be suggested to use the prepared ACCs in secondary school mathematics lessons by teachers in fraction teaching.

The ACCs developed for teaching the fractions are determined to be suitable by this study's teacher and students' views. It is thought that the development of ACCs for other mathematical subjects will effectively detect and eliminate misconceptions. Quasi-experimental research can be carried out about determining and eliminating students' misconceptions by developing learning environments that use ACCs developed within the scope of this study.

## References


Balim, A., Inel, D., & Evrekli, E. (2008). Fen öğretiminde kavram karikatürü kullanımının öğrencilerin akademik başarılarına ve sorgulayıcı öğrenme becerileri algılarına etkisi. *İlköğretim Online*, *1*(7), 188-202.

Batdal-Karaduman, G., & Elgun-Ceviz, A. (2018). Matematik öğretiminde kavram karikatürlerinin öğrenci başarısına etkisi. *Elektronik Sosyal Bilimler Dergisi*, *17*(67), 1268-1277.

Chi, M. T. H. (1992). Conceptual change within and across ontological categories Examples from learning and discovery in science. In R. Giere (Ed), *Cognitive models of science: Minnesota studies in the philosophy of science.* Minneapolis, MN: University of Minnesota Press, 129- 160.

Chin, C., & Teou, L. (2009). Using concept cartoons in formative assessment: Scaffolding students' argumentation. *International Journal of Science Education, 31*(10), 1307-1332.

Cho, H., Osborne, C., & Sanders, T. (2015). Classroom experience about cartooning as assessment in pre-service mathematics content course. *Journal of Mathematics Education at Teachers College, 6*(1), 45-53.

Coll, R. K., France, B., & Taylor, I. (2005). The role of models/ and analogies in science education: Implications from research. *International Journal of Science Education*, *27*(2), 183-198.

Demir, Y., Uzoglu, M., & Buyukkasap, E. (2012). Fen Bilgisi öğretmen adaylarının kuvvet ve hareket ile ilgili sahip olduğu kavram yanılgılarının belirlenmesinde kullanılan karikatürlerin ve çoktan seçmeli soruların etkililiğinin karşılaştırılması. *Eğitim ve Öğretim Araştırmaları Dergisi, 1*(1), 88-102.

Ekici, F., Ekici, E., & Aydin, F. (2007). Utility of concept cartoons in diagnosing and overcoming misconceptions related to photosynthesis. *International Journal of Environmental and Science Education, 2*(4), 111-124.

Erdag, S. (2011). *İlköğretim 5. sınıf matematik dersinde kavram karikatürleri ile destekli matematik öğretiminin, ondalık kesirler konusundaki akademik başarıya ve kalıcılığa etkisi*. (Yayımlanmamış yüksek lisans tezi). Dokuz Eylül Üniversitesi, İzmir.

Erdogan, A., & Cerrah-Ozsevgec, L. (2012). Kavram karikatürlerinin öğrencilerin kavram yanılgılarının giderilmesi üzerindeki etkisi: Sera etkisi ve küresel ısınma örneği. *Turkish Journal of Education, 3*(1), 1-13.

Eroglu, N. (2010). 6. *sınıf "Maddenin Tanecikli Yapısı" ünitesindeki kavramların öğretiminde öğrenci ürünü karikatürlerin kullanımı*. (Yayımlanmamış yüksek lisans tezi). Sakarya Üniversitesi, Sakarya.

Ersoy, A. (2010) ilköğretimde değer kazanımlarının incelenmesinde karikatür kullanımı: Dayanışma değeri örneği. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi*, *29*(2), 79-103.

Evrekli, E. (2010). *Fen ve teknoloji öğretiminde zihin haritası ve kavram karikatürü etkinliklerin öğrencilerin akademik başarılarına ve sorgulayıcı öğrenme beceri algılarına etkisi.* (Yayımlanmamış doktora tezi). Dokuz Eylül Üniversitesi, İzmir.

Goksu, F. C., & Koksal, N. (2016). Doğrular, açılar ve çokgenler konularının kavram karikatür destekli yapılandırmacı öğrenme yaklaşımına göre işlenmesi. *Eğitimde Nitel Araştırmalar Dergisi- Journal of Qualitative Research in Education, 4*(3), 68-91.

Guler, H. K., Cakmak, D., & Kavak, N. (2013). Karikatürlerle yapılan matematik öğretiminin öğrencilerin akademik başarılarına ve tutumlarına etkisi. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi, 26*(1), 149-160.

Inel, D. (2012). *Kavram karikatürleri destekli probleme dayalı öğrenme yönteminin öğrencilerin problem çözme beceri algılarına, fen öğrenmeye yönelik motivasyonlarına ve kavramsal anlama düzeylerine etkisi*. (Yayımlanmamış yüksek lisans tezi). Dokuz Eylül Üniversitesi, İzmir.

Inel, D., Balim, A., & Evrekli, E. (2009). Fen öğretiminde kavram karikatürü kullanımına ilişkin öğrenci görüşleri. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi (EFMED), 3*(1), 1-16.

Kabapinar, F. (2005). Effectivness of teaching via concept cartoons from the point of view of constructivist approach. *Kuram ve Uygulamada Eğitim Bilimleri, 5*(1), 135-146.

Kaplan, A., Altayli, D., & Ozturk, M. (2014). Kareköklü sayılarda karşılaşılan kavram yanılgılarının kavram karikatürü kullanılarak giderilmesi. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi, 27*(1), 85-102.

Karakus, S. (2019). *Fen bilimleri dersinde kavram karikatürü kullanımının 7.sınıf öğrencilerinin kütle-ağırlık konusundaki kavram yanılgılarına etkisi*. (Yayımlanmamış yüksek lisans tezi). Hacettepe Üniversitesi, Ankara.

Keogh, B., & Naylor, S. (1999). Concept cartoons, teaching and learning in science: an evaluation. *International Journal of Science Education, 21*(4), 431-446.

Keogh, B., Naylor, S., & Wilson, C. (1998). Concept cartoons: A new perspektive on physics education. *Physics Education, 33*(4), 219-224.

Kinchin, I. (2001). Investigating students' beliefs about their preferred role as learners. *Educational Research, 46*(3), 301-312.

Long, S., & Marson, K. (2003). Concept cartoons. *Hands on Science, 19*(3), 22-24.

Naylor, S., & Keogh, B. (2000). *Concept cartoons in science education*. UK: Milligate Hause Publishing.

Ozgen, N. (2013). Öğretmen adaylarının erozyon kavramına yönelik algıları: Fenomenografik bir araştırma. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 28*(2), 321-334.

Prescott, A., & Mitchelmore, M. (2005). Teaching projectile motion to eliminate misconceptions. In H. L. Chick & J. L. Vincent (Eds.), *Proceeding of the 29th Conference of the International Group for the Psychology of Mathematics Education* (s. 97-104).

Rule, A. C., & Auge, J. (2005). Using humorous cartoons to teach mineral and rock concepts in sixth grade science class. *Journal of Geoscience Education, 53*(5), 548-558.

Sancar, M., & Koparan, T. (2019). Ortaokul öğrencilerinin çokgenler konusundaki kavram yanılgılarının giderilmesinde kavram karikatürlerinin etkisinin incelenmesi. *Karaelmas Eğitim Bilimleri Dergisi, 7*(1), 101- 122.

Sepeng, P. (2013). Using concept cartoons and argumentative writing frames in mathematical word problem solving. *Mediterranean Journal of Social Sciences, 4*(11), 129-137.

Stephenson, P., & Warwick, P. (2002). Using concept cartoons to support progression in students' understanding of light. *Physics Education, 37*(2), 135-141.

Sahin, Z. (2018). Geometri öğretiminde kavram karikatürü kullanımının beşinci sınıf öğrencilerinin matematiğe yönelik tutumlarına ve erişi düzeylerine etkisi. (Yayımlanmamış yüksek lisans tezi). Dokuz Eylül Üniversitesi, İzmir.

Sahin, C., & Cepni, S. (2011). Developing of the concept cartoon, animation and diagnostic branched tree supported conceptual change test: "Gas Pressure". *Eurasian Journal of Physics and Chemistry Education, 3*(Özel Sayı), 25-33.

Sengul, S. (2011). Effects of concept cartoons on mathematics self-efficacy of 7th grade students. *Kuram ve Uygulamada Eğitim Bilimleri, 11*(4), 2305-2313.

Taskin-Gultekin, S. (2013). Kavram Karikatürleri ile Zenginleştirilmiş Matematik Öğrenme Ortamlarından Yansımalar. (Yayımlanmamış yüksek lisans tezi). Karadeniz Teknik Üniversitesi, Trabzon.

Ugurel, I., & Morali, S. (2006). Karikatürler ve matematik öğretiminde kullanımı. *Milli Eğitim Dergisi, 34*(170), 1-10.

Ugurel, I., Kesgin, S., & Karahan, O. (2013). Matematik derslerinde yararlanılabilecek alternatif bir öğrenme ve değerlendirme aracı: Kavram karikatürü. *Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 15*(2), 313-337.

Webb, L. (2015). The use of cartoons as a tool to support teacher ownership of mathematics curriculum change. *African Journal of Research in Mathematics, Science and Technology Education, 19*(1), 57-68.

Yenil, T. (2020). *6. sınıf öğrencilerinin ondalık gösterim konusundaki kavram yanılgılarının 5E modeline göre tasarlanan dijital kavram karikatürleri ile giderilmesi.* (Yayımlanmamış yüksek lisans tezi). Bayburt Üniversitesi, Bayburt.

Yildiz, I. (2008). *Kavram karikatürlerinin kavram yanılgılarının tespitinde ve giderilmesinde kullanılması: Düzgün dairesel hareket.* (Yayımlanmamış yüksek lisans tezi). Gazi Üniversitesi, Ankara.

Appendix: Animated concept cartoons

| Name of ACC | Misconception used in ACC | Acquisitions | Content of ACC |
|---|---|---|---|
| 3 Pieces of Cake | Part-Whole relationship | "M.5.1.3.6. Calculate the desired simple fraction of a multiplicity and the whole of a given multiplicity by using unit fractions." | Three brothers, whose mothers make cakes, have a conversation about the fact that these pieces are not equal due to the fact that the cake is divided into pieces of different sizes. |
| Waters Cut Off | Addition of fractions | "M.5.1.4.1. Add and subtract two fractions whose denominators are equal or one is a multiple of the other's denominator." | Sena and her mother have a conversation about the amount of water to be found in the tank when 2/3 of the tank is added to the water that is 1/5 full after the cut waters come. |
| Waters Have Come | Subtraction in fractions | "M.5.1.4.1. Add and subtract two fractions whose denominators are equal or one is a multiple of the other's denominator." | Ali and his grandmother have a conversation about the amount of water that will remain when 2/4 water is used from the water tank, which is 7/8 full after the water is cut off. |
| Pizza Slice | Comparing fractions | "M.5.1.3.4. Realize that simplification and expansion will not change the value of the fraction, and create fractions that are equivalent to a fraction." | One of the two brothers who want to eat pizza wants to eat 1/2 and the other 2/4 of the pizza. He who wants to eat 1/2 of it gets upset because he eats less than the other. |
| What's in It? | Representation of fractions on the number line | "M.5.1.3.1. Show and sort unit fractions on the number line." | Buket, who wants to show the unit fractions 1/2, 2/3 and 2/5 on the number line, makes a mistake. |
| Processor Speeds | Comparing fractions (Equivalent fractions) | "M.5.1.3.4. Realize that simplification and expansion will not change the value of the fraction, and create fractions that are equivalent to a fraction." | Students in a classroom talk about the processor speeds of their computers. |
| Exciting Race | Comparing fractions (Assuming that the larger of the two given fractions is greater than the other) | "M.6.1.5.1. Compare fractions, sort them, and display them on the number line." | In a running race, two athletes claim that they have won by comparing the distance they have taken in the same time in terms of fractions. |

| | | | |
|---|---|---|---|
| Flower Field | Thinking that multiplying fractions makes numbers bigger | "M.6.1.5.4. Do the multiplication of two fractions and make sense." | Burak will plant red and white flowers in certain proportions in the field with the instruction of his master. But it takes some calculation for that. |
| Attention Virus! | Thinking that dividing fractions makes dividing numbers smaller | "M.6.1.5.6. Make the division of two fractions and make sense." | While Yusuf is playing on his computer, if he cannot correctly answer the question about division in fractions that appear on the screen, his computer will be infected with a virus. There is only one answer for this. |