



Hastürk, G., & Balliel Ünal, B. (2021). Effect of Concept Cartoon Applications on The Attitudes of Candidate Teachers with Respect to Environment Problems. *International Online Journal of Education and Teaching (IOJET)*, 8(3). 1527-1542.

Received : 02.02.2021
Revised version received : 10.04.2021
Accepted : 11.04.2021

EFFECT OF CONCEPT CARTOON APPLICATIONS ON THE ATTITUDES OF CANDIDATE TEACHERS WITH RESPECT TO ENVIRONMENT PROBLEMS

Research article

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Abstract

The study was conducted for the purpose of determining the effect of concept cartoon applications with the theme of environment problems on the attitudes of candidate teachers and receiving the candidate teachers' ideas on the process in the fall semester of 2019-2020 academic year. The participants were composed of 105 students in the department of primary school teaching at a university located in Central Black Sea Region of Turkey. In the study, mixed method research design was adopted based on both quantitative and qualitative data. In the quantitative part of the study, an experimental design with pretest-posttest control groups was used. The qualitative part of the research was designed according to the case study pattern. The candidate teachers in the experimental and control groups were applied "Environmental Attitude Scale" for the purpose of detecting their attitudes with respect to environment problems at the beginning of the process. Later student-centered courses were held with the experimental group using the concept cartoon technique were carried on in line with the curriculum with the control group. The findings revealed that the concept cartoon applications developed positively the candidate teachers' attitudes toward environment problems. Additionally, it was expressed by the candidate teachers that the concept cartoon applications developed many significant skills including problem solving, critical thinking, questioning, discussing, creativity and detecting and remedying concept mistakes.

Keywords: Environment education, environment problems, concept cartoon, attitude

1. Introduction

The changes in the natural world in line with the fast development in science and technology have become remarkable. Problems including fast population increase, industrialization, urbanization and global heating, destruction of forests, acid rains, ozone layer depletion, and environmental pollutions have begun to threaten human life. In this context, the course of 'Environment Education' gains further significance from pre-school education to higher education in formal education institutions and it is emphasized that qualified education should be provided. Environment education covers the education necessary for creating a sustainable life in the dimensions of individuals' knowledge, consciousness, attitude, awareness, and behavior. It is significant to train individuals knowledgeable and conscious about the environment and sophisticated in affective and behavioral terms. Those qualities attract attention to the concept of environment literate because an effective environment education targets at popularization of "environment literacy". Examining the relevant literature, there are studies for determining individuals' environment literacy (Kaplowitz and Levine, 2005; Kuhlemeier, Huub and Nijs, 1999; Moody, Alkaff, Garrison and Golley, 2005; Nelson, 1996; Thomas and Nicita, 2002). The focal point of the studies conducted emphasizes education of individuals in the dimensions of knowledge, consciousness, attitude, and

behavior. For this reason, significance is paid to usage of different methods and techniques in the environment education provided.

We can mention a meaningful and qualified environment education when the students assume responsibility, learn by performing and experiencing, carry the environment issues out of the school walls and adapt what they learn to their lives. For this reason, it is clear that environment education cannot be provided through conventional approaches such as direct instruction, note taking, and presentation. Environment education contains many subjects and many acquisitions associated with this. Many concepts covered in environment education should firstly be learned scientifically and then adapted to real life. Additionally, it is also significant to detect which concepts they have with respect to the current issues as well as potential concept mistakes. In addition to the student-centered approaches applied in environment education, it is necessary to detect the concepts used in environment education and concept mistakes and to design the process of learning-teaching through technology integration.

The individuals of 21st century are expected to exhibit critical skills such as research, critical thinking, problem solving, knowledge and media literacy, and creativity (<http://www.21stcenturyskills.org>). On the other hand, the teachers of 21st century are expected to support creativity, use digital tools and sources, and support the students for producing solutions to problems in social dimension. For this reason, if the development of such critical skills of the individuals who will be the teachers in the future is supported, they will be able to transmit to their students more easily and effectively. In this context, the departure point of our study is revealing the effectiveness of current teaching techniques and computerized applications and creating knowledge, conscience and awareness in candidate teachers with respect to the ‘environment problems’, among the common problems of the entire world. Because technology integration into the teaching process supports teaching and prepares the ground for the formation of meaningful and permanent learning. In addition, integrating technology-based practices into educational environments in the teacher training process will make the teachers more equipped (Angeli and Valanides, 2005; Bilici, 2016; Farjon, Smits and Voogt, 2019; Graham, Tripp and Wentworth, 2009; Chen and Jang, 2010; Joo, Park and Lim, 2018; Scherer, Tondeur, Siddiq and Baran, 2018).

Curiosity, research, investigation, analytical thinking, questioning and creativity are quite critical skills in science education, a scientific branch that seeks understanding, interpreting and explaining the events in natural life. The situation is similar in the environmental education process, which has a strong connection with science education. Many current methods and techniques are used in science and environmental education to improve many critical skills in students. Among these techniques, STEM approach, inquiry-based learning, problem-based learning, project-based learning, inquiry based learning, technological pedagogical content knowledge, concept teaching techniques and argumentation can be listed (Faize, Husain and Nisar, 2017; Irwanto and Ad, 2018; Merritt, Lee, Rillero and Kinach, 2017; Pimthong and Williams, 2018; Ryu, Mentzer, Knobloch, 2019; Tsybulsky, 2019). Concept cartoon technique is discussed in this study among the many current approaches mentioned.

In this context, the technique of ‘concept cartoons’ allowing development of critical skills of individuals including research, investigation, questioning, discussing and creativity is used in our study. The concept cartoons developed by Keogh and Naylor in 1990s are visual tools that present a scientific event in daily life offering different perspectives through cartoons (Coll, 2005; Naylor and Keogh, 2000; Naylor, Downing and Keogh, 2001; Stephenson and Warwick, 2002). Naylor and McMurdo (1990) define the cartoons as “expression of a discussion by three or more characters using pictures”. Those characters interact and each

defends an idea. One of the ideas presented represents one accepted to be scientifically correct and others represent the alternative, non-scientific expressions or those which contain concept mistakes. The cartoon created expresses the ideas on the question asked using a speech bubble. Concept cartoons are significant for searching the scientific truths and justification of the assertions. The students are asked to explain which cartoon they agree with expressing the relevant justifications. Owing to this, the students are encouraged to apply the things they learn in real life, not to simply memorize justify their ideas and learn meaningfully. Furthermore, it is diagnosed whether the students who agree with the ideas of similar cartoons and justify their ideas have concept mistakes and what kind of concept mistakes they have if any. Additionally, the concept mistakes detected are discussed in the classroom and meaningful and permanent learning is supported.

Usage of concept cartoons in the educational environment together with the aforementioned features has many advantages. For instance, the visual elements they contain increase the interest and motivations of the individuals for the course and renders the course more amusing (Balım, İnel and Evrekli, 2008), allows diagnosis of concept mistakes, deficient and false learning (Atasoy and Akdeniz, 2009; Demir, Uzoğlu and Büyükkasap, 2012; Ekici, Ekici and Aydın, 2007; Ekim, 2007; Kabapınar, 2005; Keogh and Naylor, 1999), and supports development of individuals' discussion skills (Narayan, 2016), improvement of academic success (Murtiningrum, Ashadi, Mulyani, 2013), and development of critical thinking skill (Demirci and Özyürek, 2017; Yin and Fitzgerald, 2017). Furthermore, the usage of concept cartoons used in the educational environment in the classroom assists the students with discussing their ideas in the classrooms, questioning their knowledge and arranging their cognitive structures (Evrekli and Balım, 2010) and develops curiosity, research and questioning skills (Long and Marson, 2003) and used for attracting attention to the subject (Kennepohl and Roesky, 2008).

According to Keogh and Naylor, (1999); concept cartoons amuse the students, have them their knowledge and allow the students to produce scientific thoughts to associate daily life and natural science. Similarly, according to Coll, France and Taylor (2005), students develop the skill of expressing their ideas owing to concept cartoons. On the basis of the aforementioned features, the concept cartoon is a technique quite effective for revealing the concepts in the students' cognitive structures, detecting the concept mistakes and explaining their ideas scientifically. In this context, we have concept cartoons that serve for detecting the thoughts in the mental structures of the learners, their concepts and concept mistakes, as a remarkable technique with their colors and shapes. The concept cartoons designed contain alternative ideas related to any scientific event and offer the students an environment of mutual discussion as a whole. Thanks to concept cartoons, individuals aim at focusing on the event and finding the scientific truth. Similarly, according to Martinez (2004), concept cartoons allow conceptual change through analysis, discussion, research and cognitive balancing process since they do not directly offer the answer. According to Keogh, Naylor and Wilson (1998), in concept cartoons;

- Short texts are used to attract individuals' attention.
- Scientific thoughts are offered fluently in conjunction with daily life.
- The scientifically true thoughts are given together with expressions containing alternative thoughts and concept mistakes.

The students are allowed to select among the sentences that the cartoons express, the ones which are correct for them and justify their selections.

Additionally, according to Dabell (2004), cf. Balım, İnel, Evrekli (2008), concept cartoons;

- Assist the students with questioning their ideas, develop their thoughts and show different points of view to the events.
- Serve as stimulant for creation of discussion environment and allow the students to participate actively in the course.
- Guide the students for solving the problems they encounter in daily life.
- Reveal the ambiguities and false concepts in the students' minds.
- Can be used in the activities of combining the subjects and extending the subject.

When the literature on "the use of concept cartoons in environmental education", which is the focal point of our study, is examined, it is seen that it is limited to some special subjects and concepts. For example, Erdoğan and Özsevgeç (2012) investigated the effect of the use of concept cartoons on the elimination of students' misconceptions on global warming and greenhouse effect, whereas Aydın and Özyürek (2014) investigated the effect of using concept cartoons on the teaching of light pollution. However, when the relevant literature is examined, there are no concept cartoons in a holistic approach on issues such as global warming, greenhouse effect, ozone depletion, air, water, soil, sound, light pollution, extinct and endangered creatures.

When the studies conducted are examined as a whole, the concept cartoons are significant for development of the relevant critical skills in the educational environment on the basis of the approach that scientific thinking, questioning, discussing and meaningful learning are required to be realized. In addition to the aforementioned critical skills, it is considered that the use of the technique of concept cartoons in environment education and execution of the studies together with the candidate teachers, in the capacity of teachers of the future shall contribute to the literature. In this direction, the problem sentence of this research, which is carried out with teacher candidates who will be teachers in the future and will give environmental education to their students, is designed as "What is the effect of concept cartoons on environmental problems on teacher candidates' attitudes towards environmental problems and what are their opinions on the practices of concept cartoons? " The fact that the subject of the study includes environmental concepts, which are of common importance in our country and all over the world, and the target audience is selected from teacher candidates, increases the importance of the study.

2. Method

The study was carried on in the fall semester of the academic year of 2019-2020 with 105 (55 in the experimental group and 50 in the control group) students who study in the department of primary school teaching, within the scope of 'Environment Education' course for a period of 14 weeks. Semi-experimental model with pre-test – final test control group has been used in the study. The effect of the technique used on the experimental group could be searched according to the results obtained from the pre-tests and final tests applied in the experimental designs (Büyükoztürk, 2013). This method selected is considered to be the best convenient method for the purpose of the research due to its aforementioned characteristic. The group for which the students created teams of 4-5 individuals and computerized concept cartoon applications related to the environment problem determined and discussion environments are created every week was determined as the experimental group in the study and the group which is given the lectures in line with the curriculum was determined as the control group. Furthermore, interviews with the candidate teachers in the experimental group were held at the end of the process. The research is a mixed methods research method. The main purpose of preferring the mixed method here is revealing a general view of the research, together with the

relevant quantitative and qualitative dimensions. Many researchers use the qualitative and quantitative research methods jointly and suggest that qualitative data could be used to support, verify and/or explain the quantitative results (Creswell, 2003; Mertens, 2005). The experimental design of the research is given in the following Table 1.

Table 1. *Experimental Design of the Research*

Group	Pre-test	Method	Post-test
Experimental Group	Environmental Attitude Scale	Computerized Concept Cartoons	Environmental Attitude Scale and Interview
Control Group	Environmental Attitude Scale	Teaching through Presentation	Environmental Attitude Scale

2.1. Study Group

55 students compose the experimental group and students compose the 50 control group in the study carried on in the fall semester of the academic year of 2019-2020 with 105 students who study in the department of primary school teaching Convenience sampling method from purposeful sampling method was used in this study. Convenience sampling method is preferred in situations that are completely available, easy to access and fast (Patton, 2002). The teacher candidates voluntarily participated in the study within the scope of the "Environmental Education" course, which is an undergraduate course. The groups had not taken the 'environmental education' course during their undergraduate education. For this reason, the students who study in the department of primary school teaching determined for the sample composed the study group of the research provided that the students of 2-A class who take the course of Environment Education in the fall semester of the academic year of 2019-2020 are the experimental group and the students of 2-B class are the control group.

2.2. Data collection tools and data collection process

The "Environmental Attitude Scale" developed by Güven (2011) for the purpose of detecting the effect of computerized concept cartoon applications on the attitudes of candidate teachers with respect to environment problems is the data collection tool used in our study. The necessary permissions were received from the researcher in the application process. The expression of "I agree" is used for the positive items used in the scale and the expression of "I don't agree" is used for the negative items. The expression of "I'm neutral" was used for the items not containing positive and negative ideas and the scale was arranged in the as 3 point likert type. Reliability of the "Environmental Attitude Scale"; the coefficient of consistence of the scale was found to be Cronbach alpha value .88. The minimum score that could be gained from the scale composed of 45 items is 0 and the maximum score is 90. The candidate teachers were given sufficient time (25 minutes) to answer the items in the scale and they were asked to answer the items sincerely. On the other hand, the concept cartoons, the other data collection tool used in the research process was prepared using web-based "canva" "storyboardthat" and "pixton" education technologies. The following steps were followed in this study:

2.2.1. Pretest Data Collection

The “Environmental Attitude Scale” was applied to the students in the experimental and control groups for the purpose of detecting the attitudes of candidate teachers with respect to environment problems at the beginning of the process.

2.2.2 Environment Education Course (10 Weeks)

Studies were performed with the students in the experimental group were given information related to the significance of environment education and environment problems within the first 3 weeks of the course. The main purpose of these 3 weeks was to encourage the students to learn about important current issues that would be interesting and important to pursue. Students were encouraged to examine news reports, especially related to environment.

During these introductory weeks, the students discussed their efforts with each other in small-groups rarely reporting on their work as a part of whole-class discussions. The students were organized in small-groups of five before they were involved with interactions with other students and/or experts located from the internet. The second goal of the new course was to enable the students to deal with the concept of environmental problem as well as multidimensional as needed for their work in dealing with current social problems. The issues finally selected for the investigations include global heating, ozone layer depletion, air-water-soil-light-noise pollution and endangered species. Furthermore, the students in the experimental group were given information related to concept cartoons as a teaching method, the technique of concept cartoons was introduced, the purpose, features and preparation rules of concept cartoons were explained and the preparation steps were introduced in the web sites. Sample cartoons were prepared These applications lasted 6 lesson hours and it was aimed that the students would be more knowledgeable about concept cartoons and gain experience.

The rules of preparation of cartoons were explained in the sample cartoons prepared and it was stated that 4-5 characters should perform dialogs related to the subject determined. It was stated that one cartoon should defend the scientifically correct information in the dialogs and the others should produce sentences containing concept mistakes. A discussion environment was created in the classroom following the concept cartoon prepared together with the students in the classroom and the students were asked the idea of which cartoon they agreed with and why. Owing to this, they were encouraged to think scientifically, support their arguments, question their knowledge and make scientific explanations. After teaching the purpose, scope, features and preparations of the concept cartoons, the students in the experimental group were divided into groups of 4-5 and they prepared concept cartoons for the environment problems determined every week and presented the same in the classroom. They played the role of the characters in the carton during their presentations. Following the presentations, the students were asked the idea of which character they agreed with and why and they were asked to express their ideas using scientific explanations. Thus we tried to reveal the thinking forms of all students and the reasons underlying such thinking forms. Thanks to this application performed before the whole class, the in-class interaction strengthened. Following this discussion performed by the whole class, the researcher asked questions for allowing the students to question their ideas. Later, the class collectively detected which character tells the truth, together with the relevant justifications. The deficient and false ideas of the students within this process as well as the concept mistakes were detected and it was targeted at learning the scientifically correct concepts during the discussions. The researcher realized the teaching as student-centered throughout this process in the application stage and assumed the role of guide.

The course was held in line with the curriculum for the students in the control group and no concept cartoon applications were performed. The courses was carried on by the researcher in both groups and the researcher aimed at increasing the validity and reliability of the study.

2.2.3. Final test data collection

The “Environmental Attitude Scale” was applied to the experimental and control groups as the posttest at the end of the process and the findings were interpreted. Furthermore, interviews were held with the candidates in order to receive the candidate teachers’ ideas about the environment education course held using concept cartoons and assess the process more effectively. Thanks to the interviews held with the candidate teachers, it has been revealed whether the study was effective and the candidate teachers’ ideas about concept cartoons were revealed. The interview questions asked to the candidate teachers are given as follows;

Use of concept cartoon in the environment education course;

- ✓ Did it contribute to learning of the subject? How?
- ✓ Does it render the course more interesting? How or Why?
- ✓ Do you want to use concept cartoons in your courses in the future? If yes, why?

3. Findings

3.1. Findings on the scores of attitude toward the environment problems

It has been researched through independent groups t-test whether there was a meaningful difference among the means of the pre-test scores of the Environmental Attitude Scale used as measurement tool in the study where the effect of computerized concept cartoon applications on environment problems on the candidate teachers’ attitudes toward environment problems is searched. The independent groups t-test results of the students in the experimental and control groups with respect to pretest attitude scores are given in the following Table 2.

Table 2. *Independent Groups t-test Results with respect to Pretest Attitude Scores*

Group	N	M	SD	t	P
Experiment	55	44,40	5,78		
Control	50	45,24	4,85	1,256	0,27

There is no meaningful difference among the means of attitude scale scores of the candidate teachers in the experimental and control groups ($t = 1.256$, $p > .05$). The fact that the means of the pre-test attitude scores of the groups are close to one another before the beginning of the research is a situation conformant to the purpose in terms of determining the effectiveness of the teaching method on attitude change.

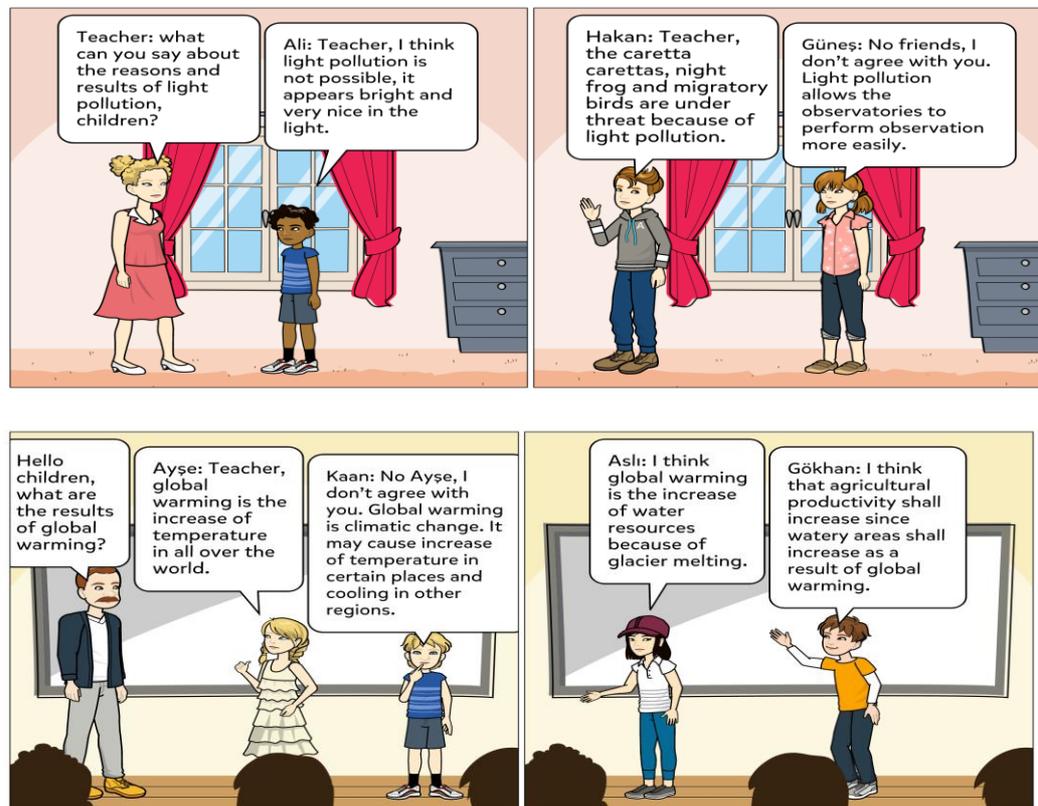
It was investigated whether there was a meaningful difference among the post test score means of the Environmental Attitude Scale applied in the study as a measurement tool through independent groups t-test and the relevant data are given in Table 3.

Table 3. *Independent Groups t-test Results with respect to Posttest Attitude Scores*

Group	N	M	SD	t	P
Experiment	55	68,20	4,80		
Control	50	58,60	5,53	13,4	0,000*

It has been detected that there was a meaningful difference among the means of attitude scale scores of the candidate teachers in the experimental and control groups ($p < .05$). It is one of the findings obtained in our study that the independent groups t-test results investigated with respect to the final test attitude scores of the groups that the computerized concept cartoon applications had a positive effect on the students' attitudes with respect to the environment problems.

The samples of concept cartoons that the students prepared are given in the following Figure 1.

Figure 1. *The concept cartoon samples prepared in the study*

When the concept cartoons in Figure 1 are examined; 1st example belongs to light pollution, 2nd example belongs to global warming. In the first example, the claim of the student named Hakan is accepted as scientific, while the statements of the other two students consist of misconceptions. Similarly, in the second example, the idea of the student named Kaan about the concept of global warming is accepted scientifically correct, while the other three students put forward incomplete, wrong and alternative ideas about the concept of global warming. With the concept cartoons prepared by the teacher candidates in the classroom environment, the candidates were asked which character they agreed with and why they agreed; they were

required to support their ideas with scientific reasons. In this way, it was aimed to gain skills in preparing concept cartoons related to environmental problems determined every week and to reveal students' opinions on the subject.

3.2. Findings obtained from the interviews

An interview consisting of 3 open-ended questions in order to receive the candidate teacher's ideas about the concept cartoons applied in the environment education course. The interview questions and the students' answers are given in percentage and frequency in Table 4.

Table 4. *Interview Questions and the Students' Answers*

	Yes		No	
	F	%	f	%
1. Did the concept cartoon applications contribute to learning the subject?	55	100	-	-
2. Do the concept cartoon applications render the course interesting?	55	100	-	-
3. Do you want to use the concept cartoon in your courses in the future?	55	100	-	-

When the findings in Table 4 are examined, all of the candidate teachers expressed that the concept cartoon applications contributed to learning the subject, rendered the course interesting and they wanted to use this application when they become teachers in the future. The interview questions and the candidate teachers' sample sentences are given as follows.

Interview question 1: Did the concept cartoon applications contribute to learning the subject? How?

All of the 55 students attending the interview answered this question saying 'yes'. The ideas of some students are given as follows as the explanation of the answer.

S2: I saw all aspects of a subject in a single cartoon. I had the opportunity to examine different thoughts in a single cartoon.

S15: I had the opportunity to question the false ideas and ideas with concept mistakes which I used to think to be correct, for example, I thought it was due to the depletion of ozone layer and I thought acid rains as the cause of air pollution. I did not know that light pollution had such bad consequences. thanks to the concept cartoon.

S34: I questioned my knowledge thanks to the concept cartoons, created an environment of discussion and realized why it was false and replaced it with the correct one.

Int: Do the concept cartoon applications render the course interesting? How or Why?

S11: Absolutely, it was very enjoyable to go out of the ordinary techniques.

S23: I was waiting for the environment education course excitedly. Using, preparing and applying the concept cartoons in the course rendered the course much more amusing.

S30: I think it was very amusing to discuss, to see the images and encounter a different cartoon every week and it interested me and attracted my attention very much.

Int: Do you want to use the concept cartoon in your courses in the future? If yes, why?

S1: Absolutely yes because I think that the children will be much more motivated given that I enjoyed in the class so much at this age.

S17: Detecting and remedying concept mistakes, isn't it what we want as teachers? The concept cartoons provides this, I use them for this reason.

S26: I definitely use the concept cartoon since I want to create an environment of discussion in the class, to render the students active and question my knowledge. We luckily learned this technique. I feel impatient to become a teacher and use this technique as soon as possible.

Examining the teacher candidates' answers, it has been detected that the candidates generally gained and developed many significant skills that they are required to have owing to the concept cartoon applications. The candidates expressed that among those significant skills, they generally learned to perform reference research, to organize the knowledge, their verbal expression skills developed, they gained knowledge about the subject, meaningful learning realized, they experienced the excitement of producing a product, they became more qualified on teaching in terms of computer use and they would use those activities when they become teachers in the future. They further stated that they detected the concept mistakes related to the subject, analyzed the reasons for the concept mistakes, learned correct and scientific concepts, their interest and motivation about the course increased and the courses became more interesting.

4. Conclusions

It has been detected in the study where the effect of the computerized concept cartoon applications on the candidate teachers' attitudes on environment problems is investigated as a consequence of analysis of the scores of the Environmental Attitude Scale applied as pretest-posttest that the concept cartoons applications changed the attitudes toward environment problems positively. It is emphasized in many researches in the field literature that the concept cartoon applications in the educational environment contributed positively to the individuals' cognitive, affective and psychomotor areas. When the concerned field literature is examined; it has been detected that the concept cartoons increased the attitude, interest and motivation toward the course (Kaptan and İzgi, 2014; Keogh, Naylor, De Boo and Feasey, 2001; Narayan, 2016), were effective in remedying the concept mistakes (Ekici, Ekici and Aydın, 2007; Kabapınar, 2005), developed the conceptual understandings and scientific discernments of the students (Pekel, 2019), and increased academic success (Demirci and Özyürek, 2017; Murtiningrum, Ashadi, Mulyani, 2013). -In addition, when the relevant literature is examined, Keogh, Naylor, and Wilson (1998) stated that concept cartoons associated with real life and daily life increase success; Bing and Tam (2003) and Long and Marson (2003) claimed that they develop individuals' thinking and reasoning skills; and Palacios and Gonzalez (2005) noticed that they develop problem solving skills; and Stephenson and Warwick (2002) noticed that the concept cartoons led students to research and study. Long and Marson (2003) and Cengizhan (2011) reached the conclusion that concept cartoons lead students to ask questions to themselves, and with this way, they notice the deficiencies related to the subject more easily.

As a consequence of the interviews held at the end of the process; one may express that the concept cartoons assisted the students with defining the problem better, increased interest and motivation, they participated actively in the lesson and in the discussion environments in the classroom, they learned by amusing, questioned the knowledge and detected and corrected the concept mistakes. Those findings resemble the studies where it is expressed that the concept cartoons assisted the students with visualizing and solving the problem (Balım et al., 2016); rendered the courses more amusing and encouraged the students for participating in the class actively (Gafoor and Shilna, 2013). Findings obtained in our study shows similarities with Cengizhan's study (2011) that received the opinions of preservice teachers about concept cartoons and all of the them (100%) who participated in the study stated that concept cartoons positively affected learning, did not distract their interest, provided motivation, and 97.7% stated that they made the lesson more interesting. In this context, concept cartoons improve students' creativity and critical thinking and problem solving skills. It also provides motivation and improvement of student learning outcomes. In addition, concept cartoons support students to take more responsibility by providing active participation in the classroom. It visualizes the theme making it more concrete, and to develops critical skills such as creativity and high-level thinking. These results are in line with the studies of Keogh and Naylor (1999); Long and Marson (2003); Morris et al. (2007), which stated that concept cartoons provide motivation by facilitating the focus on the theme.

As a result of the discussions in the environmental education course supported by concept cartoons, it can be said that it has positive contributions to teacher candidates in terms of many skills such as critical thinking, argumentation, analytical thinking, problem solving, creative thinking and decision making. As a matter of fact, in the example of Figure 1, it is seen that the concept cartoons contain different views on light pollution and global warming, and the teacher candidates approach the subject from different perspectives and express their views on environmental problems. In addition, it was determined that during the preparation process of concept cartoons, teacher candidates draw attention to the environmental problems encountered in daily life with their sense of responsibility, and they provide opportunity for discussion by putting individuals into dilemma with their explanations. It was seen from the statements of the teacher candidates that they drew attention to their positive contributions to the detection and elimination of misconceptions regarding environmental problems. In this context, it was concluded that the use of concept cartoons in many levels and disciplines contributed to the multidimensional development of the students and suggestions were made on the issue.

5. Suggestions

Prevention of environment problems that we encounter today firstly depends on providing and effective environment education to individuals. In this regard, the researchers are suggested to be oriented to technology supported and practical studies which aim at developing the individuals' environment consciousness more. The concept cartoon applications could be adapted to different subjects and disciplines. The study could be applied to students at different levels and the change in students of elementary school, secondary school and high school could be monitored. Additionally, studies investigating the effect of the concept cartoon applications on the students' critical thinking, creativity, motivation could be conducted.

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