TEACHERS' VIEWS ABOUT PROBLEM-BASED LEARNING THROUGH CONCEPT CARTOONS

Abstract. *This study aimed to examine the views of science and technology teachers towards concept cartoons integrated to problem-based learning. In this context, teachers' views were compared before and after the experimental treatment of a project. Data was gathered through qualitative research methods. Participants of this study were science and technology teachers from 9 elementary schools in the city of Izmir in the 2011-2012 academic year. In the first step of the study, a 30-hour workshop including theoretical subjects, applications and experimental treatments about concept cartoons was presented to teachers. Then semi-structured interviews were conducted with teachers. Following this workshop, teachers were requested to apply all these applications and experimental treatments. After the experimental applications, semi-structured interviews were conducted again with the same teachers. According to the findings, teachers indicated that problem-based learning modules to improve students' critical thinking, inquiry learning skills and help them relate their knowledge to daily life.*
Key words: *concept cartoons, problem-based learning, science and technology teacher.*

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Introduction

Today teacher-centred instruction is in decline, while learning and teaching approaches putting student in the centre and aiming to encourage them to learn by doing and living started to take place in the curricula. One of these methods is problem-based learning. In problem-based learning, individuals construct their own knowledge, provide solutions to the problem they have encountered in the beginning and test their own hypothesis. As indicated in literature, problem-based learning has several contributions to learning process. Problem-based learning provides improvement for problem solving skills, self efficacy beliefs (Kaptan & Korkmaz, 2002; Hmelo-Silver, 2004; Yaman & Yalcın, 2005) self directed learning skills, critical thinking skills and cooperative learning skills (Sonmez & Lee, 2003; Akinoglu & Tandogan, 2007; Araz & Sungur, 2007; Tarhan & Acar, 2007). With this method students may arise their metacognitive skills to higher levels and their metacognitive awareness and motivation may be affected in a positive way (Downing, Kwong, Chan, Lam & Downing, 2009).

According to Baysal (2005), using cartoon series, which are suitable for course objectives and which might encourage students to think might be interesting. Balim, Inel & Evrekli (2007) also stated that using concept cartoons in problem-based learning might be useful.

One of the uses of cartoons in education, especially in science education can be indicated as concept cartoons. However, concept cartoons are separated from cartoons by several properties (Keogh & Naylor, 1999; Sengul & Uner, 2010). While cartoons are being used to make individuals laugh, concept cartoons are generally being used to entertain students and encourage them to inquire knowledge (Keogh & Naylor, 1999). Concept cartoons might be defined as visual tools that bring a scientific event from daily life as discussion and represent different viewpoints about the event (Keogh & Naylor, 2000; Naylor, Downing & Keogh, 2001; Parkinson, 2002; Stephenson & Warwick, 2002; Coll, France & Taylor, 2005; Koch, 2010). Focus on concept cartoons is daily life situations, students are familiar with (Naylor & Keogh,

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1999). During the course, concept cartoons provide alternative perspectives to the scientific situation presented in the event and then students are invited to discuss through concept cartoons (Keogh, Naylor & Wilson, 1998; Keogh & Naylor, 2000). It could be indicated that concept cartoons provide students with an environment where they can discuss their views openly and encourage students to participate in the course (Keogh & Naylor, 1999; Naylor et al, 2001; Webb, Williams & Meiring, 2008; Chen, Ku & Ho, 2009; Chin & Teou, 2009; De Lange, 2009; Inel, Balim & Evrekli, 2009; Naylor & Keogh, 2009). What is more, it is emphasized that concept cartoons are useful for helping students create a cognitive conflict during the in-class discussion process (Keogh & Naylor, 1999; Keogh, Naylor & Downing, 2003).

When the studies about concept cartoons are examined, it could be seen that there are studies about concept cartoons' use as an assessment tool (Keogh, Naylor, De Boo & Feasey, 2001; Ingec, 2008; Chin & Teou, 2009), as a tool which defines and removes students' misconceptions and exploits alternative conceptions (Stephenson & Warwick, 2002; Kabapinar, 2005; Saka, Akdeniz, Bayrak & Asilsoy, 2006; Ekici, Ekici & Aydin, 2007; Atasoy & Akdeniz, 2009; Sexton, Gervesoni & Brandenburg, 2009; Demir, Uzogu & Buyukkasap, 2012), as a tool for academic achievement, permanent knowledge and logical thinking (Balim, Inel & Evrekli, 2008; Ozyilmaz-Akamca & Hamurcu, 2009; Ozyilmaz-Akamca, Ellez & Hamurcu, 2009; Golgeli & Saracaloglu, 2010; Sengul & Uner, 2010), as a tool for creating in-class discussion (Webb et al, 2008; Chen et al, 2009), as a tool for inquiry learning, logical thinking and attitude (Balim et al, 2008; Ozyilmaz-Akamca & Hamurcu, 2009; Sengul & Uner, 2010). In their study, Balim et al. (2007) gave examples about use of concept cartoons integrated to problem-based learning. Also, Inel & Balim (2011) examined the effects of using concept cartoons integrated to problem-based learning on students' motivation towards science education. According to the results of the research, concept cartoons integrated to problem-based learning have a significant positive effect on students' motivation towards science education.

Problem of Research

When the studies about problem-based learning and concept cartoons are examined, it could be seen that especially studies in science education field are limited. In addition, any study about teachers' views towards the use of problem-based learning and concept cartoons together could not be encountered in the related literature. Thus, in the study, science and technology teachers participated the course which is about problem-based learning and concept cartoons, presented the activities/plans and applied these activities/plans in their classroom. So, the problem of this research is indicated as follows; "Is there any significant difference between science and technology teachers' (n=9) views towards the use of problem-based learning and concept cartoons before and after the practice?"

Methodology of Research

General Background of Research

Within the scope of this study, teachers' views are taken through semi-structured interviews and their answers to interview questions are evaluated by using descriptive analysis method. Participants of this study are teachers (n=9) working in a city of Turkey. Within the scope of this study, a two-day seminar about the use of problem-based learning and concept cartoons was given to teachers and their views were taken just after the workshop. After the workshop, teachers practiced concept cartoons integrated problem-based learning about matter and heat unit for four weeks in their classes. At the end of this practice, teachers' views on concept cartoons with problem-based learning were taken again and compared with prior views. Views of teachers were taken through semi-structured interviews, transformed to written text and examined. The symbolic scheme of research is indicated in table 1.

Table 1.   Research design.

Workshop process	Before practice/After workshop	Practice process	After practice
PBL and concept cartoons workshop (2 days)	Teachers' views before practice	Four-week practice process	Teachers' views after practice

Instrument

Semistructured interview questions: Before the formation of semi-structured questions, question samples formed by researchers were given to experts for scope and face validity. After implications and corrections of experts, questions were transformed into final forms. According to this, interviews conducted after the seminar include five open-ended questions and interviews conducted after the practice include seven open-ended questions. Compliance percentages of experts are 1.00 for availability to qualitative research, 1.00 for availability to sixth grade students' level and.80 for availability for language and explanation.

Procedures and Data Analysis

During the data collection process, first a sixteen-hour seminar was prepared for teachers (n=9) who would use problem-based learning through concept cartoons in their classes. On the first day of the seminar, theoretical information about constructivism, problem-based learning and concept cartoons was given. On the second day of the seminar, 2005 Science and Technology curriculum was introduced; and objectives and activities for science and technology sixth grade "matter and heat" unit which was included in the project were examined. Course plans, modules and activities towards concept cartoons integrated problem-based learning (experiment 1) and only problem-based learning (experiment 2) were presented. At the end of the seminar, teachers' views towards the use of problem-based learning and concept cartoons together were taken through semi-structured interviews. Then teachers used concept cartoons integrated problem-based learning on matter and heat unit in science and technology courses. So, in the practice, there are nine teachers and their departments. After the four-week practice on matter and heat unit, teachers' views towards the practice were taken and compared with views taken before the practice (after seminar). In this research, findings are analyzed by using descriptive analysis from qualitative analysis techniques.

Results of Research

In this part, teachers' views towards the use of concept cartoons with problem-based learning before and after the practice are compared as items and some of the results are interpreted. Findings are presented in order. Uppercase letters represent teachers who participated in the project and study.

The Results Related to Problems Encountered in the Process of Problem-Based Learning Modules Use

Teachers' common views before and after the practice: Inadequate time, group problems, discipline problems, lack of problem understanding; before practice views: Issues of getting used to PBL, students' absence, crowded classes; after practice views: lack of scenario understanding, unanswered questions, lack of required materials. Teachers' general problem during the use of problem-based learning modules is inadequate course time. Before the practice teachers indicated that they will have problems during group formations. After the practice, teachers' focus changed from this topic to lack of time, lack of scenario comprehension and lack of problem definition.

Some views of teachers before the practice:

> "I am not sure if I can distribute the groups homogeneously. Students with low grades might cause discomfort in groups. There might be some issues because of group work. Maybe students with high grades would try to do all the jobs themselves and think only their views are right." TA
> "There might be dissent in groups in the beginning." TB

Some views of teachers after the practice:

> "Especially in first weeks we had several issues... when we asked them to define problem students were directly giving the answer of problem, then they slowly got used to it." TA
> "There was no thermometer in the class and it was required in the experiment." TB

The Results Related to Benefits of Problem-Based Learning Modules for Teacher

Teachers' common views before and after the practice: Provide critical viewpoints, provide group work, visualization of activities, interesting scenarios, problems and concept cartoons, relation of problems with daily life, critical thinking; before practice views: Permanent learning, effective learning, alternative thinking, provide scientific process skills, provide problem solving skills; after practice views: Encourage course participation, gain autonomy. During practice, teachers had the chance to experience the benefits they predicted beforehand and indicated this in their views after the practice.

Some views of teachers before practice:

"We can form a scenario from our daily life experience and use it to exploit the similar situations. I started to think that I can use it effectively. We were already doing it, but it can be more effective now."TD

Some views of teachers after practice:

"Our work has gone well because all students learned with experiments." TB
"Because it completely depends on experiment, we have done several experiments. I think students are visually impressed. The efficiency of the course has increased." TD
"In the second and third weeks, students have learned to apply the processes without module explanation. So the structural order, of course is formed. Students started to learn step by step." TE

The Results Related to Positive Parts of Problem-Based Learning for Teacher

Teachers' common views before and after the practice: Interesting, motivating, provide inquiry skills, encourage course participation, provide academic achievement, self definition, critical thinking skills, relating knowledge with daily life, group work; before practice views: Self confidence; after practice views: Learning responsibility. Although teachers' views about the positive properties of problem-based learning before and after the experimental practice are generally similar, there are some differences in some points. While before the practice teachers indicated that problem-based learning would improve students' abilities, after the practice they indicated that students' course participation increased, they had an active role and it provided students' permanent learning. Also, teachers said PBL increases students' learning responsibility.

Some views of teachers before the practice:

"It may help them find new ways of problem solving." TC
"They will learn by doing and living because they solve problems themselves. They will learn permanently." TF

Some views of teachers after practice:

"They were active during the whole problem solving process. At first they thought they only have to read and write the answers. But then they have realized that they should define the problem first and focus on problem. In our system we only focus on answers, but in here they find the problem first and participate actively in every step. This increased their self confidence." TC
"Even a student without course interest might participate, find something and represent his/her group." TF

The Results Related to Negative Parts of Problem-Based Learning for Teacher

Teachers' common views before and after the practice: Lack of time, lack of materials, group problems; before practice views: Problem definition, thought explanation, doing research, crowded classes, special students' problems; after practice views: Prior knowledge difference, difficult activities. Although teachers' views about negative properties of problem-based learning before and after the practice are generally similar, there are some differences

in some points. Before the practice teachers indicated that students might find it difficult to vocalize what they think, define the problem, do research, do group work and participate in the scenario. After the practice teachers indicated that lack of materials, lack of course time and some difficult activities were the negative properties of PBL.

Some views of teachers before the practice:

"Even if it's a group work some students might still stay in the background. Even though we try to guide them, they resist and stay behind." TH
"Students get bored if they couldn't define the problem. Our biggest problems are boredom, lack of problem defini- tion, lack of research interest and lack of participation interest." TI

Some views of teachers after the practice:

"There are some students who don't participate in groups or write down the problem, they don't want to get in- volved." TI
"Long time of activities, required time for writing and other time problems are the negative parts." TH

The Results Related to Parts of Problem-Based Learning Which Students Find Difficult

Teachers' common views before and after the practice: Problem definition, "what do we know?" part, "why do we have to do research?" part, group work; before practice views: Application time of activities, doing research, use of sources, self assessment; after practice views: Similar to before practice views. Long activity times, students' difficulties while reaching sources and assessment problems left with positive impressions over time.

Some views of teachers before the practice:

"Students with high academic achievement already do research before courses. However, lower grade students have less possibility of doing research. Doing research might cause difficulties." TG
"Generally, our students don't know how to reach knowledge. They don't know how to use sources. They might have a problem, but it's also a positive part because they will learn how to extract information from sources." TD

Some views of teachers after practice:

"As I told before, students couldn't define the problem about heat and temperature." TG
"After that, in "what do we know?" part students had difficulties because they hadn't got used to enquiring." TD

The Results Related to Positive Parts of Concept Cartoons For Teacher

Teachers' common views before and after the practice: Improved course participation, permanent learning, interesting and attractive, includes visuals; before practice views: Different viewpoints, helps recognition, encour- ages learning, exploits misconceptions; after practice views: Discussion environment, students' interest, forces students to think, helps students see their faults, makes abstract knowledge concrete. It can be said that teachers focused on similar properties before and after the practice. In both applications, teachers indicated that concept cartoons include visual parts, attract students, encourage course participation, provide permanent learning. Before and after the practice teachers have indicated that concept cartoons are interesting. What is more, while teachers said concept cartoons include visual parts and help students recognize knowledge before practice, after practice they commonly indicated that concept cartoons help permanency of knowledge.

Some views of teachers before practice:

"Positive parts of concept cartoons are they provide visualization. I think courses are more effective when students see little visual things, movies, short videos... I think concept cartoons will be effective for sure. Sometimes I show my

students cartoons that I have encountered and they like it. That's why I think it would be useful." TA

"Concept cartoons might help recognition because they're visual. Students may remember the visual table they saw." TF

Some views of teachers after practice:

"It drew the attention of students." TF

"Concept cartoons are more enjoyable. Because there are images students may enjoy more. As I say they like visualization." TA

The Results Related to Negative Parts of Concept Cartoons For Teacher

Teachers' common views before the practice: Concept cartoons include limited thoughts, discipline problem, all cartoons have the same style, can't be done by students who don't get the topic; after practice views: No negative views about concept cartoons after the practice. However, some teachers indicated that concept cartoons might have negative parts such as including limited thoughts, discipline problems, all cartoons' similar style and lack of student comprehension. After the practice these negative thoughts are reduced and two teachers said concept cartoons limit students' thoughts. In addition, two teachers said using concept cartoons before problem-based learning scenario might be more effective.

Some views of teachers before practice:

"No alternative thoughts. In some cartoons, we gave empty boxes to fill, but in general I saw limited boxes. There are certain thoughts. Students have to choose one of them... However, there were some empty boxes. Actually, in all cartoons there should be empty boxes. Students should be able to write down their own thoughts.

"Concept cartoons might have drawn students to take the knowledge directly and leave the rest, pass the details. They pass the topic and only take answers. Cartoons might be giving knowledge too easily. It might be a negative part."

Some views of teachers after practice:

"Negative part might be the limited thoughts included in cartoons. But because we want to keep the course out of control it shouldn't be a problem." TC

"I haven't seen a negative part." TD

The Results Related to Effects of Using Problem-Based Learning through Concept Cartoons on Students

Teachers' common views before and after the practice: Interesting, drives students to think, helps learning by making topics concrete, increases permanence of learning; before practice views: Helps students understand the problem better, enriches learning environment, exploits misconceptions; after practice views: Better/ more effective learning, includes visual parts, provides inquiry, encourages students, provides discussion environments. It can be said teachers have a common view that using problem-based learning through concept cartoons will be interesting, provide thinking and permanent learning.

Some views of teachers before practice:

"Concept cartoons might be a good way of helping students define the problem better. Concept cartoons are useful in this situation." TH

Some views of teachers after practice:

"It had an effect by visualizing. For example, we both used PBL in class b and c. In addition, use of concept cartoons in class helped students remember visually." TH
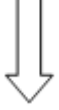
As a result, summary of findings for positive views about problem-based learning through concept cartoons can be seen in table 2 as teachers' positive views before practice, common positive views before and after practice and positive views after practice.

Table 2.   Teachers' positive views about use of concept cartoons with problem-based learning before and after practice.

POSITIVE VIEWS BEFORE PRACTICE

Provide alternative thinking, develop scientific process skills, develop problem solving skills, increase self confidence, teach problem definition, encourage to explain thoughts, do research, exploit different views, help recognition, encourage learning, exploit misconceptions (11)

COMMON POSITIVE VIEWS BEFORE AND AFTER PRACTICE

Provide critical viewpoints, visual activities, interesting scenarios, problems and concept cartoons, daily life related problems, inquisitive thinking, encourage course participation, self help, explanation, permanent learning, encourage group work, help learning by making topics concrete (13)

POSITIVE VIEWS AFTER PRACTICE

Provide learning responsibility, provide discussion/argumentation environment, students' positive attitude, drive students to think, help students see their faults, make abstract knowledge concrete, include visualization, provide inquisition, encourage students, provide discussion environment (12)

Summary of findings of negative views about problem-based learning through concept cartoons can be seen in table 2 as teachers' negative views before practice, common negative views before and after practice and negative views after practice.

Table 3.   Teachers' negative views towards concept cartoons integrated problem-based learning before and after practice.

NEGATIVE VIEWS BEFORE PRACTICE

Difficulties while getting used to PBL, students' absence, crowded classrooms, problems of special students, difficulties during the practice process, difficulties during research, difficulties while using sources, difficulties of self assessment, concept cartoons include limited thoughts, discipline problems, all concept cartoons are in the same style, difficulties for students who don't understand topics (12)

COMMON NEGATIVE VIEWS BEFORE AND AFTER PRACTICE

Lack of required time, group problems, discipline problem, difficulties while understanding the problem, lack of materials, problem definition issue, problems in "what do we know" and "what do we have to search" activities (7)

NEGATIVE VIEWS AFTER PRACTICE

Difficulties while understanding the scenario, unanswered questions, prior knowledge difference (3)

When table 2 and table 3 are examined, it can be said that there are 24 positive views before practice. During practice positive views increased (25 views), on the other hand, negative views (19 views) decreased after practice (10 views).

Discussion

In this study, the difference between science and technology teachers' views about problem-based learning and concept cartoons before and after the experimental practice were sought. Semi-structured interviews were held with teachers about concept cartoon integrated problem based learning's applicability, benefits, gains, positive and negative ways before the experimental practice. After the experimental practice semi structured inter-

views were repeated. The views before and after the experimental practice were compared. After the interviews were conducted before the experimental practice, it was revealed that teachers had time and student formation anxiety, however, after the experimental practice this anxiety lessened and scenario content comprehension and problem definition anxiety arose. In addition, inadequate time problem was emphasized during the experimental practice. Biber & Baser (2012) emphasized that students and teachers gain work skills as individuals and as a group, problem-based learning is an effective learning method in concept learning and timing is important because of the long process duration. Time loss anxiety towards problem-based learning process still stays as a serious problem. It is revealed that time loss anxiety affects scenario comprehension and problem definition, the most important stages of problem-based learning.

When teachers' views towards the benefits of problem-based learning before and after the experimental practice were examined, teachers indicated that problem-based learning modules are beneficial for several skills such as scientific process skills, critical thinking skills, visual learning skills, relating knowledge with daily life, permanent learning, problem solving skills, inquiry based learning and learning responsibility. When results are compared with the literature, benefits of problem-based learning are found as using prior knowledge, relating knowledge with daily life, improving problem solving skills, deep permanent learning, relating knowledge with different situations and providing different viewpoints (Treagust & Peterson, 1998; Senocak, 2006; Khadjooi & Rostami, 2011). In addition, other research results indicate that advanced level cognitive and thinking skills improved, attention and curiosity increased, social life improved, communication and interaction increased, creativity developed and learning responsibility improved through problem-based learning (Joan & Huges, 1994; Conway & Little, 1999; Yu-chen, 1999; Seng Tan, 2003; Miflin, 2004; Winning, Skinner, Townsend, Drummond & Kieser, 2004). Within this scope, it can be said that problem-based learning improves problem solving skills, relates knowledge with daily life, provides permanent learning and views about improvement of these skills increased after the experimental practice.

In this study, teachers' views towards negative parts of problem-based learning before and after the experimental practice were compared and general problems are defined as inadequate materials, passing over course time, time problem and group issues. It can be said that these views are similar to views of the first semi-structured interview questions, issues with problem-based learning. In the research, before the experimental practice teachers indicated a common view that students will be inadequate while defining the problem, indicating thoughts, doing research and practice will not continue appropriately because of crowded classrooms and student problems. However, after the practice these views have changed. As it can be understood, teachers have indicated some negative views because of inadequate knowledge about the process, but after the experimental practice these negative views were removed. On the other hand, some teachers indicated that they had difficulties because of different prior knowledge while some teachers indicated that they had issues because of some difficult activities in problem-based learning modules. It can be said that these difficulties vary according to different classrooms and can be overcome with little changes.

Teachers' views about student difficulties before and after the experimental practice were compared and it's found that students generally have difficulties when defining the problem, in "what do we know" activity and when doing cooperative work with the group. Research studies in literature indicates that problem's adaptability to target group, problem's difficulty level, problem's focus on target subject and inappropriate problem for subject are main negative parts of PBL (Joan & Huges, 1994; Conway & Little, 1999; Yu-chen, 1999; Seng Tan, 2003; Miflin, 2004; Winning et al., 2004; Senocak, 2006). Thus, it can be said that problem definition and problem adaptability on students are the main difficulties of problem-based learning. This situation might be caused because prepared problems were given to students and students haven't affected the problem preparation process. In this study, before the experimental process teachers indicated that student would have difficulty in practice process, doing research, reaching sources and self assessment parts. However, after the experimental practice these views are completely removed.

In this study, when teacher views about concept cartoons' positive aspects are examined, it's indicated that visual parts, attractive and interesting cartoons, encouragement to course, permanent learning and providing argumentation environment are concept cartoons' positive aspects. Parallel to these findings, Roesky & Kennepohl (2008) indicated that concept cartoons might encourage student participation in the classroom and increase student interest. According to Dabell (2004) concept cartoons redirect students to thinking processes. Also, students participate in argumentation caused by concept cartoons and might be more willing for learning (Özyılmaz-Akamca et al, 2009). Within this scope, it can be said that concept cartoons increase students' course participation and

provide permanent learning via argumentation environments. In this research before the experimental practice teachers indicated that concept cartoons help recognition, encourage learning, and reveal misconceptions. After the experimental practice, entertaining, interesting, encouraging thinking, indicating wrong answers and turning concrete knowledge to abstract were added to previous positive views. As it can be understood, teachers indicated positive views about concept cartoons before the experimental practice and positive views increased after the experimental practice. Within this scope, it can be said that concept cartoons have several positive effects on students during the learning process. When teachers views about concept cartoons' negative aspects; some of the negative views are limited to thoughts, discipline problem and similar styles of concept cartoons. However, it's found that these views were removed after the experimental practice.

When teachers' views on the use of problem-based learning with concept cartoons before and after the experimental practice were examined; positive aspects such as students' interest in process, encouragement to think, turning concrete knowledge to abstract and improvement on permanent learning were revealed. As it can be understood teachers indicated that using problem-based learning with concept cartoons will have positive effects on students. Within this scope, it can be said that problem-based learning and concept cartoons may be used together in science and technology courses. Similarly, there are studies in the literature (Balım et al, 2007; İnel & Balım, 2011) using PBL and concept cartoons.

Conclusions

It can be said that with the constructivist approach teacher-centred methods and techniques started to be abandoned and methods and techniques through which students research, enquire, use high end thinking skills such as critical, creative, analytical thinking skills and participate in courses actively during progress were adapted. Problem-based learning in which students try to solve a problem related to daily life and use high end skills such as critical thinking, research-inquiry, analytical thinking- is one of these methods. Also, it can be said that another technique is concept cartoons. Within this scope, teachers' views about problem-based learning and concept cartoons are considered to be important.

In the study, insufficient time problem was emphasized during the experimental practice and said after the practice. In the active learning approach, time loss anxiety is a serious problem. However, when the teachers and students accommodate method, this problem will be gradually reduced. When teachers' views towards benefits of problem-based learning were examined, it's said that scientific process skills, visual learning skills, relating knowledge with daily life, problem solving skills are problem-based learning modules' positive aspects. And when teacher views about concept cartoons' positive aspects are examined, teachers said that concept cartoons are useful for several skills such as visual parts, attractive and interesting cartoons, encouragement to course, permanent learning and providing argumentation environment.

Within findings of this study, it can be said that science and technology teachers' positive views about using problem-based learning through concept cartoons increased after the experimental practice. Also, it can be said that negative views are reduced after the experimental practice. Within this scope, more studies on using concept cartoons with problem-based learning may be suggested. Also theoretical and practical workshops could be done with science and technology teachers about PBL and concept cartoons.

Notes

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