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# Examination of pre-service science teachers' activities using problem based learning method

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**In this study, both the activities prepared by pre-service science teachers regarding the Problem Based Learning method and the pre-service science teachers' views regarding the method were examined before and after applying their activities in a real class environment. 69 pre-service science teachers studying in the 4th grade of the science education participated in the study. This study was designed as a case study. In the result of analysis, it was determined that the pre-service science teachers could develop activities using the features of the problem based learning method. However, it was concluded that pre-service science teachers faced difficulties in some phases during the activity development process such as generating scenarios related to daily life and finding problems to direct the students to inquiry. In the result of semi-structured interviews conducted with pre-service science teachers, it was determined that they had positive and negative views regarding the PBL method before and after the implementation in a real class setting.**

**Key words:** Problem based learning, pre-service science teachers, view.

## INTRODUCTION

Teachers, who are active from the beginning of the learning process up to its evaluation, are deemed to be individuals who provide good education of future generations in terms of their knowledge and skills. The teachers, whose behaviours are imitated and who are perceived as a role model by the students according to Alam and Farid (2011), play an important role in the learning of and acquisition of different skills by the students. Presently, different from the past, teachers are expected to apply active learning approaches in their classroom and educate their students as individuals who are capable of learning throughout their whole life. Therefore, one of the basic tasks of teachers is to plan and carry out the lesson as to include the active learning methods (Tanni, 2012). From this point of view, teacher training programs should not only aim to prepare the teachers of future to raise new generations, but also to ensure them to plan and use different methods in order to reveal the potentials of the students (Causton-Theoharis et al., 2008). On the contrary, in teacher training, approaches based on the theoretical education are used in order to prepare the teachers for their professional life and these approaches are frequently criticized (Mason, 2013). Furthermore, teachers are required to be productive individuals. They need to be able to change the program according to the students' needs instead of

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fully adhering to the educational programs. Therefore, it is very important that the teacher training programs to involve applied courses where the pre-service science teachers can learn active learning approaches, where they prepare course plans related to these approaches and where they can use the plans they have prepared in small student groups. Besides this, the assessment of the activities prepared by the pre-service science teachers can help in the determination and elimination of the difficulties they face and this can positively influence the teacher educational process. For this reason, current study makes some suggestions by taking into consideration both the activities prepared by the pre-service science teachers and their views regarding the problem based learning method, that is one of the active learning methods.

## Problem based learning (PBL)

PBL is one of the student based learning methods where the students use their own experiences in problem solving process (Shimic and Jevremovic, 2010). PBL was used for the first time by the end of the 1960s in Canada for teaching the clinical situations at a faculty for medicine (Chen, 2008; McLinden et al., 2010; Williams and Pace, 2009). Furthermore, currently PBL is frequently used at higher education institutions including nursing, law, engineering (Awang and Ramly, 2008) and other education levels including elementary, secondary and high school (Barrows, 1996). The primary aim of the PBL, which is a method that encourages learning by students (Lee and Bae, 2008), is to establish a learning environment where active learning is being increased (Lam, 2008). Besides this, PBL aims students to develop lifelong learning skills and to prepare them for meaningful learning (Schmidt et al., 2009).

In PBL, real life events are used in the learning process frequently in order to provide meaningful learning and retention (Searight and Searight, 2009). It is advised to use efficient problems related to daily life to cause conflict in students' brains (Wang et al., 2008). The problems in question should be presented to the students as interest attracting scenarios. In PBL process, students are first requested to determine the problem or problems in the scenarios they come across. This triggers the PBL process as a result of the need for students to solve a problem they face in their daily life (Shamir et al., 2008; Spronken-Smith and Harland, 2009). Contrary to the traditional learning approach, the problems are not used for the purpose of evaluating knowledge in PBL process, but for initiating learning. After the determination of the problems in the scenarios, the students try to understand the nature of each problem, to recall their previous knowledge, to ask questions with regard to the issues they could not understand, to design a plan in order to solve the problem and to determine the sources they need (Uden and Beaumont, 2005). Therefore, the students use the PBL environments for their skills like solving daily life problems, critical thinking, communication, decision making (Chaves et al., 2006; Savin-Baden and Major, 2004). Besides, PBL requires group work since it is frequently applied in small student groups (Abou-Elhamd et al., 2011). This type of work develops communication and other skills among students and also the ability to think in different perspectives related to a problem (Wilkinson, 2009).

In addition, the role of the teacher differentiates in the PBL process compared with the other methods (Sockalingam et al., 2010). In general, the tutors assist the students during the analysis process of the problem and its reporting process (Yew and Schmidt, 2009). The tutors provide PBL environments for the interaction among the students by directing the group and assisting the students to determine the information they need to solve the problem (Gijselaers, 1996). Additionally, the tutors are required to make preliminary preparations before the teaching process in order to ensure that he/she shows a better performance during the learning process (Leung and Wang, 2008). In PBL, teachers have to deal with problems during the planning, application and assessment of the instruction; in other words through the whole learning process (Ertmer et al., 2009). That is why it is very important that the teachers have sufficient knowledge on the theoretical basis and applications of the PBL method. It is thought that training provided before the service related to the PBL will positively influence the utilization of this method by the pre-service science teachers in their professional career.

## Problems and purpose of the study

Today, students are expected to gain and develop different skills including problem solving, communicating, creative and critical thinking (Tarmizi, et al., 2010). Students' lifelong learning skills such as critical thinking can be developed by utilizing active and student-centered learning approaches (Carder et al., 2001). It is therefore suggested that the instructors should use the PBL method during the learning process (Murphy et al., 2010). For this reason, it is very important that the teachers have to be trained enough about the philosophy and theoretical basis of PBL before undertaking the guide role in PBL environments (Lekalakala-Mokgele, 2010). Therefore, the aim of this study is to evaluate the activities prepared by the pre-service science teachers after the training provided related to Problem Based Learning. Besides, in the study, nine of pre-service science teachers among the participants were randomly selected and their views regarding PBL method have been determined before and after the implementation of Problem Based Learning activities prepared by them. Research questions regarding the purpose of the study are expressed as

follows.

1. How do pre-service science teachers in PBL method develop the activities?
2. What are the views of pre-service science teachers regarding the influence of preparing activities and applying the prepared activities on themselves?
3. What are the general views of the pre-service science teachers regarding the PBL method before and after applying the activities they prepare?

## RELATED STUDIES

The literature related to this study can be evaluated under two groups. A part of studies consists of qualitative studies where interviews or open-ended questions related to the PBL method are used. Within the scope of these studies, some courses were conducted at the school of communication, pharmacy, medicine and nursing. The studies utilized PBL and obtained the views of the students regarding the method (Brzovic and Matz, 2009; Ellis et al., 2008; Rowan et al., 2008; Turan, Elcin et al., 2009). The students had generally expressed positive views regarding the PBL method in these studies. The PBL method was applied in junior high and high school levels and the views of the students obtained and evaluated after the application of the studies. Lou et al. (2010) examined general views of the students regarding the method after the PBL method implementations they involved with high school students. Sockalingam et al. (2010) determined the views of high school students about the role and importance of the problems at problem based learning environment. Part of the studies regarding the PBL method was conducted at the school of education at universities. In some of these studies, PBL method was used in the teachers training programs and the views of the pre-service science teachers regarding the PBL method were evaluated. Dahlgren et al. (1998) collected the views of the pre-service science teachers regarding the PBL method. Similarly, Akpınar and Ergin (2005) determined the views of the pre-service science teachers in their study by conducting the semi-structured interviews after an experimental application that used problem based learning method.

Besides, studies that examined the activities prepared by teachers or pre-service science teachers regarding different learning methods and their views are included in the literature. Ruys et al. (2012) evaluated the activities prepared by pre-service science teachers based on collaborative learning by utilizing rubrics and determining the strong and weak aspects of the pre-service science teachers during the activity preparation process. Spronken-Smith and Harland (2009) conducted another similar study with geography teachers. The teachers implemented PBL to their lessons in the study. Both experiences and the group processes of the teachers were evaluated during the study. Observation documents, course documents and voice records were used as the data collection tools by the researchers. Results showed that the majority of the teachers were pleased to perform activities related to problem based learning method. As a result, it was thought that more studies on the use of problem based learning method by pre-service science teachers will contribute to related literature.

## THE RESEARCH METHOD AND APPLICATION PROCESS

The study was designed as a case study. The implementation phase of the study was conducted in the course “New Approaches in Science Education”, a selective course at school of education in Turkey. The pre-service science teachers were primarily provided training for two weeks (four course hours) on the theoretical basics and applications of the PBL method during the implementation process of the study. The philosophy, historical background and features of the PBL were explained during the training in question. Besides this, the pre-service science teachers were provided activity samples developed by specialists related to the PBL method. Later, the pre-service science teachers were requested to prepare a PBL activity regarding the goals in a science subject they chose. The pre-service science teachers presented the activities which they prepared (two course hours) and shared those with their peers. The pre-service science teachers had made positive and negative assessments related to the activities, and a discussion environment was created during this process. 9 pre-service science teachers were randomly selected among the pre-service science teachers who participated in the implementation, and were requested to apply the activities at the schools where they were doing their internship. Researchers evaluated the activities prepared by the pre-service science teachers and then pre-service science teachers edited their activities before their implementation. Besides, semi-structured interviews were conducted with the pre-service science teachers before the implementation of the activities. Later, the pre-service science teachers applied parts of the prepared activities during the two course hours at the schools where they were doing their internship. Again, a semi-structured interview was conducted with the pre-service science teachers after the implementation and their views after the implementation were assessed. The implementation process of the study is presented in Table 1.

## FINDINGS

### *Assessment of the activities prepared by the pre-service science teachers related to the PBL method*

During the activity preparation process in the study, the pre-service science teachers were first requested to select a science subject in the science education program of the junior high schools. Later, they prepared a PBL activity related to the achievements of the subject they selected. The pre-service science teachers were asked to pay attention to issues such as the consistency with the goals, considering the class time, consistency with the student level, providing prepared activities connected with the subject. Distribution of the subjects of the activities prepared by the pre-service science teachers is presented in Table 2.

As seen in Table 2, the pre-service science teachers

**Table 1.** Research design.

| Introduction of theoretical base | Activity preparation | Before implementation/ after training | Implementation process | After the implementation |
|---|---|---|---|---|
| Introduction of theoretical base and applications regarding PBL method (4 h / 2 weeks) | Preparation and presentation of individual PBL activities (2 h / 1 week) | Semi-structured interview with 9 randomly selected pre-service science teachers | Implementation of PBL activities those developed by pre-service science teachers with junior high school students (2 h) | Semi-structured interview with nine pre-service science teachers |

**Table 2.** Frequencies and percentages of subjects in PBL activities.

| Subject | f | % | Subject | f | % |
|---|---|---|---|---|---|
| Systems in our body | 12 | 17 | Electricity | 4 | 6 |
| Power and Movement | 10 | 14 | Acid and base | 3 | 4 |
| Matter and Heat | 9 | 13 | Pressure and Levitation force | 2 | 3 |
| Human and Environment | 7 | 10 | Growth and Development | 2 | 3 |
| Particle structure of matter | 7 | 10 | Space and Universe | 1 | 2 |
| Light and Sound | 5 | 7 | Work - Energy - Power | 1 | 2 |
| Living creatures and Life | 5 | 7 | Energy sources | 1 | 2 |

**Table 3.** Frequency and percentage values of evaluation results of PBL activities prepared by pre-service science teachers.

| Evaluation criteria | Adequate | | Partially adequate | | Inadequate | |
|---|---|---|---|---|---|---|
| | f | % | f | % | f | % |
| Scenarios being written clearly in a proper language | 23 | 33.3 | 37 | 53.6 | 9 | 13 |
| Scenarios include the daily life events | 45 | 65.2 | 20 | 29 | 4 | 5.8 |
| A problem that will lead students to inquire | 37 | 53.6 | 26 | 37.7 | 6 | 8.7 |
| Scenarios do not contain phrases directly present information | 48 | 69.6 | 11 | 15.9 | 10 | 14.5 |
| Scenario is appropriate for related subject's achievements | 53 | 76.8 | 14 | 20.3 | 2 | 2.9 |
| Activities complying with students' grade level | 59 | 85.5 | 8 | 11.6 | 2 | 2.9 |
| Sessions include questions that will guide students | 60 | 87 | 5 | 7.2 | 4 | 5.8 |
| Activity's name that is intriguing and related to the subject | 43 | 62.3 | 12 | 17.4 | 14 | 20.3 |
| Scenarios in the activities that have a relationship with each other | 23 | 33.3 | 7 | 10.1 | 39 | 56.5 |

prepared activities including different subjects in the fields of physics, chemistry and biology. It is thought that the individual activities prepared by the pre-service science teachers relating to different subjects are due to their individual differences. Two specialists using an assessment form that includes definite criterions also examined the activities related to the PBL method prepared by the pre-service science teachers. The percentage and frequency values of evaluation results are presented in Table 3.

Majority of the pre-service science teachers were able to prepare appropriate activities regarding the method after the theoretical information and education provided to them. The majority of pre-service science teachers have used questions that direct students to active learning by taking into account educational goals of the subject matter, relevance to the target audience when preparing PBL activities. For example, one pre-service teacher prepared a scenario that included statements like "*Zeynep has begun to play with her sibling after she came from the school. Zeynep and her sibling have first played in a cool room with a balloon and later went over to the room with an oven. The balloon burst after they played a while. Zeynep was very surprised that this balloon, which didn't burst in the cool room, burst in the room with the oven*." related to the achievement "performing experiments and discussions on those materials will expand and shrink from the influence of heat". Another pre-service teacher used the expressions "*Competition of Light and Sound*" in the title of her activity that would attract attention of students.

The majority of the pre-service science teachers used

daily life related science events in the scenarios they prepared. For example, one pre-service teacher chose "*putting chains on tyres in snowy weather*" event, and another pre-service teacher chose the "*moulding of bread*" event for scenarios they prepared for the activities and both topics capable of attracting the attention of the students. The pre-service science teachers have used questions in order to direct the students in the phase where they might face difficulties depending on their levels. The questions *"What are your solution suggestions for environmental pollution and please provide a solution project?", "How can environmental pollution be prevented?", "What do you think could be other samples regarding the transmission of heat by radiation?", "What might be the reasons for that organ donation is not widespread?"* may be samples for the questions used by the pre-service science teachers during the activities. At the same time, the data show that some pre-service science teachers experienced difficulties in some phases during the activity preparation process. As seen in Table 3, some pre-service science teachers reported that they experienced difficulties with regard to writing clear and understandable scenarios, inclusion of events from daily life into the scenarios, determination of a problem which would constitute the base of the scenarios and directing the students to inquiry. Besides, the expressions that contained direct information were included in the activities prepared by some of pre-service science teachers. As a result, it was determined that the majority of the pre-service science teachers faced difficulties in making connections between the scenarios.

### *The evaluation of the views of the pre-service science teachers*

Randomly selected 9 pre-service science teachers applied the activities they prepared in their field of experience (teaching practice) after theoretical and applied education regarding PBL method. Semi-structured interviews were conducted with pre-service science teachers before and after the implementation. The pre-service science teachers were asked similar questions in both interviews. The interviews were evaluated under 7 categories and sample statements of the pre-service teachers were presented.

*Problems and issues in implementation process of the activities regarding the PBL method*

The pre-service science teachers were asked before the implementation "Which problems do you think you might face during the implementation process of the activities regarding the PBL method?" and after the implementation "What problems did you face during the implementation process of the activities regarding the PBL method?" Before the implementation, pre-service science teachers expressed that they might experience problems due to poor classroom management, different questions asked by the students, difficulties in determination of the problems by students, difficulties in understanding scenarios properly by students, and being novice of the method for students. After the implementation, pre-service science teachers emphasized similar problems. Besides, they stated that they did not have enough time for students to direct well and the problems they faced in creating student groups. As a result, the views of the pre-service science teachers are similar before and after their experiences.

Statements of some pre-service science teachers before the implementation:

"Maybe, I won't receive the answers I expected for the questions I asked. Maybe they are not able to find the problem when I ask for it… We might face different ideas during class where we will perform the application. We might also face non-related questions too. It might be that the students go off topic. (P1)"
"I think that I won't be able to control the class and that undesirable behaviours may arise. Because I do not fully know how to apply it. I am not sure whether I will be able to provide meaningful feedback to students. I might experience difficulties in terms of directing… (P2)"

Statements of some pre-service science teachers after the implementation:

"…The students were interested. Therefore, there was not much of a problem. But they misunderstood the question "What do we know?"… I had asked them what they knew about the subject the story was related to… (P1)""
"I experienced some difficulties in terms of class management. They could not answer some questions when I let them speak. I experienced some difficulties in guiding the students. There were three learning goals of the subject, but I was always going off the subject by directing them… (P2)"

### *The effects of preparing and applying activities related to the PBL method on the pre-service science teachers*

The pre-service science teachers were asked before the implementation, "What were the effects of preparing activities regarding the PBL method for you?" and after the implementation "What were the effects of applying the activities regarding the PBL method?" Before the implementation, the pre-service science teachers stated that they learned how to apply the method in general as a result of the problem based activity preparation process. Besides, some pre-service science teachers stated that they learned how to prepare scenarios consistent with

students' level and that they will be able to prepare activities regarding this method in the future, too. After the implementation, the pre-service science teachers stated that they gained experience regarding the implementation of the method, had the opportunity to see their failures, and learned permanently how to apply the method. As a result, during the interviews the pre-service science teachers expressed the positive effects of preparing activities and applying those in a real class setting. It can be stated that the implementation of the theoretical knowledge of the pre-service science teachers in a real class setting contributed to their knowledge and experience.

Statements of some pre-service science teachers before the implementation:

"We learned how to apply the PBL method. We learned the knowledge we need to conduct group work. We wrote scenarios to the student level. We faced some difficulties by writing the scenarios, but we overcame these. (P3)"

Statements of some pre-service science teachers after the implementation:

"I learned to perform an activity by conducting group work in a class environment. I learned how to communicate with the students. I now have an idea about how this method can be applied. (P3)"
"I was inadequate with regards to the implementation. But with this implementation I gained experience. Applying an activity I prepared was more effective for me. (P4)"

### *The positive and negative effects of the PBL method on the students according to the pre-service science teachers*

The pre-service science teachers were asked before the implementation, "What do you think about the positive and negative effects of the PBL method on the students?" and after the implementation "What were the positive and negative effects of the PBL method on the students?" The pre-service science teachers expressed only views on the positive effects of the PBL method on the students before the implementation. They stated that PBL method supported active participation, learning with fun, the development of thinking skills like problem solving, correlating science subjects with daily life, collaborative and permanent learning. After the implementation, the pre-service science teachers emphasized both the positive and the negative effects of the PBL method on the students. They stated that the method provided active participation, collaborative learning, the development of students' problem solving skills and creativity. They also stated that, it helped students drive their attention to the course and correlate daily life and science subjects. With regard to the negative effects, the pre-service science teachers stated that the method caused the students to face difficulties when answering some questions and correlating sciences with daily life; besides the students felt themselves insufficient due to the non-provision of direct knowledge.

Statements of some pre-service science teachers before the implementation:

"I don't think that it will affect the students negatively. The positive effect is that it promotes active participation. This will decrease the boringness when lecturing the theoretical courses. The lesson will be more joyful and attractive for the students. They will be able to apply those they learned in daily life... (P5)"

Statements of some pre-service science teachers after the implementation:

"The students felt insufficient because they did not know anything at the beginning since I did not provide direct information on the subject. They thought that they did not know it. This impeded the learning of the students. (P4)
"They are not able to correlate science with daily life even if they find the problem. This is because there are many terms in science and we are always providing education towards memorizing. The students cannot transfer what they learn (P6)".

### *Techniques used together with the PBL method*

The pre-service science teachers were asked before and after the implementation "Which learning methods and techniques do you think might be used together with the PBL method? And why?" The pre-service science teachers stated before and after the implementation that the PBL method might be supported by the question-answer, direct instruction, experiment, brain storming and discussion techniques. After the implementation, the pre-service science teachers stated their views with details with providing reasons based on their experiences. Besides, they noted that visual materials such as concept cartoons and brain maps could be used together with the PBL method.

Statements of some pre-service science teachers before the implementation:

"….There is no doubt that direct instruction needs to be used in order to explain the sample event. Later the question-answer and discussion methods can be used. (P2)"
"The experiment method can be used. Case based learning can be used. The question-answer and direct instruction method can also. (P3)"

Statements of some pre-service science teachers after the implementation:

"I think that the students can perform brain storming by techniques such as mind maps in the PBL method. The PBL method can be used faster and more efficient by allowing students to express their views verbally or draw them.. (P2)"
"Experiments can be used together with this method. For example, the students may be requested to perform experiments in a group collaboratively. (P3)"

***The desire regarding the utilization of the PBL method in the professional life as a teacher***

The pre-service science teachers were asked before and after the implementation "Would you like to use the PBL method in your professional life and why?" The pre-service science teachers stated before and after the implementation that they would like to use the PBL method in their professional life. When they were asked for the reasons of their answers, they commonly justified this with the positive effects of the method on the students. They also stated that the PBL method is a joyful, engaging, daily life related method and supports retention of learning.

Statements of some pre-service science teachers before the implementation:

"We will always need to provide examples from daily life during the instruction when we get teachers. This is a suitable method that we can use. This would improve learning retention and grab their attention. (P6)"
"Yes, I would. That is because it provides retention of learning. It may attract the interest and attention of the students. That is because we provide them a different and interesting scenario. They think on it. (P9)"

Statements of some pre-service science teachers after the implementation:

"Yes, I would like to use this method in my professional life. It was good to divide the class into groups because it was more efficient than the other way. I was able to learn what the students knew thanks to this method before instruction. (P3)"

***Limitations of the PBL method***

The pre-service science teachers were asked before and after the implementation "What do you think are the limitations of the use of the PBL method during the learning process?" The pre-service science teachers stated before and after the implementation similar views regarding limitations of the method. They stated that the PBL method is not compatible with every science subject and that it is difficult to prepare activities in accordance with learning goals. Besides, they stated that the classroom management might constitute a problem during the implementation of the method, particularly in crowded classes, that the students might face difficulties on conducting group work. According to the pre-service science teachers, poor time management, failure to ensure active participation of all students, inability of the students to transfer what they learn to daily life are the limitations of the method.

Statements of some pre-service science teachers before the implementation:

"It might be difficult to prepare an activity according to the learning goals. Not every method is suitable for every learning goal. (P7)"

Statements of some pre-service science teachers after the implementation:

"I think that it will not be applicable to many subjects. We might face difficulties when finding events from daily life for every subject. These might be the limitations. (P7)"
"In my opinion, the limitation of this method is generating stories based on the given time and the learning goal. (P8)"

***Difficult stages for the students in the PBL environment***

The pre-service science teachers were asked before the implementation "At which stages of the PBL method do you think students might face difficulties? Why?" and after the implementation "At which stages of the PBL method did the students face difficulties? Why?" Before and after the implementation the pre-service science teachers stated that the junior high school students might face difficulties at revealing their knowledge, determining the problem, researching and solving the problem. They provided different answers to the related questions since they have different experiences and qualifications. They stated that retention of the students, who faced difficulties when remembering their existing knowledge, was not sufficient or that they did not have sufficient pre-knowledge. In addition, they noted that some students faced difficulties when solving the problem since they had encountered such a method for the first time.

Statements of some pre-service science teachers before the implementation:

"I think that they will face difficulties at solving problems. They need to understand the case very well. Everyone has a different perspective on the events... In addition, everyone interprets the events from his own perspective. That is why students might face problems. (P1)"
"I think that they will face difficulties at solving problems. They need to think creative at this stage. They might face difficulties at using the knowledge they gain for the

**Table 4.** Positive and negative views of the pre-service science teachers related to the Problem Based Learning method before and after the implementation.

| | Before the implementation | After the implementation |
|---|---|---|
| **Positive Views** | Active participation, faster learning, learning by experience, joyful learning, correlating with daily life, developing thinking skills, attracting attention, increasing motivation, facilitating learning, retention of learning (f=10) | Attracting attention, learning collaborative working, ability to share views, ability to state views, development of the problem solving skills, better learning, ability to access information, faster learning, correlating with daily life, ability to determine the problem, development of the creative thinking skills (f=11) |
| **Negative Views** | Pre-knowledge deficits, failure to transfer what was learned to daily life, not being suitable for every subject, difficulty to prepare activities, classroom management deficiencies, inefficiency in crowded classes, failure to ensure the participation of all students (f=7) | Inability to correlate with daily life, difficulty at determining the problem, unwillingness of students, inefficiency in crowded classes, not being suitable for every subject, time management deficiencies, class management difficulty, difficulty at grabbing the attention of the students, failure to control the group work (f=10) |

solution of the problem. Besides this, the students may get stuck on the process and not think creatively enough since they are having all the courses in the same manner.(P5)"

Statements of some pre-service science teachers after the implementation:

"They only faced difficulties when the question 'What do we know?' was asked. Actually, I expected that they would face difficulties when determining the problems. Contrary, they did not face any difficulties. They even correlated the story in the sample event with the subject very easily, and were able to say what the subjects were. (P1)"

As a result, it was determined that the pre-service science teachers had both positive and negative views related to the PBL method before and after the implementation of the activities that they had prepared. In order to make the results understandable, the before and after the implementation positive and negative views of the pre-service science teachers related to the PBL method during the interviews are presented and summarized in Table 4.

## DISCUSSION

The PBL method that presents a problem from daily life in interesting scenarios is one of the active learning methods that can be used in science education. There are many factors influencing utilization of the PBL method in learning environments (Chan, 2009a). The course planning and application are main competencies of the teachers regarding the PBL method. In this study, pre-service science teachers have prepared PBL activities regarding the different science subjects they chose. The majority of the activities prepared by the pre-service science teachers were consistent with the learning goals of the subject they chose and included events from daily life. It can be stated that pre-service science teachers used what they learned theoretically in course planning activities they participated in. Therefore, course planning by using different learning methods and techniques deem to be an important issue in teacher education (Tanni, 2012). Discussion on course plans developed by the pre-service science teachers themselves provides them an opportunity to think about the validity of their educational decisions (Ruys et al., 2012). Lee and Bae (2008) noted that teacher education programmes are required to give more importance to practical knowledge related to design and application of course plan rather than only the knowledge related to method.

In this study, after the theoretical and practical training on the PBL method, randomly selected pre-service teachers were requested to use activities prepared in their field experience. Semi-structured interviews were conducted with the pre-service science teachers before and after the implementation. There are some studies referring to more positive views of students after an education was performed related to PBL method (Akpınar and Ergin, 2005; Brzovic and Matz, 2009; Dahlgren et al., 1998; Lou et al., 2010; Rowan et al., 2008). In this study, pre-service science teachers presented both positive and negative views regarding the method before and after the implementation. Therefore, it is thought that the planning of activity and implementation process contributed to the pre-service science teachers in assessing of the method from different perspectives. Ruys et al. (2012) have noted in their study that the pre-service science teachers are able to make assessments about the relations and differences between the course plans and the class applications. Some findings draw attention when the

views of the pre-service science teachers before and after the implementation are examined in detail. The pre-service science teachers stated before and after the implementation that they may encounter problems due to poor classroom management, off topic questions forwarded by the students, students' failure to determine the problem, students' failure to understand scenarios sufficiently, students' novelty of the method. Differently, the pre-service science teachers have mentioned after the implementation the insufficiency of time, failure to lead the students well and the problems they encountered when creating student groups. Park and Ertmer (2008) determined in their study that lack of knowledge and skill constitutes an important limitation for the implementation of the PBL method by the teachers. Therefore, it is thought that the problems in question are because the pre-service science teachers do not have sufficient experience. But student teachers engage field experiences in limited time and definite periods in the teacher training. Kablan (2012) noted that the theoretical and applied activities for the pre-service science teachers on course plan preparing need to be increased in courses conducted in schools of education. Besides, studies conducted in order to create a program in school-university collaborations for the purpose of bridging theory and application at the teacher educational programs can contribute to the solution of this problem (Allen et al., 2010).

Problem Based Learning requires the tutor to make preparation and study before the education process in order to provide better learning (Leung and Wang, 2008). In this study, the pre-service science teachers stated before the implementation that they learned how to write appropriate scenarios according to the student level by the end of the problem based activity preparation training and that they will be able to prepare activities related to this method in future, too. In addition, after the application, they stated that they had enough experience related to utilization of method, that they realized their mistakes and they learned how to utilize the method permanently. In a similar study, Sağ (2010) found that the perception of self-efficacy beliefs of the pre-service science teachers in the experiment group which have developed activities and conducted applications were higher than control group by the end of the application. It can be said that the application of the theoretical knowledge learned by the pre-service science teachers in a real learning setting contributes to the increasing of their experience and self-efficacy.

The pre-service science teachers have mentioned in the interviews the effects of the PBL method on the students. The pre-service science teachers stated prior to the implementation that the PBL can provide active participation, learning with fun, development of thinking skills such as problem solving, correlation of science issues with daily life, collaborative learning and retention. In addition, PBL method can be used to develop critical thinking, creativity and self-managed learning (Chan, 2009b). Similar to the views of the pre-service science teachers, in their study, Herron and Major (2004) analysed the student views on PBL and they found that, PBL method provides active participation of the students, develops their skills such as problem solving, researching and collaborating. The pre-service science teachers, who emphasized only the positive aspects of the method before the implementation, mentioned both positive and negative effects of the method on the students after the implementation. The pre-service science teachers noted that the method caused the students to face difficulties when answering questions and correlating sciences with daily life. Furthermore they realized that the students felt insufficient due to the non-provision of direct information. Learning process starts based on their existing knowledge since the students are not given the opportunity to prepare themselves for the problem in the PBL environment (Yew and Schmidt, 2009). The tutors both assist the discussion of the students, and even if rarely, explain the terms they are not able to explain during the Problem Based Learning process (Charlin et al., 1998).

The main purpose of the PBL method is to support the students for acquiring information related to the problem and using the acquired information at the solution of the problem (Williams et al., 2008). The pre-service science teachers think that the students will not be able to learn when they are not provided direct information and face difficulties. For this reason, it can be stated that pre-service science teachers have some misconceptions regarding the application process of the active learning methods. Furthermore, Cheng et al. (2014) have determined in their study that the primary science teachers have misconceptions regarding inquiry based learning and that they faced problems by implementing the method in the class.

The pre-service science teachers noted before and after the implementation that the PBL method could be supported with the question-answer, direct instruction, experiment, brain storming, concept cartoons, mind maps and discussion techniques. In addition, there are many studies aiming to support PBL method with different methods, techniques and environments in order to use PBL method in higher education more effectively and make the method more functional for the students at younger ages. In these studies, problem based learning supported with computer (Belland, 2010; Chang, 2001; Ertmer et al., 2009; Lehti and Lehtinen, 2005); concept maps (Hsu, 2004; Johnstone and Otis, 2006); simulations (Ioannou et al., 2009) and their effects were investigated on students from different educational levels. It is thought that the preparation and application of course plans by the pre-service science teachers contribute to their skills with regard to use of the different instructional methods together and enrich the learning environment.

## Conclusion

Most of the pre-service science teachers who participated

in the study prepared the activities regarding problem based learning method consistent with the learning goals of the subject they chose and most of the activities included events from daily life. The pre-service science teachers stated before and after the implementation that they want to use the PBL method in their professional life. When the pre-service science teachers were asked for the reasons of their answers, they commonly justified this with the positive effects of the method on the students. However, the pre-service science teachers stated that the PBL method is not suitable for all science subjects and that it is difficult to prepare an appropriate activity related to learning goals. Besides, the pre-service science teachers expressed that the classroom management might constitute a problem during the application of the method, particularly in crowded classes, that the students might face difficulties at conducting group work. The pre-service science teachers expressed that poor time management, failure to ensure participation of all students to the course, students' failure to transfer the newly learned information to daily life as the limitations of the method. In addition, Lekalakala-Mokgele (2010) noted that the tutor might face difficulties when controlling the class and be afraid of losing the control in Problem Based Learning environments. According to Spronken-Smith and Harland (2009) there are two main discussions in PBL environments; a) power to control of the teachers on the learning activities and b) when and how to make interventions. It was noted in the same study that teachers mentioned the difficulties of learning activities in their views. In addition, Ertmer et al. (2009) pointed out the problems that might be encountered during the planning, implementation and evaluation process in PBL applications and offered solutions to those problems. Therefore, when taken into consideration the studies in question it is possible to say that the respective views of the pre-service science teachers are an expected result of the study. Besides, the pre-service science teachers have expressed in the study before and after the application that the junior high school students might experience difficulties when revealing their existing knowledge, determining the problem, conducting research and solving the problem during the PBL process. Individual differences and life experiences of each learner influence the PBL method, since it is a real life based learning method (Wang et al., 2008). It is thought that the pre-service science teachers have provided different answers to the related questions since their personal experiences and competencies showed different features and the students had individual differences

## Suggestions

The suggestions are presented based on the results obtained in the study in order to increase the utilization of the PBL method in science learning:

1. The PBL method is one of the active learning methods. Theoretical courses on how the active learning methods could be applied are frequently provided in the teacher training programs. In addition to theoretical courses these programs may contain applied courses including activities regarding the preparation of course plans and application of these plans in small student groups.
2. Field experiences may be performed at different grade levels during the teacher's education in order to ensure that the pre-service science teachers gain more experience.
3. It can be stated that the pre-service science teachers have some misconceptions regarding the application process of the PBL method even after the education provided to them. These misconceptions are commonly related to the implementation of the active learning methods. Therefore, future studies may focus on determination and elimination of the delusions of the pre-service science teachers related to the implementation of the active learning methods.
4. Pre-service science teachers should be trained on the techniques using together with the PBL method in order to use the method more efficiently in their professional life as a teacher.
5. The pre-service science teachers have mentioned some limitations of the PBL method. Therefore, future studies may focus on investigation of possible issues in utilization of the PBL method with students at different grades and suggestions on solving these issues.

## Conflict of Interests

The author has not declared any conflicts of interest.

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