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Suitability of Problem Scenarios Developed by Pre-service Teacher Candidates to Problem-Based Learning Approach

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ARTICLE INFO	ABSTRACT
	Purpose: The most important element in Problem-Based Learning (PBL) that has a significant place in science education is the structure of the problem. Even though it seems easy to formulate the problem that is suitable for this approach at first glance, it is rather difficult to find the problem that will meet the purposes of education. When hardship in developing problem scenarios suitable to the approach and the significance of approach in science education are taken into consideration, the quality of scenarios that teachers will use gain importance.

For this purpose, studies were conducted during this study with pre-service teacher candidates in order to develop problem scenarios that are suitable with PBL approach, and the extent to which these scenarios reflect the characteristics expected from the approach were examined.

Method: In the study conducted with 24 pre-service teacher candidates who took Science and Technology Teaching course in the 2018-2019 academic year, "characteristics that a problem should contain" scale was used for the problem situations developed in PBL.

Findings: The findings put forward that the pre-service teacher candidates were successful in preparing daily life scenarios that were appropriate to their course achievements, but they should have included more expressions in these scenarios that would allow students to think, synthesize their knowledge and develop their creativity skills.

Implications for Research and Practice: Based on the findings, it can be suggested that pre-service teacher candidates' understanding of PBL approach through experience can make a significant contribution to reflecting this approach more accurately in their professional lives; and therefore, such practices should be applied more.

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Introduction

With the unprecedented scientific and technological advancement, the changing needs of societies make it necessary to educate individuals who can adapt and contribute to this advancement (Oztemel, 2018). In this context, innovations in education became inevitable, and some changes were made in the curriculum. The newly developed curriculum is structured on new approaches, and the importance of these approaches is emphasized frequently. In this context, when the Science Curriculum that has been renewed periodically since 2000 and updated recently in 2018 is taken into consideration, it is seen that the research-inquiry-based learning strategy is adopted, through which the student is responsible for his/her self-learning, participates in the learning process actively, structures the information in his/her mind (Ministry of National Education [MoNE], 2018). It is also reported that the same program aims to educate science-literate individuals who research-inquire, can make effective decisions, solve problems, are confident, are open to cooperation, can communicate effectively, and are lifelong learners with the awareness of sustainable development. One of the student-centered teaching approaches that are effective in achieving these goals is problem-based learning.

Problem-based learning (PBL) is defined as the learning approach in which students try to solve real-life or real-like problems taken from daily life in cooperative learning environments (Barrows & Tamblyn, 1980; Newstetter, 2006; Senocak & Taskesenligil, 2005). Problem situations related to the concepts are developed in this approach without working on the subject to be taught, and students are asked to bring in solutions to this problem situation. In short, contrary to the traditional approach, the student is not expected to come up with the solution to the problem after the information is given by the teacher (Senocak & Taskesenligil, 2005). With this characteristic, PBL can be defined as the approach where "first learning is the problem" (Pepper, 2013). Therefore, it can be suggested that the problem situation to be developed is the most important step in the implementation of the approach. When the characteristics of the problems used in science courses are examined based on this significance, the information that is briefly explained below is reached.

Problems used in science courses are examined under two headings of "structure" and "content". Problems are divided into two groups according to their structure as structured (ordinary) and unstructured (unordinary) (Kizilcik, 2012). Structured problems are the ones where the introduction and purpose situation are clearly defined, and there is only one correct answer. One can achieve the correct answer through one or more numerical operations. In such kind of problems, students reach the answers of questions with the help of the formulas they have memorized without having the need to think in-depth and make interpretations (Lin, Chiu & Chou, 2004; Nakhleh & Mitchell, 1993); therefore, such problems do not contribute to the development of the problem-solving competencies of students (Jonassen, 2003). Structured problem types are not suitable for PBL approach because of this characteristic (Kizilcik, 2012). The type of problems that are called unstructured or real-life problems include complex situations that are encountered in daily life and do not have a clear and single solution (Saka, 2008; Uyeda, Madden, Brigham, Luft &

Washburne, 2002). The purpose of solving such kind of problems is to develop the skills of understanding the nature and logic of the problem, selecting and using the appropriate strategy, and interpreting the results (Altun, 2000). When solving such problems where, in general, a clear definition is not made (Lohman & Finkelstein, 2000) it may often be necessary to use more than one discipline to reach the solution. The problems that need to be used in PBL approach are these types of problems (Kizilcik, 2012).

When examined in terms of content and solutions, the problems used in science courses are categorized in four different levels. These levels can be summarized in Table 1.

Table 1.

Problems According to Content and Solutions (Kizilcik, 2012)

Problem Level	Problem Content	Solution	Situation Encountered
1. Level	Familiar for the student.	Familiar for the student.	Familiar for the student.
2. Level	New for the student.	Familiar for the student.	Familiar for the student.
3. Level	Familiar for the student.	Familiar for the student.	New for the student.
4. Level	New for the student.	New for the student.	New for the student.

When we examine Table 1, we may suggest that the students do not learn a new solution or gain new knowledge with the solution of the problems at the first level, they only reinforce the content and the solution. For the problem types at the second level, a familiar solution is used, although the content of the problem is new for the student; therefore, the problems at this level serve the students only to reinforce the solution. For the problem types at the third level, students are expected to adapt the solution they know to new situations. For the problem types at the last level, with the guidance and tips of the teacher, students will be able to find the appropriate solution strategy and solution with their own efforts because the problem's content, solution and situation encountered are completely new to them. When all the problem levels are taken into consideration, it can be claimed that the problems at the first and second levels do not allow students to discover a new solution and are not suitable for the PBL approach from this aspect. Problems at the third level are widely used in education (Unsal, 2006). The most appropriate problem level for PBL approach is the fourth level because it offers new content and solution.

As we can understand from the above explanations, the key element in the PBL approach is the structure of the problem (Goodnough, 2003). Even though it seems easy to formulate the problem at first glance, it is rather difficult to find a real-life problem that will meet the purposes of education (Shepherd & Cosriff, 1998). Because only a well-prepared problem scenario will help students in making judgments on the given information and asking questions to formulate their ideas (Wang, Cox,

Thompson, Shuler, 1998). Scenarios should be prepared in such a way that will attract the interest of students, be relevant to real life, and should not be very difficult or very complicated. Moreover, in these scenarios students should be given the opportunity to determine their current information and the information they need to know, and to learn how, where and through which method they can obtain such information (Karaca, 2014; Keles, 2015). Taking into consideration all the information described above, it can be suggested that a problem in PBL approach should have the following characteristics (Baysal, 2005):

- It should be based on the interests, individual needs, values, experiences, facts, cultures, and backgrounds of the students.

- The program should overlap with its objectives.

- It should ensure the acquisition of skills.

- It should be suitable to unite around disciplines.

- It should contain important concepts that can be reflected upon.

- It should be suitable for students to communicate with the community.

- It should be able to have the students comprehend the meaning of relationships in life with what is learned at school.

- It should challenge the students to think at a higher level, to be creative and to make a better synthesis of knowledge.

- It should be well structured and answers should not be given.

- It must be open-ended.

- It should reflect real life as much as possible.

During the implementation of the approach, the students should take their responsibilities in the collaborative work environments, examine the issue in-depth, collect information, make recommendations about the solution of the problem and prepare a report for the solution and share it with his/her friends. It is believed that students, who reach the basis of information by learning themselves during the process starting from defining the problem to sharing the solutions (Hmelo-Silver, 2004; Keles, 2015) can learn to learn and develop research, critical thinking and problem-solving skills (Jones, 2006; Murray-Harvery, Curtis, Cattley & Slee, 2005; Yaman & Yalcin, 2005). Based on this information, it can be suggested that using PBL approach in science courses can contribute to the education of science-literate individuals that are targeted in the programs. In this context, teachers who will be the implementers of the approach should be able to comprehend the approach and gain experiences to reflect on their professional lives.

The focus of the professional development of teachers is for them to gain experience on how to teach and how to turn their knowledge into practice for the development of students (Avalos, 2011). Nevertheless, in previous studies, the effect

of PBL approach applied in science courses on academic achievement (Aidoo, Boateng, Kissi & Ofori, 2016; Ayaz, 2015; Cayan & Karsli, 2015; Etiubon & Ugwu, 2016; Horak & Galluzzo, 2017) or on conceptual change (Loyens, Jones, Mikkers & Gog, 2015; Oktarisa, Utami & Denny, 2017) are sought, but there were no studies on the scenarios developed by teacher candidates. It is evident that the characteristics of the problem scenarios developed in the implementation of the approach are important (Baysal, 2005; Selcuk & Sahin, 2008), and it is clear that there is a need for studies on the characteristics of the problem scenarios developed by teacher candidates.

For the reason that the PBL approach can be used at all teaching levels, the first implementers of this approach will be pre-service teacher candidates, and the elementary school students will be able to gain the ability to make research for the first time in their education according to the problem scenarios developed by their teachers. For this reason, the quality of problem scenarios developed by pre-service teacher candidates is important and teachers can only gain this knowledge and experience during their undergraduate education. Based on all these reasons, problem scenario and research question writing studies that are suitable to PBL approach were conducted in this study with pre-service teacher candidates, and the suitability of these scenarios to the approach was determined. Answer to the following research question was sought for this purpose:

- To what extent do the problem scenarios and research questions developed by pre-service teacher candidates on the basis of PBL approach reflect the expected characteristics of the approach?

Method

Within the scope of this research, quality of the problem scenarios and research questions developed by pre-service teacher candidates on the basis of PBL approach were determined. For this purpose, the ratio of meeting the expected characteristics of the approach of the problem scenarios and research questions developed were examined, and the frequency percentage values of each characteristic were calculated. For these calculations, a qualitative research method was used.

Participants

The participants of the study consisted of 3rd-grade students who were studying at the Department of Classroom Teaching in the Department of Basic Education of the Faculty of Educational Sciences of a major public university located in Ankara, and who took Science and Technology Teaching I course in the 2018-2019 academic year. Of the 41 pre-service teacher candidates, 24 volunteered to participate in the research, and the study was conducted after obtaining the written approval forms from all participants. 21 pre-service teacher candidates were female and 3 were male.

Data Collection Process

In this process, firstly, to help for the comprehension of the PBL approach general information about the content, implementation, advantages, and disadvantages of the approach was given in a three-hours session in the Science and Technology teaching

course. In the following class, the pre-service teacher candidates were asked to write a problem scenario that is suitable to the approach. The researcher determined the outcome, and some visuals were used for guidance because the candidates did not have any experience on this topic. For this purpose, the "Makes inferences about the convergence and divergence of a sound source and its location by using the sense of hearing" outcome, which was selected from the primary school 3rd-grade science program, was given, and the information "Ali and his mother are driving down the road. Meanwhile, they hear the sirens of a police car and an ambulance. The horn sound of a car is mixed with the sirens," was provided. In the meantime, images of an ambulance, a police car, a driver sounding the horn and a car were projected on the board. They were told that they could use this information and images if they wanted, or they could fictionalize another scenario to their liking. In this process, all candidates worked individually. Scenarios developed by the candidates were read in the classroom, and the whole class discussed their suitability for the approach. In the following week, "moving and stopping objects" topic was selected from the program, the candidates were given the outcomes "Discovers by experiencing that pushing and pulling is a force" and "Observes the effects of pushing and pulling forces on moving and stable objects and explains the concept of force', and were asked to develop a problem scenario and appropriate research questions. This time, except for the outcome, information or an image was not provided. Scenarios and questions developed by the candidates were read in the classroom and the extent to which they reflect the expected characteristics of the approach were discussed. Following the practices in the course, the candidates were announced that they would be asked to develop a problem scenario within the scope of research and that volunteers could participate in this study. After obtaining the written consent forms from 24 volunteer pre-service teacher candidates, the candidates selected the outcome(s) from the Science Teaching Program to their liking and were assigned to develop the appropriate problem scenario and research question(s).

In the selection of the gains, the candidates were allowed to choose any of the 3rd through 8th-grade subjects without being limited to the 3rd and 4th-grade subjects. In this way, the diversity of subjects were increased and the candidates were given the opportunity to look at the science subjects that they will teach in their professional lives in a broader perspective and to gain experience in determining the outcome(s) in which the PBL approach can be applied most effectively. Written assignments taken from the pre-service teacher candidates were used as research data. All this process was conducted over a 5-week period.

Data Analysis

In this study, the characteristics of the problem were based on to determine the extent to which the problem scenarios developed by pre-service teacher candidates reflect the characteristics expected from the approach. For this purpose, "characteristics that a problem should contain" scale, which was expressed by Armstrong, (1998); Delisle, (1997); Torp and Sage, (1998) and Shepherd and Cosriff (1998) and developed by Baysal (2005) for the problem situations developed in PBL, was used. However, it was tried to determine within the scope of this research how

the teacher candidates would apply PBL approach in the classes, in addition to developing a problem scenario that was suitable for this approach. The researcher developed a new scale by taking into consideration the suitability of the problem scenarios, which were developed to serve this purpose, to the outcomes and whether or not the suitable questions were determined for the research of the students (Kaptan & Korkmaz, 2001). This scale was applied for the first time to 33 students who took the same course in the 2017-2018 academic-year, and the data obtained were evaluated and used for this research. The opinions of two experts in the science education field were obtained for the content validity of the scale, and both the researcher and another expert examined each item during the pilot implementation for reliability. The problem situations examined by the experts were evaluated in terms of whether or not they included the qualification in question and the reliability coefficient among the experts was calculated. This coefficient was found to be 0.83 and was used in this study without making any changes on the scale. Characteristics contained in the scale are provided in Table 2.

Table 2.

Suitability of Problem Scenarios and Research Questions Developed by Pre-Service Teacher Candidates to The Approach

Necessary Characteristics for the Implementation of Problem-Based Learning Approach	Yes	Partially	No
It is based on the interests, individual needs, values, experiences, facts, cultures, and backgrounds of the students.			
It contains important concepts that can be reflected upon.			
It is suitable for students to communicate with the community.			
It can have the students comprehend the meaning of relationships in life with what is learned at school.			
It encourages students to think, be creative and synthesize their knowledge.			
It is open-ended.			
It reflects real life.			
It has been developed in accordance with the science course gain(s).			
Suitable research questions were determined at the end of the problem scenario.			

In the analysis of the data, the problem scenarios and research questions, which were developed by pre-service teacher candidates and suitable to PBL, were examined, and frequency and percentage values were calculated for each characteristic. The problem development levels of the candidates were determined according to these values.

Results

In this section, firstly examples of some problem scenarios and research questions were given and evaluation procedure was demonstrated. In the selection of the scenarios, primarily the problem characteristics that were suitable to PBL approach were taken as the basis, and a ranking was made from the scenario that demonstrated these characteristics the least to the scenario that demonstrated the most. Afterwards, scenarios from different levels were selected by taking into consideration class levels. The examples provided below were ranked from the lesser ones to the ones more in quantity in terms of problem characteristics that are suitable to the approach, and the class levels were indicated by the outcome number (the first number given in the outcome indicates the class level and the second number indicates the number of units). The scenarios were coded with the first letter of the names and last names of pre-service teacher candidates.

Example 1:   Gain: 5.6.2.1. Expresses the importance of interaction between human and the environment.

5.6.2.2. The negative effects of environmental pollution on human health are mentioned.

Problem Scenario

Hasan and his family visited his grandparents living in the village. Hasan was very curious about the new factory built in the village that his grandfather told about. Just like they do whenever they go to the village, Hasan and his family got up early in the morning and started preparing for a picnic. When Hasan went to the chicken coop to collect eggs, he realized that the chickens did not look as healthy as they did before. When they completed the preparations and went for a picnic, they noticed that the river bed smelled very bad, but in the old days, it was very pure and clean. All this did not make any sense to Hasan. He decided to ask his grandfather the reasons. Hasan's grandfather said that since the factory was built, not only there were some problems with the chickens and river bed, but also he started to face some health problems. (A. D.)

Questions

1) Why do you think the chickens looked unhealthy?

2) What may be the reasons that the river bed smells bad?

3) Why do you think all these problems emerged after the factory was built?

4) What do you think the negative situations in this story are?

5) Why do you think Hasan's grandfather started to face health problems?

Table 3.

Suitability of Problem Scenarios and Research Questions for Example 1

Necessary Characteristics for the Implementation of Problem-Based Learning Approach	Yes	Partially	No
It is based on the interests, individual needs, values, experiences, facts, cultures, and backgrounds of the students.	✓		
It contains important concepts that can be reflected upon.		✓	
It is suitable for students to communicate with the community.	✓		
It can have the students comprehend the meaning of relationships in life with what is learned at school.	✓		
It encourages students to think, be creative and synthesize their knowledge.		✓	
It is open-ended.			✓
It reflects real life.	✓		
It has been developed in accordance with the science course gain(s).	✓		
Suitable research questions were determined at the end of the problem scenario.			✓

Example 2:   Gain: 4.5.5.1. Questions the reasons for noise pollution.

4.5.5.2. Explains the negative effects of noise pollution on human health and the environment.

4.5.5.3. Creates solutions to reduce noise pollution.

Problem Scenario

Ahmet started to practice days before for the preliminary examination of the contest that would be held among primary schools. If he passed the examination, he would represent his school in the district. At the time of examination, Ahmet was ready with his pencil and eraser and was waiting for the exam papers to be distributed. Meanwhile, there was a noise that disturbed all the class and Ahmet looked in the direction where the noise came from. The sound of the construction vehicles, the car horns, the sound of an announcement through a vendor's megaphone were all mixed. Meanwhile, the examiner began to speak and Ahmet could not hear some of the examiner's words. After some time, the examiner said that the exam was over and collected the papers while Ahmet was solving the questions on his exam paper. Ahmet could not pass the exam because he could not answer all the questions. (T. H.)

Questions

1) Why could not Ahmet hear what the examiner told?

2) What are the reasons of noise pollution in the exam place?

3) What kind of solutions can we find to reduce noise pollution? Please share your recommendations with your friends.

4) Did you also encounter some incidents that caused noise pollution? If so, what were those incidents?

5) What solutions did you find to those incidents you encountered? If you did not encounter any such incidents, please answer as if you encountered it.

Table 4.

Suitability of Problem Scenarios and Research Questions for Example 2

Necessary Characteristics for the Implementation of Problem-Based Learning Approach	Yes	Partially	No
It is based on the interests, individual needs, values, experiences, facts, cultures, and backgrounds of the students.	✓		
It contains important concepts that can be reflected upon.		✓	
It is suitable for students to communicate with the community.	✓		
It can have the students comprehend the meaning of relationships in life with what is learned at school.	✓		
It encourages students to think, be creative and synthesize their knowledge.		✓	
It is open-ended.		✓	
It reflects real life.	✓		
It has been developed in accordance with the science course gain(s).	✓		
Suitable research questions were determined at the end of the problem scenario.		✓	

Example 3: Gain: 4.2.1.4. Associates human health with balanced nutrition.

4.4.1.5.The relationship between obesity and eating habit is emphasized. Prevention of food waste is emphasized.

Problem Scenario

Every day Ali's parents prepared different kinds of healthy food for him to eat at school and put them in his school bag. However, at the feeding time Ali would not eat the healthy food he brought from home, but bought unhealthy food such as chocolate, candies and fruit juice from the canteen. He would also put his food secretly next to a tree at school. When Ali came home, he would not want to eat dinner, and always wanted foods such as chocolate and candy. Ali would get tired very quickly during the day and could not concentrate on his lessons. After a while, some changes began to occur in Ali's body. This situation also attracted the attention of his family. They began to observe what Ali ate and decided to go to the doctor. (G. S.)

Questions:

1) What would you eat during the feeding time if you were in Ali's shoes?

2) What do you eat at the feeding time? What kind of nutrition habits do you have?

3) Did you ever eat candy and chocolate too often like Ali? If so, how did you deal with this situation?

4) Do you think Ali's nutrition is appropriate? What do you think Ali should do to improve his health problems and nutrition?

5) What do you think Ali should have done with the foods he didn't eat?

Table 5.

Suitability of Problem Scenarios and Research Questions for Example 3

Necessary Characteristics for the Implementation of Problem-Based Learning Approach	Yes	Partially	No
It is based on the interests, individual needs, values, experiences, facts, cultures, and backgrounds of the students.	✓		
It contains important concepts that can be reflected upon.	✓		
It is suitable for students to communicate with the community.	✓		
It can have the students comprehend the meaning of relationships in life with what is learned at school.	✓		
It encourages students to think, be creative and synthesize their knowledge.		✓	
It is open-ended.		✓	
It reflects real life.	✓		
It has been developed in accordance with the science course gain(s).	✓		
Suitable research questions were determined at the end of the problem scenario.		✓	

Example 4:   Gain: 7.7.3.4. Expresses the causes of space pollution and predicts the possible consequences of this pollution.

Problem Scenario

It was 10 days to the last day of school. Oguz and his cousins started planning for the holiday. It was very important for them to learn about the weather forecast, as they would stay in the tent. Oguz wanted to learn how the weather would be for the region they were thinking of going to, but somehow could not reach any information. He thought that there was an Internet outage and left his research for later. After a few days, he searched for the weather forecast again, but could not reach any information. Oguz knew that there was no problem with the Internet and wondered the reason for this situation. In the meantime, news in the newspaper attracted his attention. The

newspaper wrote that a spacecraft completing its mission in space hit a meteorological satellite in the orbit of the world. (Ş. U.)

 Question:

According to this, what would the consequences of space pollution be?

Table 6.

Suitability of Problem Scenarios and Research Questions for Example 4

Necessary Characteristics for the Implementation of Problem-Based Learning Approach	Yes	Partially	No
It is based on the interests, individual needs, values, experiences, facts, cultures, and backgrounds of the students.	✓		
It contains important concepts that can be reflected upon.	✓		
It is suitable for students to communicate with the community.	✓		
It can have the students comprehend the meaning of relationships in life with what is learned at school.	✓		
It encourages students to think, be creative and synthesize their knowledge.	✓		
It is open-ended.	✓		
It reflects real life.	✓		
It has been developed in accordance with the science course gain(s).	✓		
Suitable research questions were determined at the end of the problem scenario.		✓	

Example 5:   Gain: 4.5.3.1. Questions the reasons for light pollution.

                     4.5.3.2. Explains the negative effects of light pollution on natural life and the observation of heavenly bodies in space.

                  4.5.3.3. Creates solutions to reduce light pollution.

Problem Scenario

Omer went up to the roof of their house to watch the stars in the sky. But he could not see the stars even though he went to the attic. Then, he asked his parents to go to the beach to watch the stars and they all went. But Omer could not see the stars there either. On the way home, he saw baby Caretta Carettas swimming towards the most enlightened part of the beach with city lights where there were too many glass bottles. Omer was very upset about these little poor turtles. (K. Y.)

Questions

1) Why do you think Omer could not see the stars in the attic?

2) Why do you think Omer is upset for the little turtles?

3) What do you think attracted the turtles to the city side?

4) What do you think the negative situations in this story are?

Table 7.

Suitability of Problem Scenarios and Research Questions for Example 5

Necessary Characteristics for the Implementation of Problem-Based Learning Approach	Yes	Partially	No
It is based on the interests, individual needs, values, experiences, facts, cultures, and backgrounds of the students.	✓		
It contains important concepts that can be reflected upon.	✓		
It is suitable for students to communicate with the community.	✓		
It can have the students comprehend the meaning of relationships in life with what is learned at school.	✓		
It encourages students to think, be creative and synthesize their knowledge.	✓		
It is open-ended.	✓		
It reflects real life.	✓		
It has been developed in accordance with the science course gain(s).	✓		
Suitable research questions were determined at the end of the problem scenario.	✓		

As seen in the examples given, the frequency and percentage values given in Table 2 were obtained when the problem scenarios and questions of all the pre-service teacher candidates were examined.

Table 8.

Frequency and Percentage Values of Problem Scenarios Developed by Teacher Candidates Reflecting The Characteristics of PBL Approach

Necessary Characteristics for the Implementation of Problem-Based Learning Approach	Yes		Partially		No	
	f	*%*	*f*	*%*	*f*	*%*
It is based on the interests, individual needs, values, experiences, facts, cultures, and backgrounds of the students.	22	92	2	8.3		
It contains important concepts that can be reflected upon.	18	75	4	16.6	2	8.3
It is suitable for students to communicate with the community.	23	95.8	1	4.2		
It can have the students comprehend the meaning of relationships in life with what is learned at school.	21	87.5	2	41.7	1	4.2
It encourages students to think, be creative and synthesize their knowledge.	16	66.7	6	25	2	8.3
It is open-ended.	16	66.7	5	20.8	3	12.5
It reflects real life.	24	100				
It has been developed in accordance with the science course gain(s).	24	100				
Suitable research questions were determined at the end of the problem scenario.	8	33.3	12	50	4	16.7

When the data were examined, it was seen that the problem scenarios developed by the pre-service teacher candidates were from daily life and were suitable for course outcomes. It was also found out that the majority were able to develop problem scenarios that were suitable for the students to communicate with the community (95.8%) and were based on their interests, individual needs, values, experiences, facts, cultures, and backgrounds (92%). More than half of the teacher candidates (62.5%) were able to develop open-ended problems that contained important concepts that students should think about. Moreover, it was seen that 41.7% of the candidates could not prepare scenarios that could encourage students to think, be creative and synthesize their knowledge, and that, in this direction, the questions developed at the end of the scenario were mostly knowledge-based rather than research-based.

Discussion, Conclusion, and Recommendations

This study was conducted to determine the suitability of the problem scenarios and research questions developed by pre-service teacher candidates in the event that the PBL approach was applied in science courses. In the PBL approach, which is emphasized in the Science curriculum, the problem situation is determined first, just as in the work of a scientist, and then the necessary information is gathered for the solution of this situation, and a result is achieved by evaluating such information (Senocak & Taskesenligil, 2005). In this context, an open-ended problem scenario that requires research is needed in order to implement the PBL approach. Pre-service teachers should experience the problem scenarios for the reason that the problem scenarios will be developed and given to students by teachers. In short, teachers who will be the implementers of the curriculum should acquire the ability to develop problems that are suitable to their outcomes in order for them to be able to use PBL approach in the classes. Based on this necessity, teacher candidates in the study were asked to identify research questions by writing a problem scenario suitable to PBL and these were evaluated in terms of the characteristics they should contain.

The findings demonstrated that all the pre-service teacher candidates could identify the outcome(s) that were suitable for developing a problem scenario and associate them with daily life events. When it is considered that the outcomes are not provided and the candidates determine the suitable outcome(s), it can be primarily suggested that the candidates can correctly determine the gain that the PBL approach can be applied. Moreover, when taking into consideration that not only the 3rd and 4th grades, but also the 6th, 7th and 8th grades are considered, pre-service teacher candidates can be considered to have the ability to correctly analyze the outcomes in general, and determine the suitable teaching method. Candidates were generally able to relate problem scenarios to daily life as they chose socio-scientific topics in general. When considering the aim of verbal problems to reduce the students' hardship in not being able to make a one-to-one connection with real-life (Verschaffel, 1997), the importance of the candidates' ability to develop a problem scenario based on daily life emerges once again.

Another important result obtained from the research findings was that the majority of the pre-service teacher candidates were able to develop problem scenarios that were

suitable for the students to communicate with the community, and were based on their interests, individual needs, values, experiences, facts, cultures, and backgrounds. When the vision of MoNE (2015) Science curriculum is taken into consideration, considering that science-literate individuals should have an understanding of the relationship between science and technology, society and environment and feel responsible for solving problems related to social problems, the significance of this finding emerges. Moreover, it can be clearly expressed that the practices carried out within the scope of this study are a necessity for teacher education for the reason that the students should be aware that the cultural values, social structure, and beliefs are effective in processing information in mental processes (MoNE, 2015).

As explained above, the fact that the pre-service teacher candidates chose socio-scientific issues and 75% of the candidates were able to include in the problem scenarios they developed important concepts that could be reflected upon, they could plan appropriate courses for the purpose of "Developing scientific thinking habits by using socio-scientific issues", which is taken as the basis of the MoNE (2015) Science curriculum. In addition, it can be stated that the candidates can be effective in the development of analytical and creative thinking skills as well in accordance with the vision of the program due to the fact that the scenarios include important concepts.

In the PBL approach, creative thinking skills of students improve because students use their imagination and different mental processes while solving real-life problems (Yaman & Yalcin, 2005). In science courses, it is known that associating the concepts with daily life enables an increase in scientific literacy in students, positive developments in their interests, attitudes, and motivation towards the course and the realization of meaningful learning (Costu, Unal & Ayas, 2007). Based on this information, it can be clearly asserted that it is important for the students to comprehend the relationship between real life and the information they learn at school. The findings obtained as a result of this study demonstrated that the majority of teacher candidates (87.5%) could develop scenarios in which students can comprehend the meaning of relationships in life with what they learn at school. Based on this result, it can be suggested that studies of developing problem scenarios with pre-service teacher candidates in accordance with PBL approach have an important contribution to their formation of the course environments that can support the opinion that "the program is able to establish relationships with life in the education and training process" (MoNE, 2018) as stated in the Science Curriculum.

It is seen that almost half of the pre-service teacher candidates were successful in developing scenarios that allow students to think, synthesize their knowledge and develop their creativity. The same number of teacher candidates was able to develop open-ended scenarios. It can be suggested that this success is important as the problem situations that are suitable to PBL approach should be unstructured (Kizilcik, 2012; Lohman & Finkelstein, 2000) and allow the development of creativity (Yaman & Yalcin, 2005). Before these applications within the scope of the study, the candidates were used to solving structured problems and asking them to prepare a problem situation was a very new practice for them. On the other hand, it is thought that the preliminary studies carried out within the scope of the research are effective in the

development of open-ended, challenging problem scenarios of the majority of the candidates. Based on this idea, it can be emphasized that such practices should be performed more frequently and that the candidates can easily develop and apply open-ended problems through which students can synthesize their knowledge in their professional lives and increase their creativity.

When the findings obtained from the study were examined, it was seen that the pre-service teacher candidates had hardship in asking questions suitable for the research. As it is seen in the example given in the findings section, a teacher candidate who could develop a problem scenario in accordance with the PBL approach related to space pollution asked the question "what would the consequences of the space pollution be?" and led the students to the concept of space pollution. Another teacher candidate used the concept of sound pollution directly in the research question after developing a problem scenario related to sound pollution. This situation suggests that the research questions as well as the problem scenarios should be given more importance in the studies conducted with the candidates.

When all the results obtained after examining the findings are taken into consideration, it can be asserted that pre-service teacher candidates' understanding of PBL approach through experience is effective for them in reaching a level where they can use this approach in their professional lives. This idea is supported by the view that it is important to develop teaching materials appropriate to the problem-based learning approach in teacher education, as mentioned by most of the teachers who have participated in Tapilouw, Firman, Redjeki and Chandra (2017)'s studies.

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Öğretmen Adaylarınca Geliştirilen Problem Senaryolarının Probleme Dayalı Öğrenme Yaklaşımına Uygunluğu

Özet

Probleme dayalı öğrenme (PDÖ) öğrencilerin, günlük yaşamdan alınmış gerçek ya da gerçeğe yakın problemleri işbirlikli öğrenme ortamlarında çözmeye çalıştıkları öğrenme yaklaşımı olarak tanımlanmaktadır (Barrows & Tamblyn, 1980; Newstetter, 2006; Şenocak & Taşkesenligil, 2005). Bu özelliği ile PDÖ "ilk öğrenmenin problem" olduğu yaklaşım olarak da tanımlanabilir (Pepper, 2013). Bu sebeple de oluşturulacak problem durumunun, yaklaşımın uygulanmasındaki en önemli basamak olduğu söylenebilir.

Araştırmanın Önemi: İçerik ve çözüm yolları bakımından incelendiğinde fen derslerinde kullanılan problemlerin dört farklı düzeyde olduğu görülmektedir. İlk düzeyde problemin içeriği, çözüm yolu ve karşılaşılan durum öğrenci için tanıdık iken, dördüncü düzeyde tümü öğrenci için yenidir. Bu özelliği nedeniyle PDÖ yaklaşımı için en uygun problem düzeyinin dördüncü düzey olduğu söylenebilir. PDÖ yaklaşımında en temel unsurun problem yapısı (Goodnough, 2003) olması ve ilk bakışta problemi formüle etmenin kolay gibi görünse de eğitim amaçlarını karşılayacak gerçek yaşam probleminin bulunmasının zor (Shepherd ve Cosriff, 1998) olması, bu öğrenme yaklaşımının uygulayıcısı olacak öğretmen adaylarının bu konudaki başarı düzeylerinin ne olduğu sorusunu akıllara getirmektedir.

Problem Durumu: Alan yazında yapılan araştırmalar, fen derslerinde uygulanan PDÖ yaklaşımının, akademik başarıya (Aidoo, Boateng, Kissi, Ofori, 2016; Ayaz, 2015; Çayan & Karslı 2015; Etiubon & Ugwu, 2016; Horak & Galluzzo, 2017) ya da kavramsal değişime (Loyens, Jones, Mikkers & Gog, 2015; Oktarisa, Utami, & Denny, 2017) etkisinin araştırıldığını, fakat öğretmen adaylarının uygulamaları ile ilgili çalışmalar olmadığını göstermektedir. Özellikle PDÖ yaklaşımının uygulamasında geliştirilen problem senaryolarının niteliklerinin önemli olduğu (Baysal, 2005; Selçuk & Şahin, 2008) ve öğretmenlerin bu konuda deneyim kazanmaları gerektiği düşünüldüğünde, öğretmen adaylarınca geliştirilen problem senaryolarının niteliklerine ilişkin araştırmalara ihtiyaç olduğu açıktır.

Araştırmanın Amacı: Belirlenen problem durumuna bağlı olarak bu araştırmada;

- Sınıf öğretmeni adaylarınca PDÖ yaklaşımı temelinde geliştirilen problem senaryoları ve araştırma soruları yaklaşımından beklenen nitelikleri hangi oranda yansıtmaktadır?

sorusuna cevap aranmıştır.

Araştırmanın Yöntemi: Bu araştırmada sınıf öğretmeni adayları tarafından PDÖ temelinde geliştirilen problem senaryolarının ve araştırma sorularının nitelikleri belirlenmeye çalışıldığından, adaylar tarafından geliştirilen problem senaryolarının yaklaşımdan beklenen nitelikleri karşılama oranları araştırılmış ve her bir niteliğe ait frekans yüzde değerleri hesaplanmıştır. Bu amaçla Armstrong, (1980); Delisle, (1997); Torp ve Sage, (1998) ve Shepherd ve Cosriff'in (1998) tarafından ifade edilen ve Baysal (2005) tarafından düzenlenen PDÖ'de geliştirilen problem durumları için "problemin içermesi gereken özellikler" ölçeğinden yararlanılmıştır. Ancak araştırma kapsamında PDÖ yaklaşımına uygun bir problem senaryosunun geliştirilmesinin yanı sıra öğretmen adaylarının bu yaklaşımı derslerde nasıl uygulayacaklarını da belirlenmeye çalışıldığından,senaryolarının kazanımlara uygunluğu ve öğrencilerin araştırması için uygun soruların (Kaptan ve Korkmaz, 2001) belirlenip belirlenmediği de dikkate alınarak araştırmacı tarafından yeni bir ölçek geliştirilmiştir. Bu ölçek ilk kez pilot çalışma olarak 2017-18 öğretim yılından aynı dersi alan 33 öğrenciye uygulanmış ve buradan elde edilen veriler değerlendirilerek bu araştırma için kullanılmıştır. Ölçeğin kapsam geçerliliği için fen eğitimi alanında uzman iki kişinin görüşüne başvurulmuş, güvenirlik içinse, her bir madde pilot uygulama sırasında hem araştırmacı hem de alanında uzman başka bir kişi tarafından incelenmiştir. Uzmanlar tarafından incelenen problemler durumları söz konusu niteliği içerip içermeme yönünde değerlendirilmiş ve uzmanlar arası güvenirlik katsayısı hesaplanmıştır. Bu katsayı 0,83 olarak bulunmuş ve ölçek üzerinde herhangi bir değişikliğe gidilmeden bu araştırmada kullanılmıştır.

Araştırmanın Bulguları: Araştırmaya katılan adayların problem senaryoları ve sorularına verdikleri yanıtlara ilişkin elde edilen veriler değerlendirildiğinde öğretmen adaylarınca geliştirilen problem senaryolarının tamamının günlük yaşamdan ve ders kazanımlara uygun olduğu görülmektedir. Yine büyük bir çoğunluğun (%95.8) öğrencilerin toplumla iletişim kurmalarına elverişli ve (%92) öğrencilerin ilgilerine, bireysel ihtiyaçlarına, değerlerine, deneyimlerine, olgularına, kültürlerine ve öz geçmişlerine dayalı problem senaryoları geliştirebildikleri belirlenmiştir. Öğretmen adaylarının yarısından çoğu (% 62.5'i) öğrencilerin üzerinde düşünmeleri gereken önemli kavramları içeren, açık uçlu problemler geliştirebilmişlerdir. Bunun yanı sıra adayların %41.7'sinin öğrencileri düşünmeye, yaratıcılığa ve bilgilerini sentezlemeye teşvik edebilecek içerikte senaryolar hazırlayamadıkları, bu doğrultuda da çoğu kez senaryo sonunda geliştirilen soruların araştırmaya dayalı olmaktan çok bilgiye dayalı olduğu görülmektedir.

Araştırma Sonuçları: Elde edilen bulgular adayların tamamının problem senaryosu geliştirmeye uygun kazanım/kazanımları belirleyerek bunları günlük yaşam olayları ile ilişkilendirebildiklerini göstermektedir. Kazanımların verilmediği ve uygun kazanımı/kazanımları adayların belirlediği düşünüldüğünde öncelikle adayların PDÖ yaklaşımının uygulanabileceği kazanımı doğru belirleyebildikleri söylenebilir. Ayrıca kazanımların belirlenmesinde yalnızca 3 ve 4. sınıfların değil 6.,7. ve 8. sınıflarının da dikkate alındığı düşünüldüğünde adayların genel olarak kazanımları doğru olarak analiz edebilme ve uygun öğretim yöntemini belirleyebilme becerisine

sahip oldukları düşünülebilir. Araştırma bulgularından elde edilen önemli bir diğer sonuç adayların büyük bir çoğunluğunun öğrencilerin toplumla iletişim kurmalarına elverişli ve ilgilerine, bireysel ihtiyaçlarına, değerlerine, deneyimlerine, olgularına, kültürlerine ve öz geçmişlerine dayalı problem senaryoları geliştirebilmeleridir.

Bu araştırma sonunda elde edilen bulgular öğretmen adaylarının büyük bir çoğunluğunun öğrencilerin okulda öğrendikleriyle yaşamdaki ilişkilerin anlamını kavrayabilecekleri senaryolar geliştirebildiklerini göstermektedir. Öğrencilerin düşünmesine, bilgilerini sentezlemesine ve yaratıcılıklarının gelişmesine fırsat tanıyan senaryoları geliştirmede öğretmen adaylarının yarısının çoğunun başarılı olduğu görülmektedir. Yine aynı sayıda öğretmen adayı açık uçlu senaryolar geliştirebilmişlerdir. Araştırmadan elde edilen bulgular değerlendirildiğinde adayların araştırmaya uygun sorular yöneltmede zorlandıkları görülmektedir.

Anahtar Kelimeler: Probleme dayalı öğrenme, problem niteliği, öğretmen adayı, fen öğretimi.