The Views of Preservice Teachers for Problem Based Learning Model Supported by Geocaching in Environmental Education[*]

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Abstract

The purpose of this study is to investigate the usability of Problem-Based Learning model supported by Instructional Geocaching Game (PBL-IGG). The study was conducted in Turkey, in 2015-2016 spring term with 19 geography teacher candidates who chosen by convenience sampling method. In this study, within Educational Geocaching Game (IGG) which is the complementary activity of the problem-based learning (PBL) process, treasure boxes containing various clues and tasks for the students to help them at their PBL research reports, had been prepared and students' opinions regarding the effectiveness of this game was taken. The data was collected through Problem-Solving Inventory and focus group interviews, in this instrumental case study. Paired Samples Test and content analysis were used for analysis of the data. The findings showed that PBL-IGG did not lead to a significant difference regarding the students' problem-solving skills, since the effect size is .013. However, in the light of the interviews, it was revealed that PBL-IGG increased the students' social and cognitive skills and map skills as well; that the students had positive attitudes towards PBL-IGG. They also stated that IGG applications made the lesson more enjoyable, increased awareness and motivation towards the environment. It is expected that the results will be useful to encourage using IGG learning strategy in geography and environmental education and make a contribution to new researches.

Keywords

Geocaching, Problem-Based Learning, Outdoor Environmental Education, Global Positioning System

One of the most important elements of digital age, which constitutes a source to communication and spatial technologies with the entrance of computer and internet into our lives in the 21st century, is Global Positioning System (GPS). GPS is directly related to Geography and gives the most correct and fastest answers to the question "Where?" The spatial analysis has done through GPS and satellite images in Geographic Information System (GIS). Although GIS is one of the most known applications in geography education, ''Geocaching'' game is another technology-integrated education strategy (Lary, 2004; Christie, 2007; Buck, 2009; Mayben, 2010; Hendrix, 2012). Geocaching game reached to the large masses all over the World has just come to be known for educational environments. Through this game, GPS technology can be also used independently rather than GIS courses. Thus Hendrix (2012) states that geocaching game can be used as an instrument in preparing students to professions in which GPS technology is used.

Geocaching is the name of an outdoor recreational activity, organized for the first time by David Ulmer in Oregon province in the USA in 2000. Across the world, there are followers of this outdoor recreational activity and to seek the hidden treasures in outdoors, mobile digital technology combined with online social communication network is used (Burns, 2013). In the term ''geo-caching'', ''geo'' connotes the *Earth*, *Geography* and *Global Positioning* which is given by geographic coordinates. The word ''caching'' means *the activities; that boxes within which there are gift-type objects, are hidden as a treasure, and later on, those boxes are found by using GPS receivers* (Christie, 2007; Donadelli, 2014).

Basic concept of Geocaching is that a GPS user hides a box known as *cache/geocache*, registers coordinates of this box into GPS receiver, and shares these coordinates, description of geocaches and tips on the official Geocaching website. Thus, other geocaching players (*geocachers/GPS user*) download description and coordinates of geocaches into their computers and print them out, and set out to seek boxes. According to Groundspeak (2010), there are three simple rules to be obeyed by a GPS user when the he found a geocache (Christie, 2007): (1) Take something (small gifts in general) from cache and put something of equal value or of more valuable in substitution for that. (2) Sign note-book and put the box back into the place where you found it so that other geocachers can find the box. (3)Share this experience on the website www.geocaching.com. If this game played for instructional purposes, the educator should decide what subject or which skill he wants to teach and prepare some geographic duties to be performed by students throughout the activity, for the boxes to put in. A safe play environment is required as well (Donadelli, 2014). Donadelli & Rocca (2014) define instructional geocaching activities as a geographic game in which, planning and conscious spatial thinking skills are developed. Students also can understand and use their geographic skills and gain the geographic point of view through the game.

Since GPS technology has developed, geocaching has begun to be regarded as an important educational issue, but not enough academic work has been done on this area

yet (Christie, 2007; Buck, 2009; Mayben, 2010; Hendrix, 2012; Burns, 2013). Geocaching game, of which potentials are being researched in the world as an instructional digital game, is mostly known as a recreational activity particularly in metropolitan cities, in Turkey. It can provide rich learning environments for geography education, in which map and spatial inquiry skills are the matter.

It is seen that there are studies concerning Geocaching and GPS from primary education to higher education in the literature and that theoretical foundations of the game are based on constructivist approach. In these studies, those qualities of geocaching come into prominence:

- It is a location-aware mobile game (Silva & Hjorth, 2009), which is directly related to geography science and it can be effective in gaining geographical skills (Lary, 2004; Schlatter & Hurd, 2005; Shaunessy & Page, 2006; Christie, 2007; Ihamäki, 2007; Mayben, 2010; Hendrix, 2012; Burns, 2013; Donadelli 2014, Donadelli & Rocca, 2014).

- IGG has great potentials in integrating technology into constructivist teaching environments and in providing student participation (Broda & Baxter, 2003; Schlatter & Hurd, 2005; Shaunessy & Page, 2006; Christie, 2007; Ihamäki, 2007; Matherson, Wright, Inman, & Wilson, 2008; Silva & Hjorth, 2009; Buck, 2009; Taylor, Kremer, Pebworth, & Werner, 2010; Mayben, 2010; Robison, 2011; Ihamäki, 2012; Hendrix, 2012; Burns, 2013; Donadelli 2014, Donadelli & Rocca, 2014).

- It addressed multiple intelligences and various learning styles, and enables students to learn by doing, through experience, with collaboration, by presenting real-world problems directly related to their lives, in overcoming learning difficulties (Christie, 2007; Buck, 2009; Mayben, 2010; Ihamäki, 2012; Hendrix, 2012; Burns, 2013; Donadelli & Rocca, 2014)

- It can be also used in environmental education since it is an out-of-class teaching method (Broda & Baxter ,2003; Sherman, 2004; Ihamäki, 2007; Pelton, Pelton, & Moore, 2008; Taylor et al., 2010; Robison, 2011; Hendrix, 2012; Burns, 2013; Donadelli 2014, Donadelli & Rocca, 2014).

- It is useful for students' physical-mental developments (Schlatter & Hurd, 2005; Ihamäki, 2007; Pelton, et al., 2008; Hendrix, 2012).

Şahin & Gençtürk (2007) made some suggestions how GPS technology can be used in learning environments. Geocaching game which might be deemed as a type of outdoor games, since it is generally performed outdoors, is also a digital game as played by GPS technology and internet connection. Demirel, Seferoğlu and Yağcı (2003, p.141) pointed that digital instructional games are softwares which enable for students to learn the course content by using game format, and improved their problem solving skills (Bayırtepe & Tüzün, 2007). According to Bottino, Ferlino, Ott, & Travella (2006) and Ebner & Holzinger, (2007), except for competition and luck atmosphere which is created by games, a lot of features of problem solving such as unknown result,

alternative solutions, structuring of problem, collaboration etc., can be seen on games (Bayırtepe & Tüzün, 2007). During the game, students generate problems, collect the needed information for solution by themselves and solve the problem. Instructional digital games are, by nature, game-framed problem-based learning environments (Bayırtepe & Tüzün, 2007). As a matter of fact, Prensky (2001) stated that mastery learning can be provided when instructional digital games have been integrated with other learning approaches (Çankaya & Karamete, 2008).

Jean-Jacques Rousseau emphasized in the novel ''Emile'' that children should grow up by solving nature problems (Gökmen, 2008). McCrea (2006) stated that John Dewey's explanations about learning by doing through interdisciplinary approach became one of the basic points of environmental education (Gökmen, 2008). Later on Barrows (1985) whom impressed by Dewey's explanation that students should learn by solving real life problems developed the PBL approach in medical education. By this approach knowledge could be generated and used by students themselves (Gökmen, 2008). Although PBL began to be used for the first time at medicine faculties, today it can be used in all levels of the education.

Problem-Based Learning is a life-long learning approach, in which students work in small groups and identify the problems at the center of learning scenarios representing authentic problems. They research as a scientist within the process, confine the problem in line with information they collect, and test ideas which they generate for solution of the problem. And after that, they get report and present this, by reaching to the most applicable solution. The teacher who learns together with students is a facilitator (Kalaycı, 2001; Kaptan & Korkmaz, 2001; Barrows, 2002; Hmelo-Silver, & Barrows, 2006; Biber & Başer, 2012).

The primary aim in using PBL learning approach, in which constructivist approach dominates (Akınoğlu, 2004), is to raise individuals who take their own learning responsibilities. These who has advanced problem-solving skills, search and query. They can present creative products, make the right predictions for results of events, think analytically, and use the technology effectively. They are not scared of knowing and explaining themselves, working according to scientific methods, and can generate reasonable and effective solutions to problems which they will be encountered in their lives (Kalaycı, 2001; Kaptan & Korkmaz, 2001; Aksoy, 2004; Biber & Başer, 2012).

According to their PBL studies carried out with secondary and higher education students, Aksoy (2004), Alagöz (2009), Tozo (2011) and Koçak & Ünlü (2013) stated that, students adopted PBL although they were a stranger to it, PBL increased theirs' academic success and problem solving skills, and developed positive attitude towards geography and environment courses.

It is necessary for teacher candidates to gain problem solving skills by themselves at first, so that they can cope with problem cases in their lives, and transfer these to their students. As a matter of fact, Gelen (2002), pointed out that the teachers, whom he observed in his study, were incompetent or completely incompetent in gaining these

skills to their students. In this sense, PBL is an effective approach. Besides this, environmental education might be taught in the best way through PBL approach (Aksoy, 2003; Gökmen, 2008; Alagöz, 2009), by supporting with outdoor education. Environmental problems are one of our daily life troubles and they can be the subject of real life scenarios which are addressed in PBL (Aksoy, 2003; Gökmen, 2008; Alagöz, 2009).

Instructional geocaching game that is fun and technology-assisted was preferred in the environmental class to perform outdoor education. Students state that they have broken away from PBL process from time to time, since there is a heavy workload; they have lost their attentions and motivations (Biber & Başer, 2012). In this context, IGG is expected to overcome the negativenesses, to a certain extent, which might occur in PBL approach, and besides this, it presents the chance to students to use their map skills in a real environment. The increasing popularity of geocaching has attracted the attention of researcher and felt the need to do this study on how could IGG integrate into the problem-based learning process.

PBL is a learning approach which confronts students with a problem from daily life within the scope of a scenario in learning environments. PBL and teaching by games method have the same theoretical foundations, supported by cognitive and social constructivism. The determined common characteristics of problem-based learning and educational Geocaching are as fallows: (1) both of them are applicable learning methods in constructivist learning environments. (2) Contribute to critical thinking, collaborative work and problem solving skills. (3) Acquire skills that can be used throughout life. (4) Students gain the ability to make effective decisions in real-world problems they will face (5) Using information Technologies. (6) Increasing student participation and motivation. (7) Both can be used in environmental education and pay regard to individual differences.

Common characteristics which PBL approach and IGG activities have, form a convenient basis for using both of them together. Christie (2007) asked secondary school geography students to find information about destinations within caches and then prepare brochures about these destinations. The way which Christie followed in her study shows high similarity with implementation phases of PBL. Students determined some American National Parks during the game, based on the clues in caches, such as maps, newspapers, satellite images and plastic objects etc. Later on, they did research for these parks and prepared reports. Students also planned a holiday to spend with their families in these parks by benefiting from reports they prepared.

Artvinli (2010) pointed out that studies on various aspects of the constructivist approach are mostly quantitative, empirical and emphasized the results, after moving to a student-centered education based on active learning in Turkey. Artvinli emphasized the need of researches which taken in the holistic approach to find out how the "process" is structured within the course. In geography education literature in Turkey, there is a need for studies that in which in-depth examine the students' experiences in PBL process. Except this, no other study for instructional-purpose usage of geocaching game has been encountered. This study including IGG process has significance in that it

enables PBL to integrate with field works, game-based learning and GPS technology in geography and environment courses.

The purpose of this study is to examine the effect of PBL-IGG learning process upon students, on the subject ''Atmosferic Disasters'' taking part in curricula of Higher Education Environmental Problems. For this purpose, in line with relevant subject headings, in-class PBL and out-of-class IGG activities were designed and implemented. In the study, effect of PBL enriched with IGG activities, on student' map skills and geographical inquiry skills tried to be determined. PBL-IGG effect on students' technological skills and problem solving skills were also observed. Besides this, what kind of influence PBL-IGG learning model has created on students' attitudes towards course and environment were questioned. Benefits and shortcomings of the combination of PBL and IGG activities (PBL-IGG) in learning and teaching environments, its links with geography discipline, how it can be applied in environment education and the students' views on this new practice are the subjects of this study. In consequence of the study, suggestions for increasing its functionality were presented.

The main theme of this study is how the combination of PBL and IGG activities (PBL-IGG) which are based on active learning, works in learning and teaching environments. The study was addressed around the following research questions so that the above-mentioned problem could be dealt with in an examinable manner.

1) What are teacher candidates' opinions on the usability of PBL-IGG learning model?
    a) What are teacher candidates' opinions on PBL learning process?
    b) What are teacher candidates' opinions on IGG learning process?
2) What is the effect of the PBL-IGG model on the problem-solving skills of prospective teachers?

Methodology

Research Design

McMillan & Schumacher (2010, p. 21) investigates researches under four different patterns, in general quantitative, qualitative, mixed and analytical. Under each pattern there are different research methods. In this study, the case study method which is under the qualitative research design according to the classification of McMillan and Schumacher was used.

In the study, instrumental case study model was used from the case study classification of Stake (2003, p.136-137) because it aims to examine the applicability conditions and effects of the Geocaching supported PBL approach. In instrumental case studies, it is attempted to determine the effects of the phenomenon rather than by understanding a particular event, event or situation and understanding the event itself. However, in order for these effects to be accurately determined, the case itself must be studied and understood in depth (Stake, 2003, p.137).

Within this method, quantitative and qualitative data collection tools were utilized. The main purpose of the study is to demonstrate the effects of PBL-IGG learning process on geography teacher candidates. In this context, it is examined how PBL-IGG process influences students' academic success and retention of knowledge, and problem solving skills. However, PBL-IGG learning process was evaluated, positive and incomplete aspects were determined, and students' opinions about how to apply the model in Environmental Problems and Geography lessons were taken. In this study, Problem-Solving Inventory (PSI-A) results and focus group interviews about the process were discussed.

The working group was selected by convenience sampling, which was educated at a faculty of education in Turkey, at Geography Teacher Training 2nd class, in the 2015-2016 academic year. The application was conducted in the class where the researcher was the course teacher as well. In this way, the researcher has saved time and money and achieved speed and practicality (Miles & Huberman, 1994; Yıldırım & Şimşek, 2011). The working group is a total of 19 teacher candidates, and consisted of 5 female students and 14 male students. Because of the small number of students, this working group was chosen so the geocaching applications could be applied more easily than once on the university campus. In addition, it was preferred to collect the opinions of the teacher candidates primarily for this new learning strategy which was designed by the researcher and will be applied for the first time.

The preliminary preparation, application, and evaluation of the whole PBL-IGG learning process was carried out by the researcher as objectively as possible. In this study, the researcher was the tutor as well.

Qualitative and quantitative data collection techniques were used in combination with the triangulation method (McMillan & Schumacher, 2010) to increase the validity of the measurements in the study. These are: Document Analysis Technique, Problem Solving Inventory- Form-A (PSI-A), Focus Group Interview Forms, In-Class and Out-of-Class Observation Forms, Worksheets, Reports and Student Presentations, Academic achievement and retention test. In the analysis of the data, descriptive and predictive statistical methods for quantitative data; content and descriptive analysis methods, and document analysis technique for qualitative data were used.

Semi-structured interviews were used in the focus group interviews. In semi-structured interviews, the interviewer may adopt a chat-style method, stick to the interview questions that he prepares, but have the flexibility to ask additional questions to get more detailed information if necessary (Yıldırım & Şimşek, 2011, p.122).

In this study, the focus group interview was selected because some points that would not come to mind in the individual interviews were due to coming up with other members' explanations within the group, making additional comments, reaching more individuals and not being personal and sensitive (Yıldırım & Şimşek, 2011, p.151). Gibbs, (1997), Morgan and Krueger (1993), pointed to the development of basic questions or concepts that can be used in questionnaires and interviews to reveal

hypotheses or explanations that will lead to other researches by focus group interview technique (Ekiz, 2009, p: 66).

What are the opinions of prospective teachers regarding the PBL-IGG learning process? In order to find answers to that question, students' opinions on PBL approach in class sessions and IGG activities out-of-class were consulted. The semi-structured interview form prepared for this, is composed of two parts as in-class learning environments and extracurricular learning environments. In-class PBL applications chapter includes the participation of the students to the lecture, how they reach, present and share information, interpersonal relations, social skills, PBL scenario, teacher adequacy, attitudes to environmental problems etc. The topics questioned about IGG, in the second part of the form are as follows: Geocaching-CITO activity, collaborative work, intra-group communication, critical thinking, enjoyment from the game, the students' perceptions of the environment, problem-solving situations, etc. The focus group interviews were carried out at the end of the implementation.

The interview form was developed by the researcher, by benefiting from related literature. The semi-structured interview guide was reviewed by 2 research assistants and 3 field specialists and rearranged in line with the feedback received. For the validity of the interview form, a preliminary interview was held with a group of 5 randomly selected students from the last grade geography teacher education. Students' opinions were taken about the intelligibility of the interview form questions. Also it didn't take into account whether the pilot group had PBL or IGG experience before. At the end of the preliminary interview, interview questions were finally reviewed and a focus group interview was conducted with 14 volunteers from 19 students. During the research process, interviews were recorded with the camera to describe the experiences of the study group, their experiences, and the problems they encountered.

What is the impact of the PBL-IGG model on problem-solving skills of prospective teachers? In order to answer the question, PSI-A was applied as pre-test before application and as post-test after application. The inventory consists of 35 items describing how people are responding to personal and daily life problems. This Inventory, developed as a likert scale has a six replies option. (1) Indicates complete participation, (6) indicates not fully participating. The answers given are scored between 1 and 6. During rating 9, .22. and 29 are excluded from scoring. "1, 2, 3, 4, 11, 13, 14, 15, 17, 21, 25, 26, 30." and 34 are scored in reverse. It is assumed that these items represent adequate problem solving skills. The total score range from the inventory is 32-192. PSI-A, was developed by Heppner and Peterson and adapted to Turkish by Şahin, Şahin and Heppner in 1993 (Polat, 2008). After reading the item, the person who will answer the inventory must decide whether or not to participate in the item and then mark the degree of participation on the inventory. The working group answered it approximately in 30 minutes.

The transcripts of focus group interview records were analyzed by content analysis method. In the first stage, the conceptual structure of the data was detected with

descriptive analysis, and then the analysis was carried out more intensively through content analysis (Yıldırım & Şimşek, 2011) to find the themes, codes, categories, descriptions and frequencies. The values are presented in tables. To ensure the validity and reliability of the analysis, the data set was analyzed three times at 3-month intervals and a *test-retest technique* was applied. Also, an expert and a research assistant once analyzed the data and the consistency between the results was checked and necessary corrections were made. In addition to this, in this study, direct citation of the findings was given frequently, so that the reader is able to construct his or her own opinion of the true atmosphere. Then the analysis results were described in terms of research problems and interpreted by the researcher. Finally, an open-ended questionnaire for the PBL-IGG process was administered to the students and the consistency of the statements in the focus group interviews was checked. Thus, participant confirmation has been provided. In addition, the focus group interviews were recorded by the camera with the permission of the students and data loss was prevented.

Implications of the Study

In the study conducted with the instrumental case study, the effects of the PBL-IGG model on the problem solving skills, retention of knowledge, their interest, attitudes, motivation and academic achievement of the candidate teachers' in the Environmental Problems course were questioned. And students were asked to state their views on the applicability of the PBL-IGG model. Quantitative and qualitative data collection tools were used to reach these questions.

This study limited with findings of focus group interviews and PSI-A. In order to have a clear understanding of this study in a holistic approach the whole process of preparation, implementation and evaluation of research is briefly described below. The study consists of 3 phases (Figure 1): PBL-IGG preparation period, PBL-IGG implementation process, and recreational geocaching activity (Go-Geocaching).
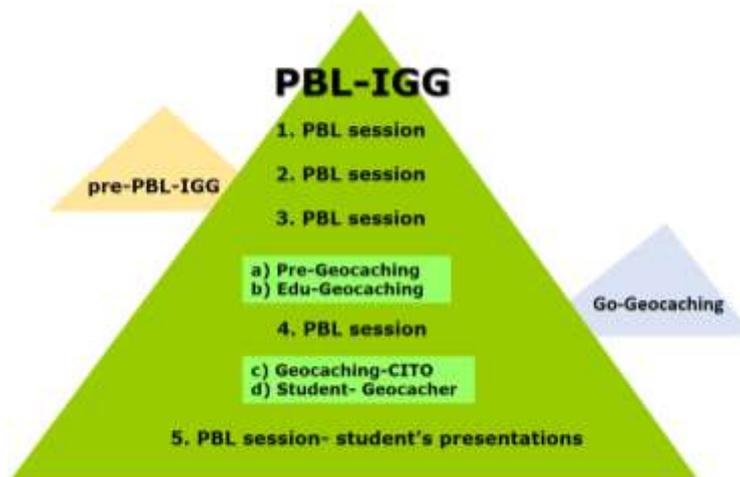
Figure 1. PBL-IGG Process

The implementation was performed in 13 weeks in total in Environmental Problems course. After informal interviews carried out with students and faculty members, during the first week of academic semester, it was determined that students had no background for PBL approach. Working group stated that they didn't have enough knowledge on scientific research process such as scientific report writing, citation by APA system, hypothesizing etc. Thereupon, implementation process and materials were rearranged and additional materials were prepared. Before the treatment the PSI-A was applied. Between 3th and 6th weeks of the implementation, students were informed about PBL approach, scientific report writing and research processes, and mini PBL sessions were arranged. Later, the PBL-IGG student groups were formed. Also, the PBL-IGG guide, prepared by the researcher, was distributed to students so that they could conduct the process in a healthy manner. Content of this guide is: Course instruction of environmental problems course, Work schedule and evaluation criteria, Outcomes of the Course, Features of problem-based learning, Writing a scientific research report guide, Instructional geocaching guide, Rubrics to be used to assess student works (*Draft for group work diary, evaluation scale for research report, evaluation scale for presentation, evaluation criteria for geocaching game, evaluation criteria for PBL worksheets*) and list of some references can be used during PBL-IGG research process.

Five PBL sessions were carried out between 7th and 11th weeks of academic education term. Student groups offered solutions, which they generated for scenario problems presented to them, in front of the researcher, a jury and the class, in the 11th week. Presentations were evaluated and it was decided that the best problem solutions had been generated by 1st group. A single PBL scenario named as ''WORKSHOP'' prepared in line with outcomes of "Atmospheric-Origin Natural Disasters", was provided to students. Students prepared solution recommendations in accordance with the role which was casted to them. 1st, 2nd and 3rd groups consisted of 5 students and 4th group was of 4 students. PBL groups were tried to be constituted heterogeneously by taking students' academic standings into consideration. After the last PBL session, PSI-A was applied as a final test.

In the second phase of the implementation, two instructional geocaching activities were carried out in a manner that Donadelli & Rocca (2014) suggested. After the 3rd PBL session, Pre-Geocaching activity was carried out, with which students learned basic rules of the game. Following that activity, Edu-Geocaching game was played for the purpose of reinforcement of the course content. Box content consisted of some additional information for disasters, list of references and a quiz. After the 4th PBL session, Geocaching-CITO activity was applied, which aimed at collecting the rubbish

at areas suitable for playing Geocaching and creating a clear environment. That activity was completed with Student-Geocacher game. In this activity, at areas where students collected the rubbish, students hide geocaches prepared by themselves before and they recorded the coordinates of those. After each group hides their own boxes, they arrived at the meeting point and exchanged their coordinates with each other. Then the groups tried to find these caches.

The aim of this activity is for students to learn designing this game. In this activity, there were tips in the boxes for students to use in their PBL researches. There were also some PBL duties in boxes. The groups should do these duties and put them into their group portfolios and presentations. These duties are precautions for disaster preventions, such as publicity of school disaster plan, family disaster plan preparation, some measures to be taken in disasters, disaster bag (kit) etc, which students failed to notice during research processes and did not mention in their studies. These boxes contained small surprise gifts and chocolates as well to motivate the students.

Each one of instructional geocaching activities lasted one hour approximately, and a GPS device was given to each group and students were requested to use GPS device by turns among themselves. IGG activities were implemented in students' leisure times and at areas which were determined before within university campus. To generate the design of geocaching game and the content of boxes took the researcher's several days, and to hide boxes for each IGG activity took the researcher's 2-3 hours. A recreational geocaching player's opinions were taken for the phase of preparing and hiding boxes. Game duration varies depending on the difficulty of duties within the boxes and the terrain, a number of boxes, students and GPS device, students' level, course content. The IGG activities can be designed for 20 minutes or more.

At the 12th week of the implementation, the researcher performed focus group interviews with four groups in different times. Recreational Geocaching Activity (Go-Geocaching) with no instructional content was carried out during the 13th week of the implementation. Firstly, students became a member of the site www.geocaching.com and found 3 caches hidden in university campus. The aim of this activity is for students to learn the game, to gain experience and follow the developments on the game. As a matter of fact, it is important for students to have experience in the game so that instructional usage of it could be enhanced. At the final week of the implementation, an open-ended questionnaire was conducted to confirm students' statements (participant confirmation) of focus group interviews, and to take opinions on the final Go-Geocaching activity.

It is a negative situation that Environmental Problems course is only two hours in a week, to continue the PBL-IGG process in a healthy manner. The researcher who wanted to compensate for this, tried to guide students, from the dedicated facebook group page out of course, as well. Except this, additional PBL sessions were arranged to groups in cases considered necessary.

Findings

What are Teacher Candidates' Opinions on PBL Learning Process?

The results of semi-structured interviews, take part in this chapter. Students's views had been split into themes, categories and codes and showed by tables after frequencies had been found. Besides, representations such as S1, S2 and S3 etc. were given to students to show which expressions belong to whom. Focus group interviews were conducted with 14 volunteer students in total. In this chapter, students' opinions on *Problem-Based Learning Approach Supported by Instructional Geocaching Game* (PBL-IGG) are explained under 4 themes, including Usability of PBL-IGG, Teacher's Role and Competence in PBL, Disadvantages of PBL and Effect of IGG on PBL Process.

Table 1
Student Opinions on Usability of Problem-Based Learning (PBL)

Category	Code	f
PBL Effect on Learning	Learning by research	9
	Permanent Learning	4
PBL Effect on Social Skills	Reporting skill	6
	Communication skills	8
	Presentation skills	3
	Gaining self-confidence	4
	Time management	2
	Problem solving skills	11
	Using technology and social media productively	4
PBL Effect on Cognitive Skills	Being able to establish connection of Environmental Problems Course with the real life	3
	Gaining disaster awareness	2
	Gaining awareness for environmental problems	1
	Developing positive attitude towards PBL	7

Three categories were obtained under **applicability of PBL** theme reached as a result of content analyses: PBL Effect on Learning, PBL Effect on Social Skills and PBL Effect on Cognitive Skills. When we examined the **PBL effect on learning**, 2 codes were obtained in this chapter: Learning by research and memorability. In Table 1, when **learning by researching** was considered, nine students stated that they learned scientific researching processes and used various information sources. A student's opinion on this code is such: **S1**: *We read at least... For example, you are obliged to read even in order to find different solutions for avalanche, I mean, however to read is compulsory but it is good, and the last ideas which came up were very nice.* Four students stated that PBL process provided **permanence in learning**. A student's opinion on this subject is like that: **S2:** *We, actually, had exam every day in our group meetings; we got ready, we gathered again in the last week, we were subjected to an exam there too, and we saw what would come out. I mean, we had long-term exams. It became permanent.*

When we examined **PBL effect on social skills**, seven codes were obtained in this chapter: In **research reports** in Table 1, number of students, who stated that they could organise their knowledge and transfer them in a good way, is six. A student expressed his opinion such: **S7:** *We didn't write every book which we read into references. I wrote some of them as the references since I was impressed by their thoughts; I may have changed thoughts of these as expression, but finally, that is basically thought of that person, so to write the book into the references doesn't become a problem.*

In the code of **communication skill** in Table 1, eight students stated that they transferred their knowledge to their friends during research process, took responsibilities, duties were shared, seethed with their friends whom they communicated little and they had the chance to know students who are known as silent even though they were in different groups. A student's opinion on this matter: **S8:** *I didn't have trouble in comparison with other groups. S7 distributed the duties already (pointing at S7 with his finger). S7 gave the duties which everyone could do. I didn't have any trouble within the group. And I did my best.*

Under the code of **presentation skills**, three students stated that they internalized their knowledge during preparation phase of the presentation, developed various strategies in order to transfer their solutions to the audience in the best possible way and that this gave them a feeling of self-confidence and satisfaction. Opinion belonging to one of these is such: **S15:** *Presentation motivated me, the jury took notes continuously while I was presenting, I morever said silently ''the jury will disprove my all hypotheses''; I sank into such desperation while the jury was taking notes, and later on, I said to myself that ''present what you have known'' and I suppressed it there... Also the jury liked, and you liked very much, too... I motivated myself.*

Under the code of **gaining self-confidence**, four students stated that being process- and result-oriented of evaluation system increased passive students' motivations and self-confidences. One's opinion of these is like that: **S1:** *Our self-confidence has increased by the process, compared to last year. Being high of student's AGNO (Weighted Grade Point Average/ Academic Achievement Average) doesn't indicate that this student has been successful in PBL; What matters was idea already... In my opinion, in general, ideas belonging to people, who didn't have high scores and whose AGNO were less, were better... For example, S6; S6 studied so.*

Under the code of **time management skill,** two students stated that they took care to end their tasks with their teammates on time and offered their presentations in a reasonable time. One's opinion of these is such: **S2:** *That happens when a long-time job has been given to a group; ''we'll do it at final week''... In long-term studies but not short-time, a target should be set for each week... Because, I know it from myself; Student starts to study during final exams week, and for example, a study for 5 weeks should be carried out, so, different quotas should be imposed for each week in group duties. For instance: It is going to be reached till that point in that week...*

Under the code of **problem solving skill**, number of students, who stated that they faced with problems constantly during the process and solved these problems by trying

to think differently and by learning on their own, is ten. Some students' opinions are such: *S1: Directly, we ourselves learned the content of this course... Our group researched much and everyone learned something... But we couldn't discuss all subjects. S2: In general, the 4ᵗʰ group had done a research on ''what the problem was''; the 1ˢᵗ group presented projects within the scope of World. The 3ʳᵈ group presented hypotheses within the scope of Turkey through a critical approach. Ours was individual solutions. S6: We were running so much while seeking for boxes; we were getting out of breath when we stopped, therefore, I had difficulty in solving questions, and I solved one or two questions. Just because we hurried up so, we had many wrongs in our questions.*

Under the code of **using technology and social media productively**, four students stated that their skills to use computer improved and they benefitted from social media networks such as Facebook, Whatsapp etc., in intragroup communication. A quotation belonging to one of these is like that: *S2: Sharing in Facebook becomes easy in particular. Because, I couldn't send video on Whatsapp, its size was large.*

When we examined **PBL effect on cognitive skills**, four codes were obtained in this chapter. The code of **being able to establish connection of environmental problems course with the real life** in Table 1 was considered; number of students, who stated that the course got associated with real life by going beyond theoric, is three. One's opinion of these is such: *S7: We thought all of suggestions which were offered by our friends, but we said that:'' we are participating in a workshop in Lyon city in France and our thoughts should not be very simple, and countries there: Canada, USA... Also, we consider it as a real workshop so what will you present to the experts in this workshop? That is, stream remediation... Already, these are the works done.*

Under the code of **gaining disaster awareness**, two students stated that they comprehended things to do before-during-and-after the disasters in line with first-hand information and the importance of disaster education, while they were researching. One's opinion of these: *S14: Even though you had put people in order, they would walk over each other so in panic... This results from low consciousness and lack of work ethic... Disaster awareness is low in us.*

Under the code of **gaining awareness for environmental problems,** students stated that for environmental problems, only obtaining information would not give result, and individual should internalize this attitude. A student's opinion on this: *S14: When we have looked at our education system at schools; instead of teaching by tests; saying to us''solve the test, take this test''... It would be better, if we could educate students in emotional domain... Most university students leave the rubbish and go, I mean, not only information but also values should be given.*

Under the code of **developing positive attitude towards PBL**, in Table 1, students are aware that PBL gained a lot of skills to them, although they had difficulty during this process, and they stated that they are willing to use this method in their professional lives. One of these student opinions are such: *S10: PBL approach prompt someone to*

think, such becomes better... I would like to use PBL on convenient subjects in my professional life... For example, on subjects open to comment.

Under the theme of **teacher's role and competence in PBL**, reached as a result of analyses in Table 2, two categories were obtained: Evaluation of the tutor in PBL and Teacher's implementation performance of PBL process.

Table 2
Student Opinions on Teacher's Role and Competence in PBL

Category	Code	f
Evaluation of The Tutor in PBL	Guidance performance	10
	Being supervisor in outdoors as well	6
Teacher's Implementation Performance of PBL Process	Designing the process in accordance with PBL	5
	Conducting the process in accordance with PBL	5

When we examined the category of **evaluation of the tutor in PBL**, 2 codes were obtained in this chapter: Guidance performance and Teacher's being supervisor out of class as well. In Table 2, when **guidance performance** was considered, students evaluated teacher's approach to groups during the process, teacher's feedbacks and to what extent teacher was able to help them. Some students' opinions were given as below. One of those is such: **S13:** *We thought we would be able to interview as soon as we went to AFAD (Disaster and Emergency Management); if you had not said to us to go and get an appointment before, we would have been bewildered just when we went; fortunately, you warned us before so. We went in a more prepared way.*

Under the code of **teacher's being supervisor out of class, as well**, in Table 2, six students expressed opinion that teacher helped them face to face or via social media out of course, as well. One of those: **S7:** *But, you were reminding yourself, and in my opinion, it became very nice. Now, Facebook is open in everyone in general. When I saw your sharings, so I was saying to myself that: S7, you are hacking around and watching TV, stand up and study''.*

When we examined the category of **teacher's implementation performance of PBL process**, two codes were obtained in this chapter: Designing the process in accordance with PBL approach and Conducting the process in accordance with PBL approach. In Table 2, the way of the groups formed; the effectiveness of the content, material and activities were evaluated by students. One's opinion of some students is such: **S1:** *You arranged well the context of groups, you distributed the close-tongued ones well. Silent friends, who were not saying anything at all, hadn't any connection with other friends, so I think that they were opened out.*

Under the code of **conducting the process in accordance with PBL**, five students evaluated how teacher implemented this method, from its beginning phase to presentation and evaluation phase. A dialogue on this subject among students is in that way: **S6:** *PBL process varied much, that is, what you said one week didn't match with the ones other week;* **S7:** *That is because: All friends were in the fun part of the matter*

while teacher was lecturing PBL process, the first stage. While the teacher was lecturing APA writing style to us, they approached the situation, in a way that ''Yesss! Time is passing so... We wished it would finish and we could go''. In fact, since they didn't utilize that informing time, they were taken aback in an instant when the teacher asked them to come to the conclusion. They said ''what will we do?''... Of course, also the teacher noticed this situation as a supervisor; they hadn't understood and couldn't constitute PBL in its full sense. For this reason, the teacher had to make amendments constantly and I realized this. It changed according to problematical groups so, and it wouldn't have been such, if everyone had understood as we had done; **S6:** *But, it became also bad for the person who started one's job in earnest and could do it;* **S7:** *But, ultimately, at one point, it is important that you have understood... Whenever you have understood, then you can do the implementation;* **S8:** *But, we got in return for it, finally, S6.*

Table 3
Student Opinions on Disadvantages of Problem-Based Learning

Category	Code	f
Lack of Intra Group and Inter Group Communication	Structure of groups and poor collaboration	9
Unfamiliar to The Approach	Lack of prior experience for PBL	4

In the Table 3, under the theme of **disadvantages of PBL**, 2 categories were obtained: Poor Intra Group and Inter Group Communication and Unfamiliarity to The Approach. When we examined the category of **lack of intra group and inter group communication**, one code was obtained in this chapter. In Table 3, when the groups' structure and their poor collaboration were considered, students stated that their motivations reduced due to the fact that their friends did not cooperate enough and did not take responsibility, and this caused them of anxiety and some students behaved passively. One of these student opinions: **S12:** *To work with group was very hard, to get along with people became very difficult... I got very tired in group work.*

When we examined the code of **lack of prior experience for the PBL approach** in Table 3 under the category of **unfamiliarity to the PBL approach**, students stated that they had never taken any course with PBL and avoided from focusing the process due to their individual characteristics and habits. One student's opinion on this situation is such: **S15:** *Well, we had difficulty initially; so I said," what is this? What are we doing... The teacher didn't lecture as normal...''*

What are Teacher Candidates' Opinions on IGG Learning Process?

In Table 4, under the theme of IGG effect on PBL process, reached as a result of analyses, four categories were obtained: IGG effect on learning, Harmony of IGG with PBL process, IGG contribution to social skills and IGG contribution on cognitive skills.

When we examined the category of **IGG effect on learning**, 2 codes were obtained in this chapter. In Table 4, when the code of reinforcement of course content was considered, students stated that the information obtained by them in PBL researches, became clearer by the help of box content and game, that information became permanent since they experienced them on a different environment. They internalized what they learned. A student opinion on this situation is such: **S8:** *I had had difficulty in the exam you held; it was mentioning the integrated disaster management and so forth and I didn't know that. But, we researched these in those duties. So, this was my duty in the group. Again, I remained much in my mind, from which questions we solved in Geocaching game. I solved more easily in second exam.*

Table 4
Students' opinions on the effect of IGG on PBL process

Category	Code	f
IGG Effect on Learning	Reinforcement of course content	4
	Increasing motivation for the course	8
Harmony of IGG with PBL Process	Enrichment of PBL process by IGG	7
IGG Contribution to Social Skills	Problem Solving Skill	8
	Using technology and social media productively	3
	Encouraging to the team work and productive working	3
IGG Effect on Cognitive Skills	Developing positive attitude towards IGG	14
	Developing positive attitude towards the environment	7

Under the code of **increasing motivation for the course**, eight students stated that they enjoyed the game and their motivations for the course increased. One of student opinions is such: **S1:** *To my opinion, if Geocaching had not existed, we would have been bored in PBL... The game motivated us well.*

When we examined the category of **harmony of IGG with PBL process**, under the code of **enrichment of PBL process by IGG** in this chapter, students stated that they realized, through geocaching duties, important points which escaped from their notice during researches and geocaching relieved the tiredness created by PBL process. Some opinions on this are such: **S1:** *Duty which was given in this box (Duty of Disaster Information Card and of Preparation for Family Disaster Plan) is a nice reminder, and we don't have, for example...* **S8:** *So, this implementation we carried out was pretty reasonable and suitable... It also created awareness in us (mentioning CITO activity), that is, we collected the rubbish.*

When we examined the category of **IGG effect on social skills**, three codes were obtained in this chapter. In Table 4, when the code of **problem solving skill** was considered, students stated that they produced some strategies to solve problems, caused by GPS, and to find boxes during the game. One of these opinions are like that: **S17:**

Now, when arrow mark changed the direction, I estimated it by myself according to my direction, for example, I looked at, I came near the box, but, if meter-distance was increasing in the direction I proceeded, then I would understand that I was in the wrong direction, so I found it myself... Particularly, I found it according to the meter information which showed my distance to the box, on GPS screen.

Under the code of **using technology and social media productively**, three students stated that they learned to use GPS through the game and realized opportunities for social media and smart phones. Some of student opinions on this subject are such: **S14:** *The phones have GPS. Now, given that we are at a scene; AFAD team would come to the place at which you are, already, if you sent the position where you are directly.* **S15:** *Later on, we learned to use GPS, to enter the coordinate into GPS, and We didn't know to use GPS and the coordinates before.*

Under the code of **encouraging to the team work and productive working**, students stated that they moved fast during the games and enjoyed this. One of student opinions on this subject is such: **S15:** *Everyone in the group went someplace, already, and when we approached the box, to find it did not become problem much.*

When we examined the category of **IGG contribution to cognitive skills**, 2 codes were obtained in this chapter. All students participating into focus group interviews developed **positive attitude towards IGG**. Students evaluated the game and expressed opinions on how they would use it in their professional lives. One of student opinions on this code is such: **S13:** *It would be perfect while lecturing the coordinate system to high-school 9th grades!*

Under the code of **developing positive attitude towards environment**, students stated that they in person saw the pollution of environment during IGG activities and they were uncomfortable with this. One of student opinions on this subject is such: **S12:** *It was very bad, very dirty... We are university students... When we looked at our environment during geocaching game, we had difficulty in finding a clear area to hide the box... We were astonished... I wouldn't guess that environment would be such bad... We ourselves collected the rubbish on the environment where we would hide the boxes. In my opinion, it become of direct connection with the course. We did Geocaching-CITO.*

What is the Effect of the PBL-IGG Model on the Problem-Solving Skills of Prospective Teachers?

Problem Solving Inventory was applied before and after the application of the PBL-IGG model to examine the effect of the students on problem solving skills. Statistical data on the Problem Solving Inventory are given in Table 5 and Table 6.

Table 5
Descriptive Statistics for Problem Solving Inventory

Test Type	N	$\overline{X}$	SD	SE

Problem	Pre-test	19	88. 21	21.77	4. 99
Solving	Post-test	19	88. 00	18,84	4.32

Results of Problem Solving Inventory (PSI) which were carried out to measure students' problem solving skills were given in Table 5. When results of Table 5 were examined, it was seen that there was a difference of 0.21 scores between averages of implementations of pre-test and post-test of PSI and this was in favor of pre-test. Being high of total scores which were taken from PSI-A shows that individual has perceived oneself inadequate in problem solving. Since total score taken from post-test of PSI-A, was less in comparison with pre-test, there has been a small increase positively in students' problem solving skills. But, Paired Samples Test was performed to determine whether this inventory made a meaningful difference in students' problem solving skills or not, and whether the effect of PBL-IGG' problem solving skills was low, middle and high or not. Results belonging to this inventory were given in Table 6.

Table 6
Results of Paired Samples T – Test for Problem Solving Inventory

Group		$\overline{x}$	SD	SE	95 % Confidence Interval		t	df	p	d
					Lower	Upper				
Difference	Pretest_ Post-test	.21	16.38	3.76	-7.68	8.11	.056	18	.956	.013

Paired Samples t-test was conducted to evaluate the effect of PBL-IGG model, on values which were taken by students from problem solving inventory test. A statistically meaningful decrease in students' scores didn't occur, from pre-test ($M = 88,21$, $SD = 21,77$), to post-test ($M = 88,00$, SD= 18,84); $t_{(18)} = 0, 056$, $p > .001$. Average decrease in PSI-A values was found as .21 and values has the 95% confidence interval ranging between -7.68 and 8.11. Effect size d statistics obtained (.013) shows that a small effect size.

Conclusions and Discussion

In this study, educational geocaching game was used as an out-of-class complementary activity of the probabilistic learning approach applied in the course of environmental problems. The effects of the PBL-IGG learning model on the learning process of the application and the problem solving skills of the students were investigated. In addition, students' opinions on the applicability of the PBL-IGG model designed by the researcher were consulted. When headings which revealed in the first research question's findings are considered, conclusions of the study can be listed in that way:

Students stated that they learned by themselves by researching during PBL process and stated what they had learned became permanent, since they researched constantly and discussed their new information in group meetings. Besides, some changes in

students' styles of researching and learning. They evaluated critically the references they used, and focused on the question 'How?' rather than the questions 'What?', 'Where?', while they were researching. Research results show similarity with study results belonging to Alagöz (2009), Kahyaoğlu (2011), Kutu (2011), Biber & Başer (2012), Baran (2013), Keleş (2015), Taşoğlu-Kartal (2015).

PBL process gained various social skills to students. These students gained writing scientific report skill, communication skills, time management and presentation skills, problem solving and reflective thinking skills. Their self-confidence had increased and they learned to use technology and social media productively. The findings show similarity with study results of Kahyaoğlu (2011), Biber & Başer (2012), Aksoy (2003, 2004), Baran (2013), Koçak & Ünlü (2013), Kutu (2011), Alagöz (2009), Taşoğlu-Kartal (2015), Kuvaç (2014), Ersoy (2012), Ulukök, (2012), Tozo (2011).

PBL process influenced students' cognitive skills positively. Students got the change to put theoretical information they learned in the environmental problems course into practice. Also, gaining for students' disaster consciousness in direct connection with the course content and being aware of environmental problems are the desired affective outcomes. In addition to this, students lean towards PBL approach and think about applying it in their professional lifes. Particularly process- and result-oriented evaluation system of PBL enabled some students, whose academic success avarages in the class were low, to motivate studying more and increased their self-confidences. Ultimately, students found PBL method applicable in environmental problems and other geographic courses. The study's results of developing cognitive skills and positive attitude towards PBL approach and the course, and developing sensitivity to environmental problems show similarity with the studies belonging to, Aksoy (2003, 2004), Alagöz (2009), Ersoy (2012), Ulukök, (2012), Tozo (2011), Biber & Başer (2012), Kahyaoğlu (2011), Kuvaç (2014), Taşoğlu-Kartal (2015), Kutu (2011), Koçak & Ünlü (2013), Biber & Başer (2012) and Baran (2013). According to results of Baran (2013) and other similar studies, it was stated that observation and evaluation of students couldn't be made, out of the class, is the negativeness of PBL. However, in this study, students found PBL evaluation process motivating and reliable.

Students stated that teacher helped them enough during PBL processes and motivated them by way of social media out of the course. Alper, Öztürk, & Altun, (2014) indicated that communication mediums such as social media should be provided for PBL applications in which group work and sharing were considered pretty important. As a matter of fact, in Baran (2013)'s study, students stated that, not controlling of out-of-school mediums in PBL applications is a disadvantage.

Students also evaluated the tutor on designing and conducting the process. Students stated that they found PBL scenario, forming the way of groups, PBL-IGG guide and other course materials effective. But, one student indicated that teacher made often change in schedule of PBL-IGG process and this decreased his motivation. Another student, however, related this behavior to the fact that some groups do not take into

consideration the PBL-EGO preparation process. The researcher arranged additional sessions to these groups due to the problem of writing the research reports and their own intra-group disagreements, and changed the order of presentation of the groups in the working schedule. Besides, the researcher was obliged to make change also in calendar of IGG activities because of overcast weather conditions. It is seen Kaptan & Korkmaz (2001), Aksoy (2004) and Biber & Başer (2012) pointed out scenarios and process should be prepared very well so that the process can continue well. Biber & Başer (2012) state that teachers and students regard incompetency of expert tutor as a factor which affects the process negatively. Teachers play an important role in continuing the process in a healthy manner and for students in getting ready for the process affectively. In addition to this, the result that students were stranger to PBL method was parallel with other studies which were mentioned here.

Teacher candidates' learning experiences are based on traditional teaching approach and they don't have experiences for learning methods which require constructivist, long-termed group work. Nevertheles, they adapted themselves to the process and stated that they looked it positively. In their studies where they took tutors' and students' opinions on PBL approach, Biber & Başer (2012) indicated that, both groups thought PBL provided a great variety of outcomes to individuals. But there are some negativenesses of the method, arising from system and implementation. The implementing of method by blending with classical education would be more productive. Besides that, in studies belonging to Aksoy (2004), Tozo (2011), Alagöz (2009) and Koçak & Ünlü (2013), similar results were reached to. John Dewey, known as the father of functional psychology, prepared some reports with the progressivist approach, at his Turkey visits. He addressed the problems of implementing the PBL approach in Turkey. It appears that his reports lost nothing of its actuality (Kahraman, Saatçı, & Baran, 2011).

Students found IGG teaching strategy, suitable for the course content and PBL approach. The researcher put various information, quizzes and PBL duties into boxes in Geocaching game. Students said that they reinforced in an enjoyable way what they learned through these box contents. And IGG relieved tiredness of PBL process. Morever, through boxes and game, the knowledge, skills and values of the course were gained to students. Study results match up with research results belonging to Lary, (2004) Christie (2007), Buck (2009), Mayben (2010), Hendrix (2012), Donadelli (2014), and Donadelli & Rocca (2014).

In this digital age, GPS receivers are useful tools in courses which would be conducted in a multidisciplinar, inquiry and field based way in student range from primary education to university (Christie, 2007). Geocaching is implementation point of GPS technology as an instructional, informational and entertaining tool in curricula (Lary, 2004; Hendrix, 2012). When relevant literature is considered, it is seen that Geocaching and GPS-based teaching implementations are also able to be integrated to different disciplinaries, including geographical courses at first, and these increased students' eagerness to learn. The content of Geocaching boxes can be designed in a multidisciplinary manner; activities, duties and hints for the course contents of fields

such as Science, Mathematics, Social Sciences, Agriculture, Environmental Problem etc., can be put into boxes. In this study, theme of the boxes is atmosphere-origin natural disasters.

Donadelli & Rocca (2014) based the pedagogical structure of IGG to cooperative and problem-solving game-based geography teaching. In box contents in IGG designs, they gave challenging tasks to students based on real and meaningful stimuli. However, Donadelli & Rocca (2014) pointed out that IGG has some disadvantages as well. Because of the cost of GPS receivers, during the game, only one GPS receiver can be provided for each group but not each of the students. The other negativeness of IGG is the duration of the game being insufficient to discuss the ideas emerging during the event. There are also administrative problems, problems of finding safe playgrounds, other disadvantages of the IGG.

IGG activities developed problem solving and collaborative working skills as it was in PBL approach. Students solved problems arisen from GPS device and find the right direction, while they were seeking for or hiding boxes. And they stated that seeking for boxes with teamwork was more enjoyable. Morever, students indicated that they learned entering the coordinates into GPS during IGG process. In this sense, they put their map skills into practice. Besides, they offered suggestions for the location-based applications on mobile phones and for social media usage.

In E6 learning model which was of active participation and based on constructivist strategy, prepared by Christie (2007) so that teachers and students could learn GPS technology and Geocaching game, there are activities for primary and secondary education students. Students who participated in 6E workshops stated that they enjoyed to use technology for a purpose in outdoor. Students indicated that they generated quicker solutions since they worked as the group in Geocaching and found all caches. They expressed that their communication and problem solving skills increased. Christie (2007) states that mobile phones are an attractive device to motivate students who are much interested in these technologies to the curricula. Mayben (2010), in his study, revealed that students enjoyed environments of active learning and learning by doing which were provided in instructional geocaching activity. Besides this, Geocaching players organize location-aware activities in amazing range, varying up to social meetings, called as ''Geocaching Events'' among themselves (Burns, 2013). When considered from this point of view, Geocaching game is one of important tools in developing social intelligence (Hendrix, 2012).

Particularly Geocaching-CITO activity caused students to realize environmental problems and to develop positive attitude towards the environment. CITO (Cache in-Trush out) are activities to clean nature, which are carried out at a designated region. Through these activities, it is targeted to creat a clean environment on which Geocaching will be played, by cleaning the rubbish such as plastic, glass etc. at the region (Burns, 2013). Robison (2011) stated that students' awareness of sustainable environmental and environmental development increased, after the geocaching activity

which he carried out with a group consisting of undergraduate students. In studies belonging to Broda & Baxter (2003), Donadelli (2014), Donadelli & Rocca (2014), Taylor et al., (2010), Pelton et al., (2008), Ihamäki (2007), Sherman (2004) and Hendrix (2012) similar results were reached to.

As a result of the study done, in Table 5, when the students' scores of PSI-A were examined, it was found that the average scores of 88.21; and the average score of the last test is 88. It is understood that there is an effect on the problem solving ability since the post test scores are lower. To clarify the importance of this effect, the effect size is determined from the results of the related samples t-test in Table 6. It is understood that the value of p is greater than 0.05 (0.956) and that the effect size is 0.013. The PBL-IGG model does not make any significant difference to the problem solving ability of the student and has a low effect. Study results are consistent with Baran (2013)'s results, but Aksoy (2004), Alagöz (2009), Tozo (2011), Ulukök (2012) reached the positive results.

The aim of this study is to investigate not only the applicability of the PBL-IGG in environmental problems course but also the influence of PBL-IGG on students' attitudes, motivation and problem-solving skills. The results are limited with the working group of this study; can't be generalized but will be an example for other researches. According to the findings obtained in the study revealed that PBL-IGG it was found out that PBL-IGG did not lead to a significant difference regarding their problem-solving skills. However, in the light of the interviews held with the students, it was revealed that PBL-IGG improved the students' intragroup and intergroup communication skills as well as their self-confidence and developed their skills in time management, presentation, reporting and technology use; that the students had positive attitudes towards PBL-IGG; and that they were able to relate environmental problems to daily life. But also, it was found out that they are unfamiliar with the PBL approach, but they used to traditional learning approach. Although they have the knowledge of these constructivist approaches, they had not found a chance to put these into practice before. In this sense the IGG has helped them to adapt to this new process. All the students liked having IGG experience and they stated that nearly all geography learning units could be put in the caches; especially the ones on map skills.

Depending on these findings, the researcher's suggestions for this learning model are as below:

- IGG can be integrated in courses and subjects, which require map skills in particular.

- IGG can be also applied in different disciplinaries since IGG box contents can be constituted in a multidisciplinary manner.

- As smartphones has become increasingly economically accessible day by day, navigation applications are becoming more diverse and easy. In this sense, any teacher can apply this IGG activity for any curricula easily, without the need for a GPS receiver by taking advantage of smartphone applications.

- IGG can be employed to increase student motivation in courses which have intense content.

- IGG can be effective on subjects for environmental problems.

- IGG can be used in minimizing the known difficulties of outdoor education. As a matter of fact, this game can be played in very different mediums, from school gardens to libraries (Donadelli, 2014).

- IGG box learning contents should be prepared as short, effective and practical as possible.

- Using score system for course tasks which are put into boxes while IGG process is being designed can increase functionality of game by preventing considerably for students to pass to next box without completing the duty.

- Besides the duty material concerning course content, adding little surprise gifts for students into IGG boxes can increase their motivations.

- Game rules should be obeyed as much as possible while IGG process is being designed. And asking from the students to shoot themselves via theirs cell phones during the game can be an extra precaution for their safety. Also, the tutor can understand the dynamics of the game and their teamwork by watching their videos.

- The fieldworks of geography education and other curricular educational trips, can be enhanced with IGG.

- During PBL process, teacher's observing and counseling students through social media networks out of course, as well, affects the process positively. However, the instructor should perform balanced supervision to prevent feelings of boredom of students.

- During PBL process, teacher's increasing intervention level in groups from time to time can be necessary on some class environments. Since some students are not used to learning via PBL, the implementing of PBL by blending with classical education would be more productive.

- In-service training courses can be held for PBL, GPS technology and instructional geocaching applications, for geography teachers.

Recommendations for further research are as fallows:

- IGG activities should be performed in student groups of all levels from primary education to higher education and thus to contribution can be made to literature, by revealing more clearly possible potentials of instructional-purpose usage of this game.

- What kinds of contributions Geocaching can provide when it has been used in supportive role to other learning approaches such as inquiry-based learning, project-based learning etc., should be researched.

- Researches can be done for direct effects of Geocaching on map skills and spatial perception teaching.

- Mixed method studies in which qualitative and quantitative data support each other should be implemented for Geocaching, GPS and problem-based learning.

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