STRENGTHS AND WEAKNESSES OF PROBLEM-BASED LEARNING IN ENGINEERIING EDUCATION: STUDENTS' AND TUTORS' PERSPECTIVES

MÜHENDİSLİK EĞİTİMİNDE PROBLEME DAYALI ÖĞRENMENİN GÜÇLÜ VE ZAYIF YÖNLERİ: ÖĞRENCİ VE ÖĞRETİM ELEMANLARININ BAKIŞ AÇILARI

Özlem ATEŞ[*], Ali ERYILMAZ[**]

ABSTRACT:

This study aims to analyze the strengths and weaknesses of problem-based learning (PBL) implementations in engineering education and problems encountered in it from the perspectives of tutors and students. A case study design was employed in this study. To this end, four tutors, their five PBL modules, and fourteen students were selected. The data were collected by means of observations, interviews, and additional data sources. The results indicated that gaining engineer's viewpoint and self confidence; improvement of communication skills, problem-solving skills, and self-directed learning skills were commonly mentioned strengths of PBL. On the other hand, weaknesses of PBL and problems of it were gathered under seven sections such as tutors' weaknesses, students' weaknesses, scenarios' weaknesses, assessment weaknesses, presentation weaknesses; tutors' problems in PBL and students' problems in PBL. Those results should be taken into account by the curriculum developers and administrators while preparing/evaluating their PBL curriculum and making necessary revisions to overcome these weaknesses and solve problems.

Keywords: Problem based learning, active learning, engineering education

ÖZET

Bu çalışmanın amacı, mühendislik eğitimindeki probleme dayalı öğrenme (PDÖ) uygulamalarının güçlü ve zayıf yönlerinin ve bu uygulamalar sürecinde karşılaşılan problemlerin öğrenci ve öğretim elemanlarının görüş ve algılarına dayalı olarak incelenmesidir. Çalışmada, örnek olay çalışması yöntemi kullanılmıştır. Bunun için, bir mühendislik bölümünde öğrenim görmekte olan 14 öğrenci, bu bölümde ders veren 4 öğretim elemanı ve bu öğretim elemanlarının eğitim yönlendiricisi olarak görev aldığı 5 PDÖ modülü seçilmiştir. Veriler görüşme, gözlem ve anket formları kullanılarak toplanmıştır. Örnek olay çalışmasının sonucunda mühendislik bakış açısı ve kendine güven kazanma; iletişim, problem çözme ve öz yönlendirili öğrenme becerilerinin artışı PDÖ'nün güçlü yönleri olarak belirlenmiştir. Diğer taraftan, PDÖ'nün zayıf yönleri ve karşılaşılan problemler yedi alt başlık altında (öğretim elemanlarının eksiklikleri, öğrencilerin eksiklikleri, senaryoların eksiklikleri, değerlendirmenin eksiklikleri, sunumlardaki eksiklikler, öğretim elemanlarının karşılaştığı problemler ve öğrencilerin karşılaştığı problemler) açıklanmıştır. Bu sonuçlar, PDÖ müfredatı hazırlarken, değerlendirirken ya da uygulamalar sırasındaki eksiklikleri gidermek ve problemleri çözmek için müfredat geliştiricileri ve yöneticiler tarafından dikkate alınmalıdır.

Anahtar Kelimeler: Probleme dayalı öğrenme, aktif öğrenme, mühendislik eğitimi

1. INTRODUCTION

Problem-based learning (PBL) is a learner-centered instructional format requiring students to participate actively in their learning by researching and working through a series of real-life problems to arrive at a best solution (Arambula-Greenfield, 1996). PBL was firstly designed for medical students at McMaster University based on the gaps of conventional medical training. However in time, some other medical schools around the world began to adapt PBL (Barrows, 1986). Therefore, most of the previous studies analyzed the effectiveness or outcomes of PBL compared with the conventional instruction in medical education from different points of view (Albanese & Mitchell, 1993; Berkson, 1993; Vernon

* Dokuz Eylül Üniversitesi, Eğitim Fakültesi, Fizik Eğitimi Anabilim Dalı, ozlem.ates@deu.edu.tr

** Orta Doğu Teknik Üniversitesi, Eğitim Fakültesi, Fizik Eğitimi Anabilim Dalı, eryilmaz@metu.edu.tr

Bu makale, Özlem Ateş (2009) tarafından, Yrd. Doç. Dr. Ali Eryılmaz'ın danışmanlığında hazırlanan doktora tez çalışmasının bir bölümünden oluşturulmuş ve INTE 2010 (International Conference on New Horizons in Education 2010) konferansında sunulmuştur.

& Blake, 1993; Colliver, 2000; Smits, Verbeek, & Buisonje, 2002; Prince 2004; Gijbels, Dochy, Bossche, & Segers, 2005).

Analyzing the most of these prior studies in literature, neglecting investigation of the actual learning process, not clearly reporting the implementation and learning environment, mentioning various implementations of PBL, uncertainty about the outcomes of those implementations, insufficient number of detailed studies in the disciplines other than the medical education, and mostly focusing on quantitative experimental design were seen as important weaknesses of prior studies (Charlin, Mann, & Hansen, 1998; Dolmans 2003; Lee 2004).

In fact, there are some studies aiming to define PBL interventions and investigate components of PBL environment in terms of students' and tutors' opinions or perceptions (Vernon, 1995; Kaufman & Holmes, 1996; Kaufman & Mann, 1996; Dahlgren, Castensson, & Dahlgren, 1998; Hollinshed, 2004; Ribeiro & Mizukami, 2005; Barman, Jaafar, & Naing, 2006). Instead of testing the effectiveness of PBL as compared to conventional curriculum on outcome measurement, they are focusing on fundamental issues and potential factors that may contribute to effectiveness. However, the vast majority of these studies are still investigated in medical education and very few of those provided detailed and rich descriptions about what happens in the PBL environment and what are the students' and tutors' perceptions related with the implementation of PBL.

In the past few decades, in addition to medical education, PBL has spread globally in all forms of undergraduate institutions including nursing, economics, pharmacy, dentistry, physiotherapy, architecture, business, law, engineering, social work, and science as well as in elementary and secondary education. For example, in higher education, engineering is one of the popular disciplines that PBL has been used as a teaching strategy based on the gaps of conventional engineering instruction (Hadgraft 1999; Perrenet, Boutuijs, & Smits, 2000; Denayer, Thaels, Vander Sloten, & Gobin, 2003; Polanco, Calderon, & Delgado, 2004; Ribeiro and Mizukami 2005; Said, Adıkan, Mekhilef, & Abd Rahim, 2005; Guzelis 2006). Some universities such as University of Manchester (UK), University College London (UK), University of British Colombia (Canada), University of Aalborg (Denmark), University of Samford (USA), University of Maastricht (Netherlands), University of Linköping (Sweden) University of Newcastle (Australia), and University of Delaware (USA) reported that they implemented PBL in their engineering curriculum.

Educating prospective engineers requires more holistic approach than simply teaching the principles and practices of the profession. Engineering instruction should bridge the gap between theory and practice. Moreover, engineering students need some skills such as problem solving, collaborative, communication and self-directed learning skills (Perrenet et al., 2000). In literature, the main strengths of PBL pointed out by the students and tutors were attributed to the fact that it is a satisfactory approach (Albanese & Mitchell, 1993; Vernon & Blake, 1993; Kaufman & Holmes, 1996; Riberio & Mizukami, 2005) that fosters communication skills (Musal, Taskiran, & Kelson, 2003; Riberio & Mizukami, 2005; Canavan, 2008; Mitchell & Smith, 2008) and self confidence (Riberio & Mizukami, 2005), develops problem solving and self-directed learning skills (Ryan, 1993; Hmelo-Silver, 2004), and constructs collaboration (DeGrave, Boshuizen, & Schmidt, 1996). This explains why engineering departments have been implementing PBL in their curriculum.

Although PBL was originally implemented in the whole curriculum, it became possible to see some institutions adopting the approach as a partial strategy, such as hybrid PBL, course-by-course models, etc. (Major & Palmer, 2001). Savin-Baden (2008) mentions seven

different forms of PBL curricula (Table 1) that have been implemented in the content of engineering education.

Table 1. Different Approaches of Problem-Based Learning Curricula in Engineering Education

Approaches	Explanation
Single module approach	PBL is implemented in one or two module in one year of a program
PBL on a shoestring	PBL may be used in many models throughout the curriculum
Funnel approach	Curriculum enables students to be funneled away from a lecture-based learning approach towards a PBL approach
Foundational approach	Lectures, tutorials, and laboratory are provided to the students to understand the necessary knowledge in the first year and they utilize
Two-strand approach	PBL is seen as the crucial component of the curriculum using other learning methods simultaneously.
Patchwork PBL	Curriculum is designed using PBL consisting concurrently run modules instead of consecutive ones
Integrated approach	Curriculum is integrated so that all the problems are sequential and are linked both to one another and across disciplinary boundaries.

Some researchers state that if the dimensions and implementations of this multifaceted approach are not clearly reported in most of the studies, the educational outcomes may not give confidence to the readers (Charlin et al., 1998; Dolmans 2003; Lee, 2004). Due to these varieties of PBL, researchers emphasize the need for detailed and rich descriptions about what happens in PBL environments, what factors affect the implementation of PBL in institutions and what are the outcomes of PBL implementations in certain settings and conditions.

The main purpose of this study is to analyze the implementation process of PBL, to identify strengths and weaknesses of PBL implementations from the perspectives of tutors and students, and to state the practical problems experienced by them in engineering education. These results may help curriculum developers or administrators overview their weaknesses and fix those weaknesses to improve their performance and instructional practices. Therefore, analyzing the PBL and taking the ideas of students and tutors who are the basic components of it seems to be of fundamental importance to contribute PBL implementations.

2. METHOD

2.1. Research Design

Merriam (1998) stated that qualitative research based on the case study design is an appropriate way to provide a "holistic description and analysis of a single instance, phenomenon, or social unit" (p.27). Similarly, Yin (2003) described case study as follows: "case study is used in many situations to contribute to our knowledge of individual, group, organizational, social, political, and related phenomena (p.1). Based on the characteristics listed above, case study design was used in this study in order to provide detailed and rich descriptions about the implementation of PBL and strengths and weaknesses of it through the perceptions of tutors and students.

2.2. Participants of the Study

The study was conducted in a university of Turkey during the spring semester of the 2006-2007 academic years. To provide anonymity, neither the program nor the participants are named in this study. An engineering department which had been implementing PBL for 4-5 years at that time was considered a natural setting for tutors and students. There were 22 tutors and 284 undergraduate students in this department in that academic year. Participants in this research were chosen using two types of purposeful sampling technique (criterion and intensity sampling) in which the researcher purposefully selects participants to maximize information. Criterion sampling involves the cases that meet some predetermined criterion of importance (Patton, 2002). The researcher used criterion sampling to select tutors that meet some criteria such as: 1) tutor should have an experience in conducting PBL tutorials, 2) tutor should be willing to take part in the study, 3) tutor should accept the researcher as an observer in his/her PBL module. At first, three tutors were selected to make observation and conduct interview. However, after the study has begun, the researcher decided to add one more tutor to the study to enrich it.

In order to select students, the researcher used intensity sampling which involves selecting cases that are information-rich manifesting the phenomena of interest intensely but not extremely (Patton, 2002). Therefore, 14 volunteer students from each grade level having high, low or medium cumulative grade points were selected to participate in this study and conduct interviews about the instructional method.

2.3. Context

The mentioned engineering department has been implementing PBL since 2002 in all curriculum and grade levels. Freshman, sophomore, junior, and senior curriculum of this department consist eleven, twelve, thirteen, and seven PBL modules respectively. A PBL module consists PBL tutorial sessions, presentations, laboratories, scientific consultation, and module discussion hours. A typical PBL tutorial session consists of 8–9 students meeting with a tutor to discuss a problem. It takes place in the PBL rooms and includes 3–4 sessions during a two or three week period. PBL sessions take 2–4 hours providing a learning environment where students attempt to define and then solve a real life problem introduced with a motivating scenario (Guzelis, 2006). During presentation hours, students are given presentations conventionally about the topical outline determined before for each module. Moreover, for every module, there is two hour long consultation hours every week in which students can ask any questions about the modules (presentations, scenarios etc.) to the tutors who guide them during the PBL sessions. Besides, students participate in laboratories related with physics, computer, electronic, programming etc. At the last week of the module, students take module exam and then participate into discussion hours to discuss and evaluate the scenario/module as a whole.

Project-based learning takes place as a co-strategy for the freshman and senior engineering education. In the freshman year, all modules of both semesters consist two hours of project-oriented learning sessions. However, in the senior year, all modules are organized around four-week long real design problems or projects in which the students are confronted with the complexity of a real engineering project (Kuntalp, Oztura, Yuksel, Kuntalp, & Güzeliş, 2002; Guzelis, 2006).

The tutors in this department participate in the modules as a facilitator. Although it changes as the number of the students change; in freshman, sophomore, junior and senior modules, students are mostly divided into 10, 6, 9 and 4 groups respectively meaning that much of tutors are needed to guide those groups. Scenarios about the topic of each module are

prepared by one or two content experts. Those tutors guide one of the PBL tutorial sessions, do presentations, and participate to the discussion hours and scientific consultations of their PBL groups. Other PBL sessions are guided by the remaining tutors whose area of specialization may differ. Therefore, since there is not much tutors in the department, tutors may guide the modules the topic of which is not directly related with his/her area of specialization.

2.4. Data Sources

2.4.1. Observations

In this study, five PBL modules of the four selected tutors were observed. In fact, the researcher planned to observe one module of each tutors before the study began. Those modules were selected on condition that a schedule of one module did not overlap with another and the modules would be related with tutors' area of specialization. However, one tutor recommended the researcher to observe her two modules. Therefore, the researcher observed two modules of that tutor.

The data related with observations were collected through non-participant observation. An observation checklist (given in Appendix) was developed as a guide in order to better report how frequent some PBL characteristics (in terms of tutors' roles, students' roles, PBL session process, and assessment) occurred during tutorials. During observations, the researcher took notes related with the participants' actions/interactions and the PBL process, and then she filled one observation checklist for each module by considering the average of all observed sessions and added her comments.

2.4.2. Interviews

Semi-structured interviews were conducted with tutors and students to support the observations and provide the means to analyze the strengths and weaknesses of PBL and problems encountered in it in engineering education. Review of the literature and pre observations of the researcher formed the questions for the interviews. The interviews lasting from 40-60 minutes were conducted once with each participant. The interviews were held in Turkish and all of the interviews were audio-recorded. The interviews were transcribed and coded by the researcher.

2.4.3. Additional Data Sources

Patton (2002) points out that "methods triangulation often involves comparing and integrating data collected through some kind of qualitative methods with data collected through some kind of quantitative methods (p.556). In this study, in order to test the consistency of the data obtained qualitatively from observations and interviews, some questionnaires were selected according to their relevance to the research questions. These questionnaires were used as additional data sources and analyzed both as a part of the triangulation of data and to increase the understanding of participants' perspectives. For example, in the mentioned department, students fill module questionnaires every term evaluating the modules they are involved in. This questionnaire consists two sections namely "general consideration" and "evaluation of program outcomes". Students mark the numbers between 1 and 5 (1: very poor, 5: excellent). The researches reached the module questionnaires filled by 74% engineering students in 2006-2007 academic year and analyzed the results of these questionnaires descriptively and reported those as additional data sources in related sections.

Moreover, every academic year, one student delegate is chosen from each grade level. In the spring semester, the delegate of sophomore students prepared a questionnaire about the implementation of PBL in this department. He conducted it to volunteer sophomore and junior engineering students. 59% sophomore and junior engineering students participated in this questionnaire. There were some open-ended questions related with some research questions of this study such as (Are you satisfied with the PBL scenarios? Do you think that the PBL sessions are effective? What are the characteristics of a good PBL tutor? etc.). The responses to the open-ended questions were coded into categories in terms of their relevance to the research questions and the results were reported in related sections.

2.5. Data Analysis

The qualitative data gained from the interviews and observations were analysed via content analysis. "Developing some manageable classification or coding scheme is" stated as the first step of qualitative analysis (Patton, 2002, p. 463). Bogdan and Biklen (1998) explained that the most general information on the setting, topic or subjects" can be sorted under codes. In this study, coding schemes was used to gain a more detailed perspective about what was occurring based on the purpose of the study. These coding schemes helped to analyze the transcripts of the participants. In order to achieve investigator triangulation, a colleague who is familiar with the nature of this study and has an experience in PBL coded 10% of the randomly selected transcripts independently by using the developed coding scheme. The percentage of agreement was 93.65 which was calculated by adding up the number of codes that rated by both judges and dividing that number by the total number of codes rated by them. Moreover, descriptive statistics were used to analyze quantitative data collected via questions in the questionnaires.

3. RESULTS

Based on the observation notes, interview notes, and additional data sources, the results of this study are given in three sections. Observation of the PBL tutorials are summarized in the first section named "Implementation Process". In the second (Strengths of PBL) and third (Weaknesses of PBL and Problems Encountered in PBL) sections, mainly the interview and observation results are given. These results and the findings of the additional data sources related with the second and third sections are not reported under separate subheadings but reported when necessary.

3.1. Implementation Process

During the observation of five PBL tutorials, the researcher constantly recorded notes regarding how PBL tutorial process, how students and tutors acted during tutorial sessions, how tutors assess the students and how students assess themselves or the process. The researcher identified following specific stages (Table 2) in all PBL tutorials.

Table 2. Implementation Process During PBL Tutorials

Students	• read the problem in turns, each one reading a part. • tried to identify the main points of the problem. • discussed the terms in the problem. • brainstormed and tried to make links with their previous knowledge or what they saw at the lab or presentations in order to find the answers of the questions. • shared results, tried to explain one another, made calculations, drawed or graphed the related parts on the writing board or the related parts of the session papers. • shared the roles such as director for explaining the problem or secretary for writing on the board/solving problem.
Tutors	• asked some questions to direct students toward unclear or unraised parts of the problem. He/she did this either to supplement their understanding, or to focus their attention to the related part. • encouraged students to explore possibilities, find alternative solutions, and collaborate with other students. • checked the tutor copy of the handout given for the scenario while students were reading or discussing the problem. • checked whether the learning objectives were reached or not. Because, sometimes students reached them all, sometimes not. At the end of the session, students listed those learning objectives. Those parts that were not raised by students were given as homework.
PBL Session	• student copy of the scenarios was delivered to each student in the first session. • until the next session, students were expected to work individually or as a group to search the unclear parts raised in the first session to reach specified learning objectives on using various resources (library, books, internet etc.). • in the next sessions, students read the next stages of the scenario; they tried to apply the result of their research to the problem and tried to explain the points rose during the first session. Students were expected to discuss much since they had time to search and discuss the objectives.
Assessment	• tutor checked student's understandings and assessed students' performance during sessions. • students and tutors gave feedback mostly at the end of the last tutorial session. • tutors gave grades or put some marks near to the students' name on the student list according to their participation and explanations to the questions they asked. • mostly conventional type questions are asked during module exams at the end of each module.

As a result of the field notes, the researcher filled the observation checklist. Although those mentioned stages given in Table 2 were observed, the frequency of behaviors changed during some tutorials. For example, although the tutors who were content experts usually asked very important questions to re-focus students' discussions, check their previous knowledge or explore alternative solutions, they intervened the group discussions (especially in module II and III) more frequently and provided more direct instruction than the others. In fact, that much of intervene and direct instruction is not an expected PBL behaviours. Moreover, although some students participated in the discussions freely and shared their results comfortably, not all the students participated in those processes. It was noted that certain students seemed to answer most of the thing or tried to put forward an idea, whereas others mostly listened and did not speak. Out of 8-10 students, generally 3-4 students were trying to participate in the discussions.

3.2. Strengths of PBL

During interviews, the primary strength of PBL that the 71% of the students and all the tutors mentioned (Figure 1) was that students gained engineers' viewpoint and therefore self

confidence due to PBL tutorials. For example, a fourth grade student mentioned that their practice for future career improved their self confidence and stated:

> PBL is a good method because if you are really going to be an engineer, you have to conduct a problem-based study. In work life you can encounter a problem that you don't know anything about. The implementations here are like that. When the students face a problem they don't know anything about it. They try to learn about it and come up with solutions. It provides you self confidence that you are able to handle it.

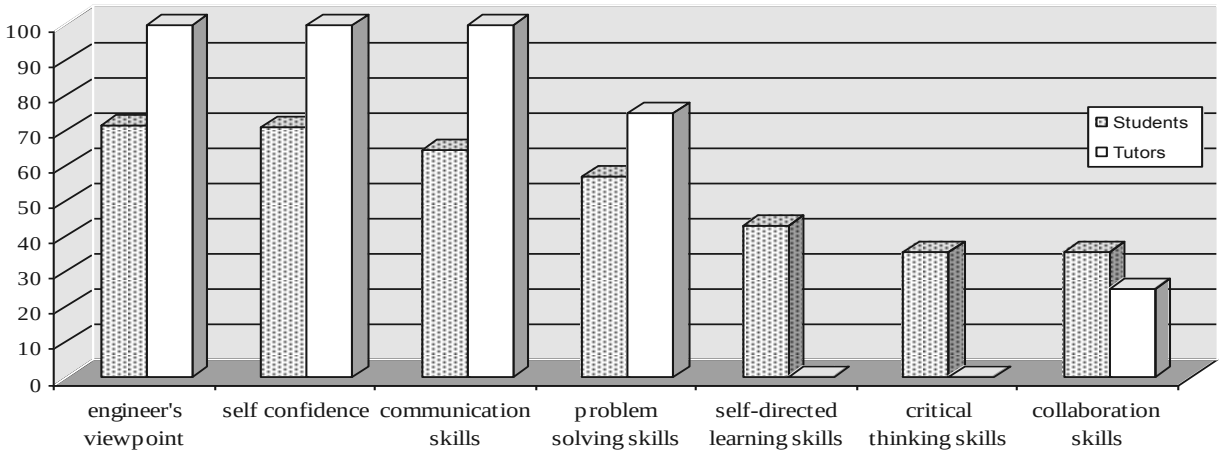

Figure 1. Students' and Tutors' Perspectives about Strengths of PBL

Moreover, students mentioned that they gained some important skills with the help of PBL which are: communication skills (64%), problem solving skills (57%), self-directed learning skills (43%), critical thinking skills (36%), and collaboration skills (36%). The observation notes confirmed that students who participated to the discussions seemed very comfortable while mentioning/sharing their ideas or drawing/writing something on the board. Moreover, the results of students' module questionnaires indicated that average ratings of the students for the evaluation of a program outcome (ability to communicate effectively in both oral and written fashion) and another outcome (a possession of leadership properties, self confidence, and an ability to work in teams) were 3.7 (1: very poor, 5: excellent).

Similarly, three of the tutors mentioned that PBL promoted engineering viewpoint, communications skills, feeling of self confidence, and problem solving skills of the students. One of the tutors emphasized that especially those senior students are very good at expressing themselves, they are enterprising and open minded on approaching a problem.

Besides, another tutor gave example of practical trainings. She explained that in practical trainings, some students coming from the other universities have difficulties in how to start the projects while her students start to do it with courage even if they do not understand the project totally. She believes that they somehow actualize it.

3.3. Weaknesses of PBL and Problems Encountered in PBL

Although most of the interviewees found PBL as a satisfactory methodology and mentioned the strengths of PBL, they also mentioned that there are lots of problems encountered due to the shortcomings in PBL implementations making them unsatisfied with the current situation. Observations also confirmed that some students and tutors seemed unsatisfied with the implementations. This section presents their perceptions about the weaknesses of PBL and difficulties with PBL under the headings of "tutors' weaknesses",

"students' weaknesses", "scenarios' weaknesses", "assessment weaknesses", "presentation weaknesses", "tutors' problems in PBL", and "students' problems in PBL". Table 3 summarizes the interview results related with this section.

Table 3. Interview Results Related with the Weaknesses of PBL and Problems Encountered in PBL

Category	Code	Students (%)	Tutors (%)	Category	Code	Students (%)	Tutors (%)
Tutors' Weaknesses	Difference in PBL implementations	64	75	Scenarios' Weaknesses	Carelessly prepared scenarios	86	100
	Insufficient guidance during modules	50	0		Difference in scenario applications	64	75
	Negative attitude to PBL	43	0		Problems in group works	29	25
	Insufficient preparation for modules	36	75	Assessment Weaknesses	Difference in assessment procedure	93	100
Students' Weaknesses	Insufficient preparation level	43	100		Non-functional assessment	71	100
	Disinterest / negative attitudes	36	75		Too many and too long exams	50	75
	Weaknesses of study habits	29	75	Presentation Weaknesses	Too many presentations	57	50
	Insufficient knowledge about the system	21	25		Difference in presentation styles	29	0
Tutors' Problems	Low number of tutors and increase in their work load	50	100		Inconsistency between presentations & sessions	21	0
	Time inadequacy	36	100	Students' Problems	Loaded curriculum	71	100
	Writing scenarios	0	100		Time inadequacy	71	100
	Deficiency in organization /administrative problems	0	50		Too many exams / adaptation problems	64	0

3.3.1. Tutors' Weaknesses

The most common complaint of students (64%) was different PBL implementations of the tutors. For example, a first grade student mentioned that behaviours and attitudes of the tutors are different from one another. Apart from these, some students stated that tutors do not guide them efficiently (50%), have negative attitudes towards PBL (43%), and come to the sessions unprepared (36%). Although PBL hours are designed as 4 hours in the curriculum, students complained that some tutors may finish a scenario in 15 minutes. For example, a third grade student emphasized that some of the tutors try to clarify the subject even if they don't know about it; some others may look forward to the end of the session on the contrary.

Similarly, three tutors complained that some of the tutors come to the sessions unprepared, and some do not make enough effort to give better guidance. For example, while making interview with him, one expressed his thoughts as follows:

> As far as I can observe, the biggest problem is the insufficient knowledge of the tutor about the module subject. Some tutors are of the opinion that it is enough to read the scenario without analyzing it.

Another tutor added that tutors do not discuss about the modules/scenarios enough before implementing them. According to him, when they have a problem about the module, they can only talk about it after the session finishes.

During observations -as mentioned in "Implementation Process" part- it was observed that two tutors intervened the group discussions more frequently than the others although that much of intervene is not an expected PBL behavior. As a result of interviews, when asked about the reason of this behavior, they stated that problems in the implementation of PBL in their department decrease their motivation and they may not do a work that is appropriate to its definition.

3.3.2. Students' Weaknesses

The primary weakness of the students that the participants (43% students and 75% tutors) mentioned was students' insufficient preparation to the sessions and presentations. Those tutors explained that some students are not interested in/curious about learning and do not have the required studying habits. For instance, one of the tutors stated:

> Students do not do what they are expected to do in sessions. Instead of learning something in sessions, they are content with what is covered in two hours of presentations just like in the conventional lessons. They do not study enough.

Besides, one of the tutors emphasized the big discrepancy between what the students should do and what they do. She complained stating:

> The students do not study in order to learn but study in order to pass the exams. They follow the sessions with that opinion. They are only focusing on the exams. Therefore, they do not demonstrate the behaviours that a PBL student is expected to do.

Similarly, a second grade student confirmed this idea and emphasized that most of the students do not care about the sessions and see those sessions as two hours of past time activity making their burden heavier. Moreover, 29% of the students reported that they fail to develop regular studying habits.

The observation notes confirmed that some students only listened to their friends while certain students tend to answer all questions or tried to put forward an idea. There were always some nonparticipating students preferring only listening to the discussions or seeming disinterested about what is going on around. As a result of interviews, some students and tutors stated that this weakness occurred due to either coming to sessions unprepared or student's low level of adaptation to PBL.

Similarly, one tutor explained the weakness he observed in the freshman students is that they still think that they are educated in the conventional system therefore they can't adapt the new system, at least in the first year.

21% of the students taught that they do not have sufficient information about PBL and that shows why they fail. For instance, a second grade student stated:

> Usually we have PBL sessions before taking presentations. The aim is to make the student come prepared, do brainstorming and make them express their opinions. However most of our friends do not have an idea about it because they think that firstly they should have the conventional presentation and then participate to PBL sessions.

3.3.3. Scenarios' Weaknesses

During interviews, 86% of the students and all of the tutors stated that they faced both well prepared and badly prepared scenarios but almost all of them explained that majority of the scenarios were carelessly prepared. They pointed out the missing parts of the scenarios and the features that the scenarios should have.

Tutors expressed that failing to integrate the subjects in the scenarios is one of the biggest weaknesses. For example one of the tutors pointed out the difficulty of writing scenarios saying:

> I think writing scenario is a work of fiction. Nobody here is a scenarist. We can't integrate the subjects well into the scenarios. Sometimes scenario writers make absurd connections just to integrate one subject to another which cause to decrease the fluency of a scenario. This situation prevents scenarios to be good and quality.

A third grade student found some sessions so difficult that the students could not go further when they have not sufficient input. A second grade student added this idea stating "… although we made connections with real life in some scenarios, there were also some scenarios in which just the subject was given including very difficult proofs that we could not handle."

As additional data, the results of the questionnaire that was prepared and conducted by the delegate of sophomore students were investigated. The results have shown that 64% of the participant sophomores and 60% of the juniors were not satisfied with the scenarios due to the fact that scenarios lacked authentic and interesting problems, they were not applicable, and the connection of them with the module topics were not proper. Moreover, 92% of the participant sophomores and 90% of the juniors marked "No" for the statement of "I think that the PBL sessions are efficient." Observation notes confirmed the tutors' and students' unsatisfaction with the scenarios. While observing the PBL sessions it was noted that students mostly criticized the scenarios while giving feedback about them at the end of each module.

3.3.4. Assessment Weaknesses

Most of the students (93%) and all of the tutors stated that there is no standard assessment procedure that the tutors use while evaluating the students, so it differs from tutor to tutor. Some others (50%) mentioned that they were constantly having exams during final and year-end exams and this affected the quality of education and assessment negatively. A second grade student stated that it was very difficult to have so many exams-especially in the first grade- in a short time interval.

The tutors also criticized the situation of repeating or failing the class. One of them emphasized that by this assessment system, students may pass the class without knowing anything from some modules since the average is taken into account while passing or failing the class. Moreover, the tutors pointed out that final exams, year-end exams and evaluation forms do not function well. One of them criticized the student evaluation form and stated:

> There is a list of criterion that is used to evaluate students but it is nonfunctional. It is too long to fill so it takes too much time. I don't think there left any tutor who pays attention to it.

Additionally, one of the tutors questioned the form of exam questions saying:

> In module exams, I prepare questions related with the presentations like most people do and just like I do in the conventional system. It is not a problem-based exam. We make the same kind of exams as the exams of conventional system. For that reason, if you ask whether the system and the exams are compatible with each other, I'll say no.

3.3.5. Presentation Weaknesses

57% of the students (especially first and second grade ones) complained about having too many presentations in a very short time which reduces the efficiency in PBL. They stated that in these conditions, presentations were not effective and they had to take exams without comprehending the subject. One of the tutors expressed his point of view as follows:

> Think that I was giving a unit in 14 weeks in conventional system whereas in this system I have to give it in 4 weeks causing to make 28 hours presentation in 2 weeks.

Similarly, another tutor mentioned that she added extra presentation and problem solving hours to some modules which are difficult for students to understand. According to her, this application is inconsistent with the nature of PBL. When the program of this department was compared with the conventional program of other engineering departments, it was realized that here, the program was more loaded. Intensity of hours between these programs becomes nearly equal when the PBL session hours are extracted from the program.

21% of the students expressed that they encountered some modules in which there were no parallelism between the scenario and presentations. A third grade student stated:

> Sometimes presentations go fast and sometimes PBL sessions. Presentation can not catch up with the sessions when sessions go fast. In those times, we cover the scenario in the last session before the presentations were covered. There are such disunities.

Besides, one of the tutors emphasized how the presentations take the system away from PBL and stated:

> It is very difficult for us to be adapted to such a system quickly since all of the tutors here are accustomed to conventional system so much. Therefore, it is very difficult to adapt a student to a new system without adapting the tutor.

3.3.6. Tutors' Problems in PBL

Half of the students and all the tutors stated that tutors have problems since there are not enough tutors in the department which cause to increase their work load and restrict their time. For instance, two of the tutors emphasized that they used to have too much time in the conventional system but this system began to be very tiring for them since their burdens became heavier. One of these tutors expressed that she spends too many hours while getting ready for the sessions especially for the ones that are not related her area of specialization.

Moreover, all the tutors emphasized the difficulty of writing scenarios. One emphasized the difficulty of finding appropriate problems for especially totally theoretical modules. Besides, two tutors mentioned their complaints about deficiency in organization and one stated his complaints as follows:

> There is an administrative problem. There is no control over which topics do scenarios cover, to what extend they can be applied, does the problem too complex or too simple etc. There are some modules in which the scenarios haven't changed for 4-6 years.

Lastly, two tutors expressed that their complaints were not paid attention, so their belief and motivation for PBL decreased.

3.3.7. Students' Problems in PBL

Most of the students (71%) and all the tutors mentioned that students' stress levels were increased and they were demotivated due to time inadequacy, loaded curriculum, and taking too many exams. According to a tutor, there is a serious psychological pressure on students in this system due to having lots of exams in short time intervals and possibility of failing.

Moreover, 64% of the students emphasized that most of them could not adapt to the system. They emphasized that one reason of having difficulty to adapt to the system may be being accustomed to conventional learning settings. For example, a second grade student stated that students started to be educated in PBL with reactive feelings and therefore have difficulty to adapt to the system. He also added that some students attend to the tutorials just to exist there and get grade but attend to presentations to learn something since the presentations are done in a directive manner.

Apart from these, five students (36%) stated that they complained about the defects in the implementations but their complaints were not paid attention. He pointed out that this situation caused people to become sceptic about the system.

4. DISCUSSIONS

4.1. Strengths of PBL

In this study, most of the participants mentioned that PBL would foster communication skills and students would gain self-confidence due to PBL tutorials. The observation notes also revealed that students seemed very comfortable while mentioning/sharing their ideas or drawing/writing something on the board. This finding is compatible with the literature since the main strengths of PBL pointed out by the students and tutors were attributed to the fact that it is a satisfactory approach developing students' communication skills (Musal, et al., 2003; Riberio & Mizukami, 2005; Canavan, 2008; Mitchell & Smith, 2008) and self confidence (Riberio & Mizukami, 2005).

Self-directed learning is another skill that PBL focuses on helping students to develop. Hmelo-Silver (2004) stated that good self-directed learners can adapt their personal strategies to the situational demands. Similarly, in a qualitative study, Evensen (as cited in Hmelo-Silver, 2004) interviewed medical students from a PBL group. In his study, the students' self-directed learning strategies evolved over time to adapt to the self-directed learning demands of a PBL program. The same was observed in this study especially in successful students (having high cumulative) or students (higher grade ones) who reported to be adapted to the implementation of PBL. For example one of the successful students emphasized that he became a confident learner that he could easily learn the topics that were in the book and believed that this is important to become an engineer. He emphasized that sometimes he can also learn on his own without attending lectures.

4.2. Weaknesses of PBL and Problems Encountered in PBL

In their study (Dolmans, Grave, Wolfhagen, & Vleuten, 2005), it is pointed out that poor implementation of PBL causes some problems (too directive tutors and dysfunctional tutorial groups) in educational practice. They emphasized that with too directive (dominant) or too passive tutors the learning process is hindered. In a typical dysfunctional tutorial group, activation of prior knowledge does not take place, connections between new ideas and other ideas are not made, and some students in the groups are well-prepared for the sessions but others prepare and involve less. These finding was compatible with the findings of this study. The participants of this study complained and it was also observed that there are some weaknesses in the implementation of PBL causing some problems in their department. For example, students' coming to sessions unprepared and not participating to tutorial sessions was reported as weaknesses for the implementation of PBL. Although students' actively participation to the learning process is one of the main aims of PBL, it seemed that some students could not internalize this role and have adaptation problems.

In fact, not only poor implementation of PBL but also being accustomed to conventional learning settings may cause some problems (such as adaptation) in PBL process. Some participants of this study agreed that one reason of having difficulty to adapt to the system or having negative point of views may be being accustomed to conventional learning settings. For example, one tutor explained: "Since we are accustomed to conventional education so much, it becomes hard to depart from that system and adapt to PBL."

In this study, almost all the participants complained about the assessment procedure while evaluating the students during sessions and exams. This assessment procedure is not

compatible with what literature says. In the literature, researchers question to assess students by conventional type exams in PBL and emphasize that the assessment of students in PBL should include methods of measuring content knowledge as well as higher order skills such as critical thinking and problem-solving skills (Miller, 2000; Gijbels et al., 2005). Frost (1996) and Kaufmann and Holmes (1996) criticized the inadequacy in the assessment procedures of studies. Similarly, in the study of Canavan (2008), students reported the inconsistency between the methods of learning employed during PBL activity and the conventional end of year examination. Our study supports this statement since the interviewees complained that assessment was not effective and functional.

The amount of time involved in implementing PBL is another concern for both tutors and students. Albanese and Mitchell (1993) in the outcomes of their meta-analysis suggested that students spend more time for studying than do conventional students due to its self-directed nature of PBL. Moreover they indicated that it takes more time (~ 20%) to cover the course content using PBL rather than lecture method of instruction. In this study, this aspect was noted by the many participants and mentioned as one of the problems they encountered in PBL. Both the tutors and students complained about lack of time since they had very busy and mixed weekly schedule.

5. IMPLICATIONS AND SUGGESTIONS

This study shows that those students (especially novice ones) who are accustomed to conventional learning may feel uncomfortable while fulfilling their roles (doing research, collaboration with students etc.) and have difficulty to adapt PBL. Similarly, tutors who are unfamiliar with this kind of an unconventional learning environment may feel that PBL is useless and uncertain. Therefore, both tutors and students should not be involved in PBL cursorily until they are familiarized with their roles, benefits of PBL, process and the learning environment thoroughly. It is necessary to develop a detailed student training/orientation program addressing their roles (how they work in sessions, how to collaborate in sessions, how to improve their study skills etc.). Moreover, tutors training programs should be given more importance and tutors should be trained about their roles/responsibilities (how to guide students, how to write a scenario, how to assess students etc).

This study shows that the tutors have some problems/weaknesses in terms of assessment, tutorial skills, time inadequacy, disorganization, workload, adaptation to the system, etc. They mentioned those issues and complained that their suggestions/complaints were not taken into consideration and the system could not refresh itself. By examining the results of the study, we can say that tutors are reactive to the operation of the curriculum. Therefore, communication of tutors between themselves and administrators should be improved. There should be regular/continued evaluation of PBL processes at institutions to discuss the program regularly by giving and receiving feedback.

Curriculum developers of the universities implementing PBL (especially in engineering education) should take into consider the problems/weaknesses mentioned by the participants of this study about the implementation of PBL while evaluating their curriculum and making necessary revisions to improve their performance and instructional practices. Moreover, faculty, educators, or administrators that are planning to adapt PBL to their curriculum may make well-informed choices about whether to adapt it, how to adapt it in their settings and which outcomes may be achieved as a result of their adaptations.

Appendix

Some Items Belong to Observation Checklist

Element	PBL Characteristics / Criteria	Rating of Evidenced*				
		Module I	Module II	Module III	Module IV	Module V
Students						
	Actively participate in group learning					
	Take responsibility for own learning					
	Skillful in communicating with peers					
Tutors						
	Facilitate, coach, guide of group processes					
	Provide direct instruction about what is needed (negative criteria)					
	Intervene group process					
PBL Session						
	Is a student-centered process					
	Consists a learning group small in size (6-10)					
	Allows collaboration					
	Begins with the problem encounter					
	Ends with analysis and reflection of what was learned					
Assessment						
	Occurs often (is on going- embedded)					
	Involves problem solving skills and self-directed learning skills					

* *Always: A* *Frequently: F* *Sometimes: S* *Never: N*

6. REFERENCES

Albanese, M. A., & Mitchell, S. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. *Academic Medicine, 68,* 52-81.

Arambula-Greenfield, T. A. (1996). Implementing problem-based learning in a college Science class. *Journal of College Science Teaching, 26*(1), 26-30.

Barman, A., Jaafar, G., & Naing, N. N. (2006). Perception of students about the problem-based learning sessions conducted for medical and dental schools' students of University Sains Malaysia. *Education for Health, 19*(3), 363-368.

Barrows, H. S. (1986). A taxonomy of problem-based learning methods. *Medical Education, 20,* 481-486.

Berkson (1993). Problem-based learning: Have the expectations been met? *Academic Medicine, 68,* 79-88.

Bogdan, R., & Biklen, S. K. (1998). *Qualitative research for education: An introduction to theory and methods* (3rd ed.). Needham Heights, MA: Allyn & Bacon.

Canavan, B., (2008), A summary of the findings from an evaluation of problem-based learning carried out at three UK universities, International *Journal of Electrical Engineering Education, 45* (2), 175-180.

Charlin, B., Mann, K., Hansen, P. (1998). The many faces of problem-based learning: a framework for understanding and comparison. *Medical Teacher, 20*(4), 323-330.

Colliver, J. A. (2000). Effectiveness of problem-based learning curricula: research and theory. *Academic Medicine, 75*(3), 259-266.

Dahlgren, M. A., Castensson, R., & Dahlgren, L. O. (1998). PBL from the teachers' perspective. *Higher Education, 36*, 437-447.

DeGrave, W. S., Boshuizen, H. P. A., & Schmidt, H. G. (1996). Problem-based learning: Cognitive and metacognitive processes during problem analysis. *Instructional Science, 24*, 321-341.

Denayer, I., Thaels, K., Vander Sloten, J. & Gobin, R. (2003). Teaching a structured approach to the design process for undergraduate engineering students by problem-based education. *European Journal of Engineering Education, 28*, 203-214.

Dochy, F., Segers, M., Van den Bossche, P. & Gijbels, D. (2003). *Effects of problem-based learning: a meta analysis. Learning and Instruction, 13*, 533-568.

Dolmans, D. (2003). The effectiveness of PBL: the debate continues. Some concerns about the BEME movement. *Medical Education, 37*(12), 1129-1130.

Dolmans, D., Grave, W., Wolfhagen, I. & Vleuten, C. (2005). Problem-based learning: future challenges for educational practice and research. *Medical Education, 39*, 732-741.

Frost, M. (1996). An analysis of the scope and value of problem-based learning in the education of health care professionals. *Journal of Advanced Nursing, 24*, 1047-1053.

Gijbels, D., Dochy, F., Van den Bossche, P., & Segers, M. (2005). Effects of problem-based learning: a meta analysis from the angle of assessment. *Review of Educational Research, 75*(1), 27-61.

Guzelis, C. (2006). An experience on problem-based learning in an engineering faculty. *Turkish Journal of Electrical Engineering 14*, 67-76.

Hadgraft, R. (1999). Student reactions to a problem-based, fourth-year computing elective in civil engineering. *European Journal of Engineering Education, 22*, 115-123.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology review, 16*(3), 235-266.

Hollingshed, M. M. T. (2004). Students' perceptions of problem-based learning in an introductory computer application course. *Dissertation Abstracts International, 65*(10), 3768A. (University Microfilms No. AAT3150640). Retrieved, February 20, 2007, from Digital Dissertations database.

Kaufman, D. M., & Holmes, D. B. (1996). Tutoring in problem-based learning: perceptions of teachers and students. *Medical Education, 30*, 371-377.

Kaufman, D. M., & Mann, K. V. (1996). Students' perceptions about their courses in problem-based learning and conventional curricula. *Academic Medicine, 71*(1), 52-55.

Kuntalp., D.G., Oztura, H., Yuksel, Y., Kuntalp, M., & Güzeliş, C. (2002). *How to create scenarios for problem-based EEE curriculum*. Paper presented at the New Information Technologies in Education Symposium, Izmir, Turkey.

Lee, W (2004). Exploring professional knowledge and practices collaboratively in problem-based discussions: online and face-to-face discourses in a nursing class. *Dissertation Abstracts International, 65*(10), 3719A. (University Microfilms No. AAT3150017). Retrieved, March 15, 2007, from Digital Dissertations database.

Major, C. H., & Palmer, B. (2001). Assessing the effectiveness of problem-based learning in higher education. *Academic Exchange Quarterly, 5*(1), 4-9.

Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education*. San Francisco: Jossey-Bass.

Miller, P. J. (2000). The relationships among peer assessments, self-assessments, and faculty assessments of student-performance in problem-based learning. *Dissertation Abstracts International, 61*(12), 4674A. Retrieved, June 17, 2005, from Digital Dissertations database.

Musal, B., Taskiran, C., Kelson, A. (2003). Opinions of tutors and students about effectiveness of PBL in Dokuz Eylul University School of Medicine. Med Educ Online, 8(16), 1-5. 08. 03. 2008 tarihinde http://cogprints.org/3361/1/f0000073.pdf adresinden alınmıştır.

Patton, M. Q. (2002). *Qualitative Research and Evaluation Methods*. 3 rd ed. Thousand Oaks, CA: Sage.

Perrenet, J. C., Boutuijs, P. A. J., & J. G. M. M. Smits. (2000). The suitability of problem-based learning for engineering education: theory and practice. *Teaching in Higher Education 5*(3), 345-358.

Polanco, R., Calderón, P. & Delgado, F. (2004). Effects of a problem-based learning program on engineering students' academic achievements in a Mexican university. *Innovations in Education and Teaching International, 41*(2), 145-155.

Prince, M. J. (2004). Does active learning work? A review of the research. *Journal of Engineering Education, 93*(3), 223-231.

Ribeiro, L. R. C., & M. G. N. Mizukami. (2005). Problem-based learning: a student evaluation of an implementation in postgraduate engineering education. *European Journal of Engineering Education 30*(1), 137-149.

Ryan, G. (1993). Student perceptions about self-directed learning in a professional course implementing problem-based learning. *Studies in Higher Education, 18*(1), 53-63.

Said, S. M., Adıkan, M., Mekhilef, S. & Abd Rahim, N. (2005). Implementation of the problem-based learning approach in the department of electrical engineering, University of Malaya. *European Journal of Engineering Education, 30*(1), 129-136.

Savin-Baden, M. (2008). Problem-based learning in electronic engineering: locating legends or promising problems? *International Journal of Electronic Engineering Education. 45*(2), 96-109.

Smits, P. B. A., Verbeek, J. H. A. M., & de Buisonje, C. D. (2002). Problem-based learning in continuing medical education: a review of controlled evaluation studies. *British Medical Journal, 324*, 153–156.

Vernon, D. T. (1995). Attitudes and opinions of faculty tutors about problem-based learning. *Academic Medicine, 70*(3), 216-223.

Vernon, D. T., & Blake, R. L. (1993). Does problem-based learning work? A meta-analysis of evaluative research. *Academic Medicine, 68*(7), 550-563.

Yin, R. K. (2003). Case *study research: Design and Methods* (3rd ed.). Thousand Oaks, CA: Sage.

Genişletilmiş Özet

Probleme dayalı öğrenme (PDÖ), öğrencilerin en iyi çözüme ulaşabilmek için gerçek yaşam problemleri üzerinde çalışarak öğrenmelerinde aktif bir şekilde rol aldıkları öğrenci merkezli bir öğretim yöntemidir (Arambula-Greenfield, 1996). PDÖ ilk olarak McMaster Üniversitesi tıp fakültesi öğrencileri için, geleneksel tıp eğitimindeki boşlukları doldurmak amacı ile tasarlanmıştır. Ancak zamanla, diğer tıp okulları ve hatta diğer fakülteler tarafından da kullanılmaya başlanmıştır. Örneğin mühendislik, geleneksel eğitimde oluşan boşlukları doldurmak için PDÖ'nün bir öğretim yöntemi olarak kullanıldığı popüler branşlardan biri haline gelmiştir (Ribeiro and Mizukami 2005; Said, Adıkan, Mekhilef, & Abd Rahim, 2005; Guzelis 2006).

Literatüre baktığımız zaman bu öğretim yöntemi ile ilgili çalışmalarda görebildiğimiz bazı eksiklikler şu şekildedir: PDÖ uygulamaları sırasında ortaya çıkan gerçek öğrenim sürecinin yeterince incelenmemesi, bu uygulamaların sonuçlarındaki belirsizlik, tıp alanı dışındaki alanlarda yeterli sayıda detaylandırılmış çalışmanın mevcut olmaması ve bu çalışmaların çoğunun nicel deneysel desenleri tercih etmiş olması (Charlin, Mann, & Hansen, 1998; Dolmans 2003; Lee 2004). Aslında, PDÖ uygulamalarını ve ortamını değerlendirmek üzere, örneğin öğrenci ve öğretim elemanlarının düşünce ve algılamalarını ortaya koymaya yönelik çalışmalar yok değildir (Hollinshed, 2004; Ribeiro & Mizukami, 2005; Barman, Jaafar, & Naing, 2006). Ancak, bahsettiğimiz gibi, bu çalışmaların da çoğu tıp alanındadır ve bunların çok azı detaylı ve zengin betimlemelerle PDÖ ortamında neler olduğunu ve öğrenci ve öğretim elemanlarının PDÖ uygulamaları sırasındaki algılamalarını ortaya koymaktadır. Bu gibi nedenlerle bu çalışma, öğrenci ve öğretim elemanlarının gözüyle, mühendislik eğitimindeki PDÖ uygulamalarının zayıf ve güçlü yanlarını tayin etmeyi ve uygulamada karşılaşılan güçlükleri belirlemeyi amaç edinmiştir.

Çalışma, 2006-2007 eğitim yılının bahar döneminde, PDÖ yöntemini o zamanlar 4-5 yıldır uygulamakta olan bir mühendislik bölümünde gerçekleştirilmiştir. Çalışmada, nitel araştırma yöntemlerinden örnek olay yöntemi kullanılmıştır. Bahsedilen öğretim yılında bölümde bulunan 22 öğretim elemanı ve 284 lisans öğrencisi içerisinden amaçlı örnekleme yöntemi kullanılarak 4 öğretim elemanı, 5 PDÖ modülü ve 14 öğrenci seçilmiştir. Bu araştırmada temel veri toplama araçı olarak katılımsız gözlem ve yarı yapılandırılmış görüşme teknikleri kullanılmıştır. Veri analizi sonucunda PDÖ uygulamasının başlıca güçlü yönleri olarak şunlar belirlenmiştir: öğrencilerin mühendislik bakış açısında güçlenme; kendine güvenlerinde artış; iletişim, problem çözme ve öz yönlendirili öğrenme becerilerinde artış. Diğer taraftan, PDÖ uygulamasının zayıf yönleri ve karşılaşılan problemler ise yedi alt başlık altında açıklanmıştır: öğretim elemanlarının eksiklikleri, öğrencilerin eksiklikleri, senaryoların eksiklikleri, değerlendirmenin eksiklikleri, sunumlardaki eksiklikler, öğretim elemanlarının karşılaştığı problemler ve öğrencilerin karşılaştığı problemler.

Bu çalışmada, katılımcıların çoğu PDÖ uygulamasının öğrencilerin iletişim becerilerini arttırdığını ve onlara öz güven kazandırdığını belirtmişlerdir. Gözlem verileri de, öğrencilerin düşüncelerini ifade ederken, fikirlerini paylaşırken ya da tahtada yazıp çizerken oldukça rahat göründüklerini desteklemektedir. Bu bulgular, literatürde PDÖ uygulamasının öğrencilerin iletişim becerilerine (Musal, et al., 2003; Riberio & Mizukami, 2005; Canavan, 2008; Mitchell & Smith, 2008) ve öz güvenlerine (Riberio & Mizukami, 2005) etkileri ile ilgili bulgular ile de uyumludur.

Dolmans, Grave, Wolfhagen ve Vleuten (2005) çalışmalarında, zayıf PDÖ uygulamalarının eğitim süresince neden olduğu bazı problemlere dikkat çekmiştir. Bu çalışma da onların bulguları ile uyumludur. Katılımcıların belirttiği ve gözlemlerin betimlediği üzere, PDÖ uygulamaları sırasında bazı zayıflıklar vardır ve bu zayıflıklar bir takım problemleri tetiklemektedir. Katılımcıların en yoğun olarak bahsettikleri eksiklik ve problemler şunlardır: öğrencilerin yüklü müfredatı, öğretim elemanlarının iş yükündeki artış, öğrenci ve öğretim elemanlarının yaşadığı zaman sıkıntısı ve adaptasyon sorunları, amaca uygun senaryo yazılmasında yaşanan güçlük, öğrencilerin ilgisizliği ve yeterince hazırlık yapmaması, öğretim elemanlarının PDÖ uygulamaları sırasında kendi içlerinde çelişmesi ve değerlendirmenin işlevsel olmaması. Öğretim elemanları ve öğrenciler, yaşadıkları problemlerle ilgili olarak öneri ve şikayetlerinin yeteri kadar dikkate alınmamasından dolayı sistemin kendi içinde yenilenmediği ve düzeltilemediğini vurgulamışlardır. Bu nedenle, öğretim elemanları ve öğrencilerin PDÖ müfredatının dolayısı ile PDÖ uygulamalarının bu şekilde uygulanmasına tepkili olduklarını söyleyebiliriz. Dolayısı ile öğretim elemanları ve

öğrenciler ile yöneticilerin iletişiminin kuvvetlendirilmesi gereği bu çalışmanın önemli bir bulgusu olarak ortaya çıkmaktadır. Fakültelerde, geri dönüt almaya ve programın uygulanışını izlemeye yönelik, devamlı ve düzenli bir PDÖ değerlendirmesi yapılmalıdır. Bu çalışma aynı şekilde göstermektedir ki, öğrenciler -özellikle geleneksel yönteme alışkın olan yeni öğrenciler- PDÖ uygulamaları esnasında kendilerine düşen rolü yerine getirirken zorlanabilir ve rahatsız olabilirler. Benzer şekilde PDÖ uygulamalarına aşina olmayan öğretim elemanları, PDÖ'nün gereksiz ve etkisinin belirsiz olduğunu düşünebilirler. Dolayısı ile PDÖ'nün felsefesini anlamadan; rollerine, PDÖ'nün güçlü ve zayıf yönlerine, yaşanabilecek problemlere, bu problemlerle nasıl başedebileceklerine, dolayısıyla sürece ve öğrenme ortamına iyice aşina olmadan gelişigüzel bir şekilde PDÖ sürecine dahil olmamaları gerçeği ortaya çıkmaktadır. Bu nedenlerle öğrenciler, kapsamlı bir PDÖ tanıtım programı ile uygulama öncesinde kendilerine düşen roller (PDÖ oturumlarında nasıl çalışacakları, arkadaşlarıyla nasıl iş birliği yapacakları, çalışma becerilerini nasıl geliştirecekleri vs.) hakkında bilgilendirilmeliler. Ayrıca, öğretim elemanları için hazılanmış eğitim programlarına daha çok önem verilmeli ve kendilerine rolleri ve sorumlulukları (öğrencileri nasıl yönlendirebilecekleri, senaryo yazarken nelere dikkat edilebileceği, öğrencileri nasıl değerlendirebilecekleri vb.) ile ilgili eğitim verilmelidir. Son olarak, bu sonuçlar, PDÖ müfredatı hazırlarken, değerlendirirken ya da uygulamalar sırasında oluşan eksiklikleri gidermek ve problemleri çözmek için müfredat geliştiricileri ve yöneticiler tarafından dikkate alınmalıdır.