The Effect of Problem Based Learning on Student Motivation Towards Chemistry Classes and on Learning Strategies

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SYNOPSIS

INTRODUCTION

Solutions and their physical properties is one of the subjects which has a significant and wide coverage in high school and university chemistry curriculum; which is related to many chemistry topics; and which helps students to explain a set of facts that they might face in daily life. As in many other countries, solutions and solubility subjects are mostly centered upon numerical problems in our country’s education system. For instance, when a solute is added to a pure dissolvent, the vapor pressure, boiling point and freezing point of the solution changes according to pure solvent. Successful solution of these quantitative results regarding the amount of this change by the students will have specific contributions for them. However, it is stated that the basic concepts of the problem were not understood sufficiently or misunderstood (Smith & Metz, 1996; Pinarbasi & Canpolat, 2003). Understanding such changes requires thinking about the behaviors of particles in a molecular sense as well as understanding how these behaviors reveal themselves in such macroscopic properties as boiling point elevation, freezing point depression and vapor pressure lowering.

PURPOSE OF THE STUDY

The purpose of this study is to identify the effect of Problem Based Learning (PBL) on the motivation and learning strategies of university students on their chemistry classes by comparing it with traditional teaching method. To this end, problem cases considering the attainments, including the goals to be achieved, in the scope of solutions and their physical properties subject within the general chemistry class at undergraduate level were prepared to use in problem sessions. Besides, the appropriate of these problem cases to Bloom’s revised cognitive taxonomy levels was determined, on one hand, and expert opinions were taken...
using the problem rating scale developed by Tatar (2007), to identify the level of having 10 basic properties that should be in a PBL problem, on the other hand.

**METHODOLOGY**

Non-equivalent control and comparison groups pre-post test design, which is a quasi-experimental research design, was used in this study (McMillan & Schumacher, 2006, p.273).

The participants of the study were 84 first grade students in two different classes at Ataturk University, Kazım Karabekir Education Faculty, Department of Elementary Education, Science Education Programme and taking General Chemistry-II classes in 2009/2010 spring semester; and 9 lecturers from the Chemistry Teaching Programme of the same university.

**Data Collection Tools**

a) **Motivated Strategies for Learning Questionnaire**

To determine the effect of PBL on student motivation towards chemistry courses and its effects on learning strategies Motivated Strategies for Learning Questionnaire (MSLQ), which was first developed by a group of researchers in 1986 at “University of Michigan, Center for Study of Higher Education and National Research” and improved by Pintrich, Smith, Garcia and McKeachie in 1991, was used. This is a Likert-type scale including 81 questions. Adaptation of the questionnaire into Turkish was made by some researchers who were unaware of each other on different samplings at different periods (Buyukozturk, Akgun, Ozkahveci & Demirel, 2004; Altun & Erden, 2006; Karadeniz, Buyukozturk, Akgun, Kilic-Cakmak & Demirel, 2008).

b) **Problem Scenarios**

Considering the acquisitions with which students will be equipped within solutions and their physical properties subject and benefiting from the literature (Ebenezer & Erikson, 1996; Smith & Metz, 1996; Blanco & Prieto, 1997; Ebenezer & Fraser, 2001; Pinarbasi, 2002; Calik, Ayas & Ebenezer, 2005) regarding the existing misconceptions of the students, 5 problem situations to be used in problem sessions were prepared by the researchers. Each problem situation includes a topic, image, text and key words.

c) **Problem Rating Scale**

Whether the problem situations prepared by researchers really have the adequate qualities for PBL method or not was carefully examined. To this end, problem rating scale, which was developed by Tatar (2007), was used.

d) **Scale that Determine Problem Cases in Accordance with Student Attainment**

The acquisitions of solutions and their physical properties subject were determined and listed. When determining these acquisitions both the subject area of solutions and their physical properties and Bloom’s revised cognitive taxonomy levels (remembering, understanding, applying, analyzing, evaluating and creating) were taken into account. The list of acquisitions prepared was checked by 8 lecturers of Atatürk University, Kazım Karabekir Education Faculty Secondary Science and Mathematics Education Department for their opinions and suggestions.

e) **Interview**

An interview protocol was prepared to find out the opinions of the experimental group students regarding the application process and to bring out ideas that cannot be revealed through the other scales.
FINDINGS

According to the results of pretest data, the motivation of the students towards chemistry courses, the cognitive and metacognition self-regulation and resource management strategies of both experimental and control group students had similar features. The post-application findings of the research revealed that PBL method had positive contributions on some of the sub-dimensions of motivational beliefs dimensions which are; target orientation, topic value and self-efficacy; statistically, it had no significant effect on focus on goal (p>0.05), learning beliefs (p>0.05) and exam anxiety (p>0.05). Also, the post-application findings of the research revealed that PBL method had positive contributions on some of the sub-dimensions of the cognitive and metacognition self-regulation and resource management strategies which are; elaboration, critical thinking and metacognitive self-regulation, regulation of time and work environment, effort regulation, peer learning and help searching; statistically, it had no significant effect on repetition (p>0.05) and organization skills (p>0.05).

DISCUSSION and CONCLUSION

In this study, the level of efficiency of two different teaching methods were tried to be found out in the scope of general chemistry courses of science teaching programme. According to the results of pretest data, the motivation of the students towards chemistry courses, the cognitive and metacognition self-regulation and resource management strategies of both experimental and control group students had similar features. These results fit the purpose of equalizing groups before the study and determining the level of efficiency of the methods.

The post-application findings of the research revealed that there is a significant difference on behalf of experimental group in their motivation towards chemistry course and cognitive and metacognition self-regulation and resource management strategies.

In general, it is understood that there is a statistically significant difference between experimental and control group means after the application. However, while PBL method had positive contributions on some of the sub-dimensions of motivational beliefs dimensions which are; target orientation, topic value and self-efficacy; statistically, it had no significant effect on focus on goal (p>0.05), learning beliefs (p>0.05) and exam anxiety (p>0.05). This situation can be explained with the fact that the PBL applications were limited to 5 weeks. This period of time is not enough to expect a positive impact on students’ learning beliefs. This situation is in harmony with the finding of the study of Tarhan et al. (2008), stating “students understand the nature of PBL in general, however, they are not ready for PBL method yet and they need some time to be experienced in this method.” Besides, since students are new in PBL method and PBL classes are not taught based on a curriculum, it is found that PBL method have not left a positive impression on students’ exam anxiety.

In the literature, it is reported that in some studies PBL method proved positive results in students’ motivation or their attitudes towards science courses (Diggs, 1997; Ram, 1999; Senocak, Taskesenligil & Sozbilir, 2007; Tarhan & Acar, 2007; Rajab, 2007; Serin, 2009; Kelly & Finlayson, 2009), while in some it had no effects (Kocakoglu, 2008). On the other hand, in some studies it is found that PBL had no positive effect on students’ exam anxiety, self-efficacy and learning beliefs (Sungur, 2004).

In determining the change in student motivation interviews were made as well as application of Motivated Strategies for Learning Questionnaire (MSLQ). Data obtained from the interviews showed that PBL method had positive impact on target orientation, topic value and self-efficacy, which are the sub-dimensions of motivation of students towards chemistry. Moreover, although the modified averages of experimental group students on exam anxiety
are higher than the control group students; some students stated that PBL method helped them control exam anxiety.

It is possible to say that PBL develops such skills as elaboration, critical thinking and metacognitive self-regulation, regulation of time and work environment, effort regulation, peer learning and help searching but has no effect on repetition and organization skills. In addition, data obtained from the interviews showed that there is an increase particularly in students’ elaboration, metacognitive self-regulation, help searching and peer learning skills. In PBL students developed their decision-making skills by associating their existing knowledge with new information they acquired while providing alternative solutions to problem situations. When discussing and analyzing the problem situations in PBL method, students improve their self-learning skills, realize their strengths and weaknesses and identify missing points in their learning.

In the literature, it is reported that PBL method develops students’ self-adjustment (Senocak, 2005; Tarhan & Acar, 2007), sharing information, attending group activities (Tarhan & Acar, 2007), scientific and critical thinking skills (Tarhan, Ayar-Kayali, Ozturk-Urek & Acar, 2008) and their self-efficacy beliefs towards learning science (Rajab, 2007).

In a study by Araz (2007), it is reported that PBL method helps students to be more successful in such skills as using the necessary information in a given problem, putting the ambiguities forward, organizing the concepts and interpreting the data; and in another study by Ram (1999) it is reported that at the beginning of the semester students use internet and especially yahoo.com more frequently and find it sufficient. However, as the semester passed, they examined books and magazines in depth, and found these resources more efficient than internet.

It is understood that informal interviews with the lecturers in the preparation phase of the problem situations, determination of the concepts that students have difficulty in understanding or misconceptions of students, literature review to identify the misconceptions about solutions and their physical properties as well as consulting to a lecturer who studies doctorate in the field sufficiently meet the skills that developed problem situations aims to bring in. Besides, it is identified that problem situations prepared with the expert opinions meet the level of having 10 basic properties in a PBL problem at medium and adequate level.
REFERENCES


