BUCA EĞİTİM FAKÜLTESİ DERGİSİ 30 (2011)

A STUDY ON THE EFFECT OF CASE BASED LEARNING FOR PRE-SERVICE SCIENCE TEACHERS' ATTITUDES TOWARDS AN ANALYTICAL CHEMISTRY LABORATORY EXPERIMENT

FEN BILGISI ÖĞRETMEN ADAYLARININ BIR ANALITIK KIMYA LABORATUARI DENEYINE YÖNELIK TUTUMLARINA ÖRNEK OLAYA DAYALI ÖĞRENME YÖNTEMININ ETKISI HAKKINDA BIR ARAŞTIRMA

Sibel KILINÇ ALPAT*, Melis Arzu UYULGAN, Özge ÖZBAYRAK***, Şenol ALPAT******

Abstract

It is aimed to analyze the change of the pre-service science teachers' attitudes towards chemistry laboratories using case-based learning, an active learning method, in this research. This research is an semi-experimental study with a control group. The sample of this research was originated by the second-year students (N=61) of the department of science education in Dokuz Eylul University, Faculty of Buca Education. In the first stage of the research, a case about the experiment of determining the ionization constant of weak acid (K_a) was created and the case was discussed among the student groups in the experimental group as a workshop. In the second stage, the experiment was performed in the laboratory. And in the control group, the experiment was performed using conventional teaching methods. In conclusion, the effectiveness of case-based learning method in the attitudes of students towards chemistry laboratories was analyzed.

Key Words: Case-Based Learning, Workshop, Attitude towards Chemistry Laboratory, Science Teaching

1. INTRODUCTION

To make the learning process of the students more lasting and meaningful, it is important to expose them to different experiences in learning environments. Thus, students reach new information by researching and discovering with the help of the related information they acquired in advance. To be able to provide these learning environments, constructivism in science education and especially in laboratory activities is of great importance (Zuzovsky, 1999).

The significance of constructivism in science education result from students' creating the information they acquired from their environment with their own conceptions in their minds. Several learning methods are used in constructivism. The one that is the most important in terms of science education is case-based learning (Horzum and Alper, 2006). In

* Yrd. Doç. Dr., Dokuz Eylül Üniversitesi, Buca Eğitim Fakültesi, OFMAE, sibel.kilinc@deu.edu.tr
**Arş. Gör., Dokuz Eylül Üniversitesi, Buca Eğitim Fakültesi, OFMAE, melis.cekci@deu.edu.tr
*** Arş. Gör., Dokuz Eylül Üniversitesi, Buca Eğitim Fakültesi, OFMAE, ozge.ozbayrak@deu.edu.tr
****Yrd. Doç. Dr., Dokuz Eylül Üniversitesi, Buca Eğitim Fakültesi, OFMAE, senol.alpat@deu.edu.tr

this learning method, students are given a written case about a part of a subject. With the questions asked about the case, students are enabled to think about the case and to discover the theoretical basis in the case. Thus, the high-level cognitive area efficiency of students is also improved (Thomas et al., 2001).

According to Horzum and Alper (2006), there are highly favorable aspects of case-based learning. One of these is the fact that students can improve their skills to work in teams and to find solutions to any problems they may encounter in the future easily. This method is also said to be used effectively in training teachers (Flynn and Klein, 2001).

Different learning methods, problem based learning, case based learning, project based learning, context based learning etc., can be used in constructivist learning approach. These teaching methods are not completely different each other. Common aim of these methods for the students is to produce solutions of existing problems by investigating topics and resources.

The context-based approach is the employment of more 'real-life' examples. It has also been identified as a recommendation for the teaching of chemistry following a review of the science curriculum in schools. The materials which are used in this approach tend to focus on applied areas of chemistry, such as industrial, pharmaceutical, forensic, and environmental chemistry. This approach has already been used in higher and undergraduate education of United Kingdom (Belt et al., 2005). In this approach there are case studies which revealed that not only could the problem-based or case-based approach deliver curriculum content, but it also succeeded in engaging, enthusing and motivating undergraduates in chemistry (Belt & Phipps, 1998; Belt et al., 1999, 2002; Summerfield et al., 2003). In the context based learning when the context selection, the students would be motivated by a related theme, since it is topical (and will continue to be so in the foreseeable future), relevant to all students, and encompasses both economic and environmental considerations. As a difference between context-based learning and case or problem based learning, it covers students' and teachers' social and cultural environment where the school take place.

Problem-based learning (PBL) is also known as case-based learning. While there isn't any universally-accepted definition of PBL in the literature (Maudsley, 1999), the basis of PBL can be thought as the use of a real - life problem or situation as a context for learning (Morgan, 1983; Barrows, 1985; Boud, 1985; Duch, 1995; Domin, 1999; Michel et al., 2002). Students should be free in analyzing the problem in the PBL environment using their context and environment (Coles, 1990, 1991) and they should construct a method for arriving at a detailed analysis, if not a final conclusion (this process is sometimes referred to as "situation-based learning") (Dockett and Tegel, 1993; Russell, Creedy, and Davis, 1994; Cheaney and Ingebritsen, 2005).

Considering the difference between problem based learning (PBL) and case based learning (CBL), problem is presented to students directly in the problem based learning. In

the case based learning, the problem is revealed by focusing of the students on the sample from daily-life (Boud and Feletti ,1997; Cox, 2003; 2004; Christensen and Hansen, 1986; Duch, Groh and Allen; 2001). This teaching method includes searching a topic and decision making of group or individual. Students can put theirselves in heroes of story and thus they gain motivation for research. Furthermore, connection with daily life of their knowledge and developing students' abilities for problem solving, analyzing, individual learning and collaborative learning can be realized by using this method (Naumes and Naumes, 1999). Case based learning also focuses on student's development of positive attitudes towards learning, creating awareness in their cognitive levels and developing their learning ability in high levels. CBL is carried out as the way in the Fig. 1.

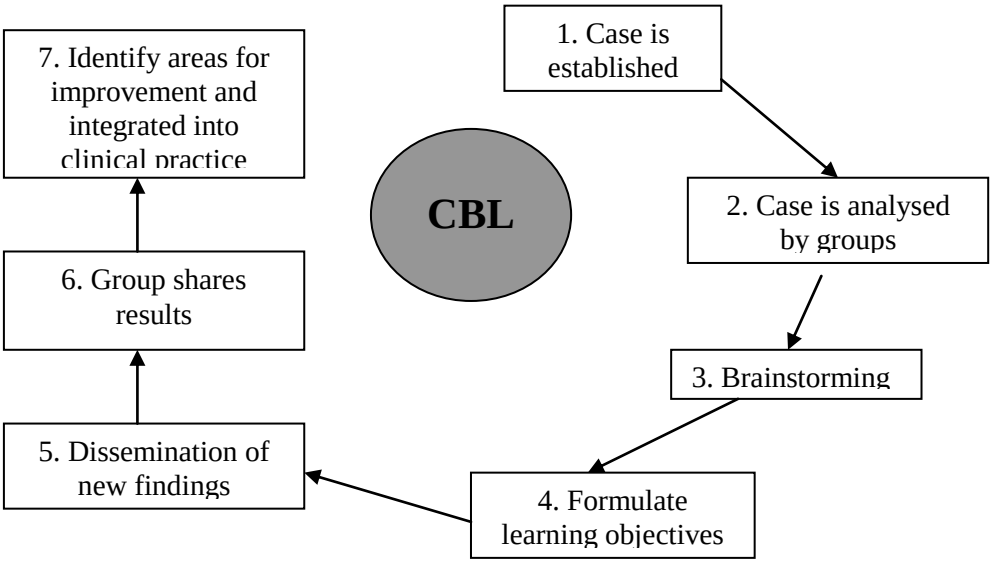


Figure 1. The case based learning (CBL) process (Williams, 2005).

After using different teaching methods during several study sessions, several significant aspects of the students' attitudes to CBL were demonstrated by Kassebaum et al (1991). These results show that the CBL method is better than other teaching methods on students' abilities for asking questions and making comments during class discussion. The studies made on CBL demonstrate that many of the students enjoy CBL and easily adapt to this method (Çam and Geban, 2011).

Pearson et al. (2003), Kassebaum et al. (1991) and Hansen et al. (2005) discussed the comparison between traditional teaching method and case based learning. Pearson et al. (2003) stated that innovative case based learning (CBL) will effectively help the traditional teaching.

Kassebaum et al. (1991) brought out that the students, on whom the CBL was carried out, can ask better questions, can comment better in the classes and that CBL makes learning more entertaining. Articles have shown that many students like CBL and find it enjoyable.

Jones (1997) expressed that students like cases and think that they are convenient for real life. Arambula – Greenfield (1996) stated that with the CBL students can easily contact a relation between cases and the method also helps their personal development. Cliff (2006) projected a case study in order to enrich the understanding of oxygen transfer with blood-borne.

Çam and Geban (2011) were applied case based learning as a small group format in their study. General chemistry subjects, dissolution, stochiometry, chemical equations, ionic compounds, chemical equilibrium characteristics, solubility, common ion effects and Le Chatelier's principle, were studied. In the result of this study, they have found that case based learning could have positive effect on students' attitudes towards chemistry. Some studies also show whether gender differences affect their attitudes or not (Dhindsa and Chung, 1999; Barnes et al. 2005; Salta and Tzougraki 2004).

In this study, CBL, not commonly used in Turkish education system, was used in Dokuz Eylul University, in the Faculty of Buca Education, the Department of Science Education, in the class of analytical chemistry laboratory and the differences in the attitudes of the students towards the class were analyzed.

2. METHOD

In this research, "semi-experimental model with pretest-posttest control group" was used. Due to the use of semi experimental model, instead of choosing universe and sample, working group was selected considering equality.

Quantitative data of this research was collected an attitude scale towards chemistry laboratory. A valid and reliable attitude scale prepared and developed by Demirtaş (2006) related to the laboratory attitudes of students were used as a data collection tool. In order to achieve effective data collection, a likert-type scale was used. The items in the questionnaire were listed according to the scale of "strongly agree, agree, not sure/undecided, disagree, and strongly disagree." The reliability co-efficient of the scale (KR-20) is 0.8831. The scale was applied to the students in experimental and control groups first as a pretest and then as a posttest.

Qualitative data was collected by means of the interviews. As another data collection tool semi- structured interviews were made with the students. Opinions of the students in experimental and control groups on laboratories were acquired by semi-structured interview questions.

Semi-structured interviews was performed with a total of 10 students; five of the experimental, five of the control group. The main objective of the interviews is to determine how case-based learning method creates an impression on the students' attitudes towards analytical chemistry laboratory.

Semi-structured interview questions were given below;

- What is your opinion on difference between applied case based learning method and conventional learning method in Analytical chemistry laboratory?
- How the used method affects your awareness?
- What is your positive or negative aspects about the case based learning method?
- What do you prefer an exam before experiments or case based learning without an exam?
- Do you like make an experiment in laboratory, how is your attitude on chemistry laboratory?

Questions about the case based learning method weren't asked to the control group students.

Phases of the case based learning method used in this study were applied as below;

Phase I: Analyzing a case

- In the first step, student groups were formed,
- A case including a problem connected with a daily life was delivered to the student groups and they read it together,
- They recognized major topics and current problem,
- They made collaborative group discussion for identifying prior knowledge and outstanding questions.

Phase II : Researching the questions

- Main topics were given to the groups to be able to solve the problem of the case,
- Student groups searched their main topic by themselves from different sources,
- They shared their knowledge and views each other and discussed what they have learned,
- The new collaborative groups were made up from prior groups. New groups were composed of expert students who have knowledge about each main topic. These new groups discussed each other to solve the problem and to get an answer to the questions,
- After their class discussion, they continued to group study to get final solution of the problem in class or laboratory.

Phase III: Evaluation of the results

- It was important to evaluate what the students have learned,

- The group workings were controlled and taken their views about solution of the problem by the lecturer,
- Leaders of the groups presented their results. These results were written to the board and the most suitable solution of the problem was determined by the directions of the lecturer,
- The most suitable solution of the problem was required the experimental procedure at laboratory,
- Finally, they made an experiment at the laboratory and gave their results as a report.

The material used for Case Based Learning is given as an Appendix.

2.1. Research Questions:

1. Does case based learning create a difference between pre-service science teachers' attitudes towards chemistry laboratory?
2. Is there any difference between the results of semi structured interviews made with control and experiment group students?

2.2. Data Analysis

Analysis of covariance (ANCOVA) known as a technique that provides the control of a variable or variables, the effect of a tested factor or factors outside the relationship with the dependent variable, in a study statistically (Özdamar, 2004).

For this reason in this study, SPSS 15.0 Statistics Packaged Software was used; descriptive statistics such as arithmetic average, standard deviation and ANCOVA results were calculated and according to the variables at hand, data was analyzed using t test.

In the analysis of the interviews content analysis was used. Content analysis is a data reduction technique that has been used extensively to pick out patterns n media coverage, political statements and other textual materials. It involves either manual or automated analysis of keywords and phrases. Once keywords or themes are identified in textual materials, the frequency with which those themes are mentioned can be counted. For the identified themes, frequency and percentage analysis were made and presented in tables.

3. RESULTS AND DISCUSSION

ANCOVA results of pre-test and post-test scores of the scale of attitude towards laboratory were given in the Table 1.

Table 1. ANCOVA results

Source of variance	Sum of squares	df	Mean of squares	F	Level of meaningful
Program(Reg.)	816.463	1	816.463	31.617	.000*
Group	**639.795**	**1**	**639.795**	**24.775**	**.000***
Error	1471.951	57	25.824		
Total	2775.803	61			

*The mean difference is significant at the 95% confidence level.

Considering the ANCOVA results, there is a significant difference between corrected post-test mean scores according to pre-test scores of control and experiment groups [F_{1-57}=24,775, p<.05]. On the other hand, attitudes of the students are related to their training program. When evaluated the obtained interview data, it was found that the students gave positive feedback on case-based learning.

According to the study of Myers and Fouts (1992), case based learning supplied active studying of students and decreased active role of teacher. For the reason of that, students' attitudes affected positively. It is said that their attitudes also affected positively in a short period in some of studies based on constructivist approach like case based learning (Uzuntiryaki and Geban, 2005).

The opinions of students about the chemistry laboratory in which case based learning carried out were generally positive (Fig. 2). This study, based on students, can be said to serve its objective. The reliability of the qualitative analysis were made by researchers and field experts and found to be 0.85. This result showed that the analysis was reliable in 85%

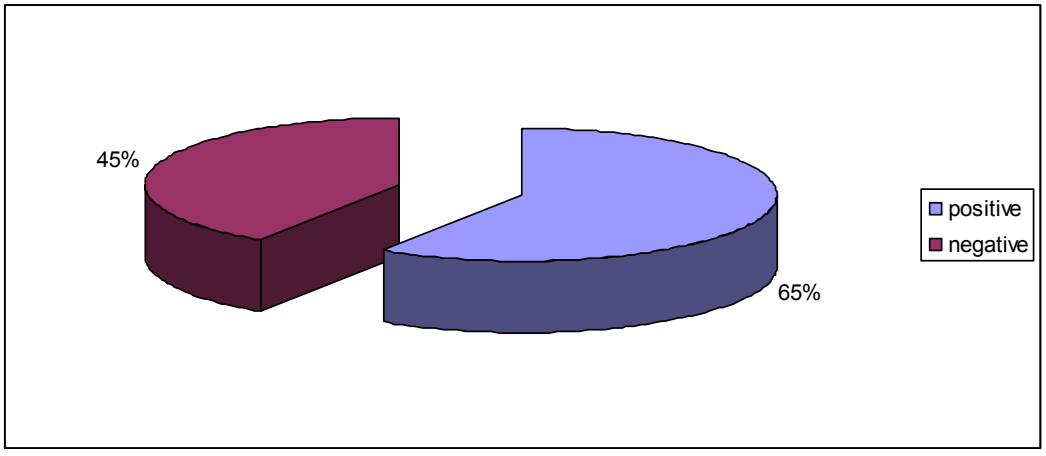


Figure. 2 The opinions of students about the chemistry laboratory in which case based learning carried out.

In Table 2, there are themes which are found out according to interviews with the students and student's positive statements about them. Rate of frequency (f) and percentage (%) are equal to the total amount of the positive statement related to the each theme.

Table 2. Positive statements of the students

Themes	**Positive statements**	**f**	**%**
Team Work	"Of course, I can't remember now if you ask me something but in a team work when I share and discuss it with my friends, I have a general opinion. I mean, I learn it better. Now I have more in my mind than the time that I participate in the classes."	10	12
Laboratory exams and anxiety	"Laboratory class is not difficult. There were not exams before. The exams before the laboratory also provided benefit for the class. Now just one-day study is enough. I can accomplish with one-day study."	7	8.5
Awareness	"For example, when I am cleaning my house, it is written pH 5.5 on the cleaning materials that I use. Also on the shampoos. Thanks to these laboratory classes, I know at least what it means. Sometimes our mothers mix hydrochloric acid and bleacher, namely acid and base. By means of these classes I have learned that the steam can cause blindness. It has made my life easier."	13	16
CBL	"I think this method is very useful for the cohesion of the class and you learn it better with the help of experiments rather than theory. I mean, what is pH? How do we find pH? It is beneficial to combine theory with practices."	23	28
Working in Laboratory	"Without laboratory it would not be understandable. We could not use our knowledge and practice it. But if there were not be laboratory classes, it would not be different as we would first have learned the subject and then practice it."	18	22
Being able to associate with daily life	"When we get home after the experiments, we can go on to discuss it. For example, after I analyze whether Talcid or Renee is better in the	3	3.7

	neutralization reactions, now I can recommend using Talcid instead of Renee. I can adjust these to daily life."		
Self-confidence	"In the last experiment that we conducted to find out which acid is which, we found the level of titration, sorry I said titration I meant pH levels and also ionization. Before that it was harder for us to define them. But now, I mean after these practices, I can easily answer it."	8	9.8

When the statements of the students are taken into consideration, it is seen that Case Based Learning provides benefit for the students in many aspects. Especially basic objectives such as social interaction and developing personal self-confidence, which are among the main learning objectives, could be reached thanks to this study. Herried (1994) found that case based learning method contributed to the students' attitudes towards chemistry.

Another student sentence related to team work theme (Table 2) is also given below;

Student 1: I make more mistakes on my own. I have a chance when I discuss different ideas in team work. So far as I couldn't produce much more ideas on my own, discussing with my friends contribute to me.

This sentence clearly shows that students' knowledge about discussed topics was developed when they worked as a team. Also students comprehended the importance of sharing their ideas in team work. Flynn and Klein (2001) found that the students enjoy working with small groups in cased based learning and think that their learning is increased while working in group.

In Table 3 there are themes which are found out according to interviews with the students and student's negative statements about them. Rate of frequency (f) and percentage (%) are equal to the total amount of the negative statement related to the each theme.

Table 3. Negative statements of the students

Themes	**Negative statements**	**f**	**%**
Team work	"The negative aspect is the class is so crowded. While only one person is performing, the rest four people are just watching. If just observing were enough, everyone could master on this. For us it is better to learn with practice. Team work is useful, but everybody should be active, the way we did is not educatory."	2	9.5

Laboratory exams and anxiety	"The aim of examine the students is to determine the knowledge of students, whether it is true or not. It will be better for students if they make research."	10	47.5
Awareness	There is not any negative statement	0	0
CBL	"It can be good to do every experiment in this way in order to learn the terms that we don't know. Another practice can be made like an exam. If it always goes on like this, the students can make fun of it. It is better to have it occasionally.	5	24
Working in laboratory	"We are science students anyway. Laboratory class is a must for us. Yet as we didn't deal with so much in secondary school, now we have difficulties. Anyway a science student must be close to the lab. Science is research. It is to do experiment. It should be increased as much as it is necessary."	4	19
Being able to associate with daily life	There is not any negative statement	0	0
Self-confidence	There is not any negative statement	0	0

There are not any negative statements of the students about awareness, self-confidence and being able to associate with the daily life. It is seen that features like awareness, self-confidence, test anxiety which are the characteristics of the students, are positively affected after this practice. Most of the students evaluate the exams made before the laboratory class negatively. However it is also seen that some students find it useful for them. For instance, the students stated that by means of these exams their discipline and motivation of studying to the class were increased.

4. CONCLUSION

In this research, the change of the pre-service science teachers' attitudes towards chemistry laboratory by means of case based learning was analyzed. In order to reveal the CBL effectiveness semi structured interviews were done with experiment and control group students.

Case based learning method is one of the constructivist approaches. This method contributes to support of the students' attitudes towards chemistry and some of their personal properties. While working in the group, the knowledge of the students developed because the students discussed the main subjects which were given for working on them. Considering the team work theme which is found in research findings, was enhanced the students' some personal properties like debating on a subject, collaborating, making presentations, launching an idea about any chemistry subject. Team members have common tasks to perform and share responsibility for team outcomes, so using team work in CBL was provides to students on taking responsibility of a group. And also, teams can accomplish better outcomes than individuals working alone as can be seen in the findings of the research the students maintained that they are more successful than working alone. CBL also contributes the students' success with this aspect.

About the findings of the research it can be seen that CBL supplied more positive attitudes of the students towards laboratory and to work in chemistry laboratory. It is said in many researches that experimental work in laboratories has widely used in all dimensions of chemistry education. It was the main aim that to develop the students like a technician works on laboratory previously. But today, the aim of graduating a chemistry student is changed. Making researches are become much more specialized because chemical knowledge has expanded. Laboratory work is described the practical activities which the students do experiments by using chemicals and equipments in a chemistry laboratory. In the interviews done pre-lab the students said that the laboratory experiments are too long, they don't work in a team and they can't gain the expected knowledge. But the later interviews, after the application of CBL and doing their experiment in laboratory, their ideas on working lab are changed positively.

The main concern for the pre-service science teachers is to search the efficient and enjoyable methods for communicating chemistry concepts to students. In this research, it has been emphasized that this can be actualized by suggesting new strategies. CBL could be the one of the instructions for this. According to the semi structured interviews made with the students it was revealed that acquired knowledge by students at laboratory studies supported class studies and active learning was more meaningful than conventional learning. Also, it was determined that students gained more confidence by their selves. Moreover, the lesson was found enjoyable and useful by CBL and they connected to their knowledge with daily life.

In this research also it was used cooperative learning in case based learning environment. Considering the cooperative learning features, pre-service teachers also have opportunities to practice observation and analytical skills. This skills help to pre-service teachers in reflection process. So the research shows that the cases used in the CBL method sophisticate them in reflection process. Therefore the lack of teacher education programs, how to reflect graduating the pre-service teachers is important. Embedding meditative activities like case-based learning could be one way, but not the only way.

Case based learning is applied in some of the medical faculties in Turkish education system (Çakır et al., 2002). Çam and Geban (2011) found that students' attitudes towards chemistry were increased by CBL application in some topics of chemistry. It can be suggested that the case based learning applied in this study can be used more enjoyably in teaching the sub categories of chemistry science like biochemistry, organic chemistry, physical chemistry etc. in the near future of Turkish education system.

5. REFERENCES

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

Barnes G., McInerney D.M., Marsh H.W., (2005). Exploring sex differences in science enrolment intentions: an application of the general model of academic choice. *Australian Education Research*, 32(2): 1–23.

Barrows, H. (1985). *How to Design a Problem-Based Learning Curriculum for the Preclinical Years.* New York: Springer.

Belt S.T. and Phipps L.E., (1998), Using case studies to develop key skills in chemists: a preliminary account, *University Chemistry Education*, 2, 16-20.

Belt S.T., Clarke M.J. and Phipps L.E., (1999), Exercises for chemists involving time management, judgement and initiative, *University Chemistry Education*, 3, 52-58.

Belt S.T., Evans E.H., McCreedy T., Overton T.L. and Summerfield S., (2002), A problem based learning approach to analytical and applied chemistry, *University Chemistry Education*, 6, 65-72.

Belt S.T., Leisvik M. J., Hyde A. J. And Overton T. L., (2005). Using a context-based approach to undergraduate chemistry teaching – a case study for introductory physical chemistry, *Chemistry Education Research and Practice*, 6 (3), 166-179.

Boud, D. J. (1985). Problem-based learning in perspective. *In Problem-Based Learning in Education for the Professions.* Sydney: Higher Education Research and Development Society of Australasia.

Boud, D. and Feletti, G., (1997). *The Challenge of Problem-Based Learning*, 2nd Ed., Kogan Page.

Cheaney J. and Ingebritsen T. S. (2005). Problem-based Learning in an Online Course: A case study. *The International review of research in open and distance learning*, Vol 6 (3).

Christensen, C.R. and Hansen, A.J., (1986). *Teaching and the Case Method*, Boston: Harvard Business School Publishing Division.

Cliff, W.H., and Curtin, L.N., (2000). The directed case method: Teaching concept and process in a content-Rich Course. *Journal of College Science Teaching*, 30(1) 64-66.

Coles, C. R. (1990). Evaluating the Effects Curricula Have on Student Learning: Toward a more competent theory for medical education. In Z. M. Nooman, H. G. Schmidt, and E. S. Ezzat (Eds.) *Innovation in Medical Education: An Evaluation of Its Present Status* (p. 76-87). New York: Springer.

Coles, C. R. (1991). Is problem-based learning the only way? In D. Boud and G. Feletti (Eds.) *The Challenge of Problem-Based Learning* (p. 295-307). London: Kogan Page.

Cox, M. D., (2003). *Faculty Learning Community Program Director's and Facilitator's Handbook*, Miami University, Ohio.

Cox, M. D., (2004). Introduction to Faculty Learning Communities, in Cox, M.D. and Richlin, L. (Eds.) *Building Faculty Learning Communities* (p. 5-23).New Directions for Teaching and Learning: No: 97, San Francisco: Jossey-Bass.

Çam A. and Geban, Ö. (2011). Effectiveness of Case-Based Learning Instruction on Epistemological Beliefs and Attitudes Toward Chemistry, *Journal of Science Education Technol*ogy, 20:26–32.

Çakır, Ö. S., Berberoğlu G., Alpsan D., Uysal C., (2002). Örnek Olaya Dayalı Öğrenme Yönteminin Cinsiyetin ve Öğrenme Stillerinin Öğrencilerin Performanslarına, Biyoloji Dersine Karşı Tutumlarına, Akademik Bilgilerine ve Üst Düzey Düşünme Yeteneklerine Etkisi, *V. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, Bildiriler Kitabı*, s.14.

Demirtaş, B., (2006), Studying the effectual teaching of "Vee" diagrams in chemistry experiments. *Unpublished master thesis*, Dokuz Eylul University, 2006, 111-112.

Dhindsa HS., Chung G., (1999), Motivation, anxiety, enjoyment and values associated with chemistry learning among form 5 Bruneian students. *In: Paper presented at the MERA-ERA joint conference*, Malacca, Malaysia.

Dockett, S., and Tegel, K. (1993). "But we was just turtles:" Situation-based learning in early childhood teacher training. Australian Journal of Early Childhood 18(3) 43 – 48.

Domin, D. (1999). A review of laboratory instruction styles. *Journal of Chemical Education 76*(4) 543 – 547.

Duch, B. J. (1995). What is problem-based learning? *About Teaching: A newsletter of the Center for Teaching Effectiveness, 47.* Retrieved October 7, 2005 from: http://www.udel.edu/pbl/cte/jan95-what.html

Duch, B. J., Groh, S. E., & Allen, D. E., (Eds.), (2001), The Power of Problem- Based Learning: A Practical "How To" for Teaching Undergraduate Courses in Any Discipline, Sterling, VA: Stylus.

Flynn, A. E. and Klein, J. D., (2001). The influence of discussion groups in a case-based learning environment, *Educational Technology, Research and Development*, 49(3), 71-87.

Fraser, B. J., (2002). Learning Environments Research: Yesterday, Today and Tomorrow. In S.C. Goh and M. S. Khine (Eds.). *Studies in Educational Learning Environments* ,Chapter 1, 1-25. World Scientific Publishing Co. Pte.Ltd., Singapore.

Hansen, W., Ferguson, K., Sipe, C. et al., (2005). Attitudes of faculty and students toward case-based learning in the third-year obstetrics and gynecology clerkship. Am J Obstet Gynecol;192(2):644–7.

Herreid C.F., (1994), Case studies in science. A novel method of science education. *J College Science Teaching* 23: 221–229.

Horzum, M. B. and Alper, A., (2006), The Effect of Case Based Learning Model, Cognitive Style and Gender to the Student Achievement in Science Courses, Ankara University, *Faculty of Educational Sciences Journal* 39, (2), 151-175.

Jones, M. A., (1997), Use of a classroom jury trial to enhance students' perception of science as part of their lives. *Journal of Chemical Education*. 74(5), 537.

Kassebaum, D., Averbach, R., Fryer, G., (1991), Student preference for a case-based vs. lecture instructional format. *J Dent Educ*; 55 (12) :781–4.

Maudsley, G. (1999). Do we all mean the same thing by "problem-based learning"? A review of the concepts and a formulation of the ground rules. *Academic Medicine 74*, 178 – 185.

Michel, M. C., Bischoff, A., and Jakobs, K. H. (2002). Comparison of problem- and lecture-based pharmacology teaching. *Trends in Pharmacological Sciences 23*, 168 – 170.

Morgan, A., (1983). Theoretical aspects of project based learning in higher education. *British Journal of Educational Technology 14*(1) 68 – 78.

Myers R.E., Fouts J.T., (1992), Classroom environments and middle school students' views of science. *J Educ Res* 85(6):356–361.

Naumes, W. and Naumes, M. J., (1999), The Art and Craft of Case Writing, SAGE Publications, 1999.

Özdamar, K., (2004). Paket Programlar ile İstatistiksel Veri Analizi, Cilt 1., 5. Baskı, Kağan Kitap Evi, Eskişehir.

Pearson, T., Barker, W., Fisher, S., et al., (2003), Integration of the case-based series in population-orientated prevention into a problem-based medical curriculum. Am J Prev Med; 24(4):102–7.

Russell, A. L., Creedy, D., and Davis, J. (1994). The use of contract learning in PBL. In S. E. Chen, R. Cowdroy, A. Kingsland, and M. Ostwald (Eds.) *Reflections on Problem Based Learning* (p. 57-72). Sydney: Australian Problem Based Learning Network.

Salta K., Tzougraki C., (2004), Attitudes toward chemistry among 11th grade students in high schools in Greece. *Science Education*, 88: 535–547.

Summerfield S., Overton T. and Belt S., (2003), Problem-solving case studies, *Analytical Chemistry* 75, 181A-182A.

Thomas, M. D., O'Connor, F. W., Albert, M. L., Boutain, D., Brandt, P. A., (2001), Case-based teaching and learning experiences. *Issues in Mental Health Nursing*, 22, 517–531.

Uzuntiryaki E. and Geban Ö.(2005), Effect of conceptual change approach accompanied with concept mapping on understanding of solution concepts. *Instr Sci* 33: 311–339.

Williams, B., (2005), Case based learning—a review of the literature: is there scope for this educational paradigm in prehospital education? *Emerg Med J.*; 22: 577–581.

Zuzovsky, R., (1999), Performance Assessment in Science: Lessons from the Practical Assessment of 4th Grade Students in Israel. *Studies in Educational Evaluation*, 25, 195-216.

Web sources:
http://www.clipartguide.com
http://www.cartoonstock.com

GENİŞLETİLMİŞ ÖZET

Öğrencilerin öğrenmelerini anlamlı ve kalıcı hale getirebilmek için öğrenme ortamlarında farklı yaşantılarla karşı karşıya kalmalarını sağlamak önemlidir. Bu sayede öğrenciler daha önceden edindikleri ön bilgileri yardımıyla yeni bilgilere araştırarak, keşfederek ulaşırlar. Bu öğrenme ortamlarını sağlayabilmek için fen eğitiminde özellikle laboratuar etkinliklerinde yapılandırmacılığın önemi oldukça büyüktür (Zuzovsky, 1999). Fen eğitiminde yapılandırmacılığın önemi öğrencilerin çevrelerinden edindikleri bilgileri kendi kavramlarıyla zihinlerinde oluşturmalarından kaynaklanmaktadır. Yapılandırmacılıkta pek çok öğrenme tekniği kullanılmaktadır. Bunlardan özellikle fen eğitiminde dikkate alınması gereken bir öğrenme tekniği örnek olaya dayalı öğrenmedir (Horzum ve Alper, 2006). Bu öğrenme tekniğinde; öğrencilere bir ünite ya da konuyla ilgili bir bölüm hakkında yazılı bir olay verilir. Horzum ve Alper'e (2006) göre olaya dayalı öğrenme yönteminin pek çok olumlu yanları bulunmaktadır. Bunlardan bir tanesi öğrencilerin ileride karşılaşabilecekleri problemlere kolaylıkla çözüm üretebilecekleri ve işbirliği içinde çalışma yeteneklerinin gelişeceğidir.

Örnek olaya dayalı öğrenme yaklaşımı; bireysel ya da grupla karar vermeyi ve öykü-olay incelemeyi içeren bir öğretim yöntemidir. Öğrenciler öyküdeki karakterlerin yerine kendilerini koyabilirler, böylelikle öğrencide araştırma güdüsü sağlanır. Aynı zamanda gerçek yaşamla da bağlantı kurabilmeleri de sağlanır. Öğrencilerin problem çözme, analiz, bireysel öğrenme ve işbirliği ile öğrenme gibi yeterlilikleri geliştirilir (Naumes ve Naumes, 1999). Bu yöntemin öğretmen eğitiminde de etkili olarak kullanıldığı söylenmektedir (Flynn ve Klein, 2001).

Türk eğitim sisteminde bazı tıp fakültelerinde örnek olaya dayalı öğrenme yöntemi uygulanmaktadır. Kimya eğitimi alanında örnek olaya dayalı öğrenme yöntemi ile ilgili çok fazla çalışmaya rastlanmamıştır. Çam ve Geban (2011) örnek olaya dayalı öğrenme yöntemini genel kimyanın çözünme, stokiyometri, iyonik bileşikler, kimyasal dengenin özellikleri, çözünürlük, Le Chatelier prensibi konularında küçük öğrenci grupları üzerinde uygulamıştır. Bu çalışmalarının sonucunda örnek olaya dayalı öğrenme yönteminin öğrencilerin kimyaya yönelik tutumlarını olumlu yönde etkilediği belirlenmiştir. Bu yöntemin kullanıldığı bazı çalışmalarda ise öğrencilerin kimyaya yönelik tutumlarını cinsiyetin etkileyip etkilemediği de incelenmiştir (Dhindsa and Chung, 1999; Barnes et al. 2005; Salta and Tzougraki 2004).

Bu çalışmada, aktif öğrenme yöntemlerinden biri olan örnek olaya dayalı öğrenme yöntemi kullanılarak Fen Bilgisi öğretmen adaylarının Kimya Laboratuarlarına yönelik tutumlarının değişimlerinin incelenmesi amaçlanmıştır. Araştırmanın modeli olarak "ön test-son test kontrol gruplu yarı deneysel desen" kullanılmıştır. Araştırmada yarı deneysel desen kullanıldığından dolayı evren ve örneklem seçimine gidilmemiş, bunun yerine çalışma grubu alınmış ve bu grupların eşitliği üzerinde durulmuştur. Araştırmanın örneklemini Dokuz Eylül Üniversitesi Buca Eğitim Fakültesinde Fen Bilgisi Öğretmenliğinde 2. sınıfta okuyan öğrenciler (N=61) oluşturmaktadır. Araştırmanın ilk aşamasında bir zayıf asidin iyonlaşma sabitinin (Ka) hesaplanması ile ilgili günlük yaşamda da karşılaşılabilecek bir örnek olay

tasarlandı. Deney grubu öğrencileri gruplara ayrıldı. Gruplar rastgele örnekleme yöntemiyle belirlendi. Örnek olay deney grubundaki öğrenciler ile workshop şeklinde tartışıldı. Her bir öğrenci grubuna örnek olayda yer alan temel kimya konuları hakkında araştırma soruları verilerek, grup halinde araştırma yapmaları istendi. Tekrar yapılan tartışmalarda öğrenci gruplarından konuları hakkında sunum yapmaları ve sunumlar sonunda işbirlikli öğrenci grupları oluşturularak öğrencilerin örnek olaydaki probleme çözüm bulmaları sağlandı. Daha sonraki aşamada, olayla ilgili deney laboratuarda yapıldı. Kontrol grubuna ise örnek olaya dayalı öğrenme yöntemi uygulanmamıştır. Kontrol grubu öğrencileri deneye önceden bireysel olarak çalışıp gruplar halinde deneylerini gerçekleştirmişlerdir. Veri toplama aracı olarak kullanılan laboratuara yönelik tutum ölçeği Bülent Demirtaş (2006) tarafından hazırlanıp geliştirilmiş olup, geçerlik ve güvenirliği belirlenmiştir. Ölçeğin güvenirlik katsayısı 0,8831'dır. Ölçek, deney ve kontrol gruplarındaki öğrencilere önce ön test, daha sonra son test olarak uygulanmıştır. Aynı zamanda deney grubu öğrencileri ile yarı yapılandırılmış görüşmeler yapılmıştır. Verilerin analizinde SPSS 15.0 İstatistik Paket Programı kullanılmış, aritmetik ortalama, standart sapma gibi betimsel istatistikler hesaplanmış, ele alınan değişkenlere göre veriler t testi kullanılarak analiz edilmiştir. Elde edilen yarı yapılandırılmış görüşme verileri içerik analizi ile analizlenmiştir. Verilerin güvenirliğini sağlamak için içerik analizi iki farklı araştırmacı tarafından yapılarak, bu araştırmacılar arasındaki uyuşuma bakılmıştır. Uyuşum yüzdesi 0.85 olarak belirlenmiştir. Araştırmada kontrol altına alınamayan dış etkileri ortadan kaldırarak uygulanan ölçeğin ön test ve son test puanları arasındaki farkın analizi için ANCOVA analizi yapılmıştır. Öğrencilerin bireysel özelliklerinin farklılığına bakılmaksızın sadece yöntemin etkililiği incelendiğinde kontrol ve deney gruplarının düzeltilmiş ortalama puanları arasında farklılık olduğu belirlenmiştir[F1-57=24,775, p<.05]. Aynı zamanda deney grubu ile yapılan yarı yapılandırılmış görüşme verileri incelendiğinde örnek olaya dayalı öğrenme yöntemi hakkında olumlu geri bildirimler alınmıştır. Görüşme verilerine göre öğrencilerin yöntem hakkında % 65 olumlu % 45 olumsuz yönde ifade kullandıkları belirlenmiştir. Herried(1994)'ın çalışmasına benzer olarak bu çalışmada da örnek olaya dayalı öğrenme yönteminin öğrencilerin laboratuara yönelik tutumlarında olumlu etki yarattığı belirlenmiştir. Öğrenci ifadeleri dikkate alındığında öğrenciler için örnek olaya dayalı öğrenme yönteminin birçok açıdan yararlı olduğu gözlenmiştir. Ayrıca laboratuar çalışmaları sayesinde elde ettikleri bilgilerin sınıftaki çalışmalarını desteklediği ve aktif öğrenmenin geleneksel öğretimden daha etkili olduğu belirlenmiştir. Genel olarak eğitimde kazandırılması hedeflenen sosyal etkileşim ve öz güvenin artması gibi etkenler bu çalışma sayesinde öğrencilere kazandırılmıştır. Öğrencilerin örnek olaya dayalı öğrenme yönteminin uygulandığı dersleri daha eğlenceli buldukları açığa çıkarılmıştır. Daha ileride yapılacak çalışmalarda biyokimya, fizikokimya, organik kimya, analitik kimya gibi kimyanın alt dallarında bazı konuların öğrenilmesinin daha eğlenceli hale getirilmesi amacıyla örnek olaya dayalı öğrenme yöntemi kullanılabilir.

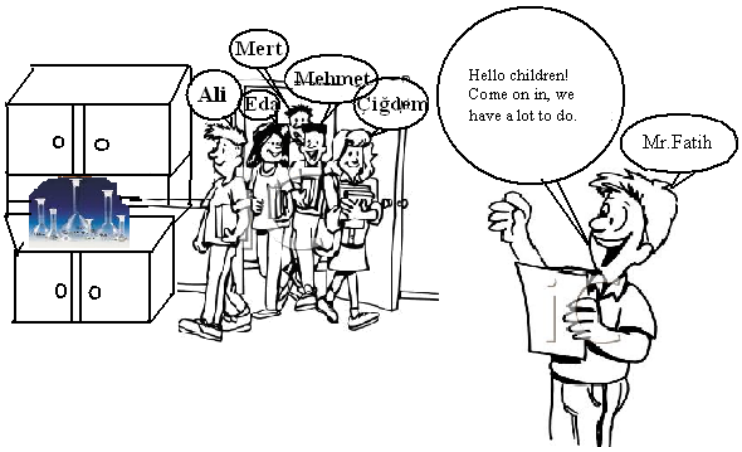
Anahtar Kelimeler: Örnek olaya dayalı öğrenme yöntemi, Workshop, Kimya laboratuarına karşı tutum, Fen eğitimi

Appendix :

Applied Material* in CBL

What can we do? Shilly shally?

What last compunction is to serve, there is worth for everything …..



It was required that preparation of various solutions by Mr. Fatih, who is working at Department of Mining Engineering at Dokuz Eylül University, for using at students' experiments. To prepare the solutions in soonest time, Mr Fatih decided to take help from the senior class students for preparation of solutions. Ali, Mert, Eda, Mehmet and Çiğdem, who are attending to the senior class, announced their willingness for preparation of the solutions to Mr. Fatih.

Mr. Fatih required from the students to make different weak acid solutions at concentration of 0.3 M. While students were working at research laboratory, Mr. Fatih went to the Chemistry Laboratory where the students' experiments were performed. Mr. Fatih ordered the materials used in the laboratory and prepared the lacking indicator solutions.

Students prepared the solutions and left the laboratory without informing Mr Fatih worked at the other laboratory. After accomplished his work, Mr. Fatih came back to the research laboratory and controlled to the weak acid solutions.

However, he encountered the carelessness of the students. Only two of the five bottles were labelled, but the other three were forgotten. Mr. Fatih got very nervous to their carelessness and he invoked the students to the laboratory for solution of this problem.

Students started to wonder how they could find which non-labelled solution belonged to which acid…

*Cartoons taken from http://www.clipartguide.com and www.cartoonstock.com were modified as a CBL material.