

INTERNATIONAL CONFERENCE ON NEW HORIZONS IN EDUCATION
INTE2012

The Effects of Problem-Based E-Learning on Prospective
Teachers' Achievements and Attitudes towards Learning
Mathematics

Devrim Üzel^{a,*}, Emine Özdemir^a

^aBalıkesir University, Educational Faculty of Necatibey, Balıkesir 10100, Turkey

Abstract

The aim of this study is to investigate the achievements and attitudes of prospective teachers towards mathematics in problem based e-learning. Experimental research model was used to determine the achievements and attitudes of prospective teachers towards mathematics in Problem based e-learning. The participants of this research include 73 (36 in experiment and 37 in control group) prospective teachers, who take course from the first researcher. The assignment form and attitude scale which were developed by researchers was applies before and after the course at 2010-2011 spring semester. Data received by assignment form and attitude scale, were analysed with t test for dependent samples and t-test for independent samples. The differences between prospective teachers' mean scores of assignment form and attitude scale were found statistically significant in the level of $p=.05$. These differences were found significant in favor of prospective teachers who took the course on problem based e-learning.

© 2012 Published by Elsevier Ltd. Selection and/or peer-review under responsibility of The Association of Science, Education and Technology. Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).

Keywords: Problem based e-learning; mathematics education; prospective teachers; attitude; t-test for independent samples and dependent samples.

1. Introduction

E-Learning is a contemporary teaching method supported by the use of information and communication technologies. E-learning enables the use of a much broader pedagogical strategy when compared to classical education and learning activities. The most important advantage of e-learning when compared to other traditional methods is that it significantly decreases the costs when compared to the other educational methods (Terzi, nd).

In this context, the study's frame is created by using Problem-based learning (PBL) and e-learning approach together within the scope of coeducation models. PBL was first developed in medical education

* Corresponding author. Tel.: +90-266-241-2762; fax:+90-266-249-5005
E-mail address: duzel@balikesir.edu.tr

in the 1950s (Barrows, 1996). The adoption of PBL in education outside the medical field started and carried out in 1990s. PBL has been applied globally in a variety of professional schools and teacher education (Oberlander & Talbert-Johnson, 2004). It is a pedagogical strategy for posing significant, contextualized, real world situations, and providing resources, guidance, and instruction to learners as they develop content knowledge and problem-solving skills (Mayo, Donnelly, Nash, & Schwartz, 1993). According to the study of Günhan (2006), PBL increased the geometrical thinking levels of students in mathematics lesson, created a positive attitude towards mathematics and increased the level of access. In the study of Uslu (2006), it was seen that PBL in mathematics has a meaningful positive effect on students' attitude towards mathematics when compared to the traditional method. In the study of Luck & Norton (2004), online problem based groups success was found higher than the face to face problem based groups in terms of cooperation sub-dimension.

When the literature is analyzed, it is seen that learning purpose web contents are not sufficient. Content of the web pages of schools that are bound to the ministry of education is no more than the presentation of institution, so academic level information sharing is almost non-existing. Universities have the same problem. Another significant situation is that individuals are still afraid of computer usage which is a negative effect; these kinds of attitudes will surely create problems in transition to e-learning. Today, in Turkey, some institutions that do not get government grant have to take some of the expenses from workers; managers of primary and secondary schools sometimes have to take support from the parents of students in order to build and update computer laboratories. Employment problem has a negative effect on transition to e-learning in education. E-Learning practices' areas of applying in Turkey are divided into four categories: Universities, companies, public and individual directed practices. In universities, certificate and post graduate programs are mainly practiced in e-learning model. During university education, some lessons in universities are presented completely with e-learning model (Çınar, 2010; Göktaş & Kayri, nd.). But this can not be generalized for every university. According to the results of many researches, PBL has a more positive impact on students' attitude towards lessons when compared to traditional method (Goodwin, 2006; Tavukçu, 2006, Çiftçi et al. 2007; Akınoğlu & Tandoğan, 2007). This is why, this study is important in terms of determining the efficiency of sufficient knowledge of prospective teachers in the faculty of education by using problem based learning and e-learning approach on the issue of e-learning and problem based learning on students' success and attitudes.

The purpose of this study is to examine the effectiveness of problem-based e-learning on pre-service teachers' achievements and attitudes towards learning mathematics. The study includes an attitude and achievement test in order to examine changes in pre-service teachers' achievements and changes in the attitudes from pre-test to post-test. Two research questions guided this study: 1. What is the effect of PBeL environment on pre-service teachers' achievements? Are there any differences in learning methods knowledge between experiment and control groups after using the program? 2. What is the effect of the PBeL environment on pre-service teachers' attitudes? Are there any differences in attitudes between experiment and control groups after using the program?

2. Method

2.1. Research model and study group

Experimental design with pretest posttest control group was used in this study. There were randomly chosen two groups in pretest-posttest control group design. One of the groups was experimental while the other was control group. In both groups, measurements were made before and after the experiment (Karasar, 2005). Experimental design with pretest posttest control group was used in this study. Randomly chosen 2 classes out of 3 which were equal in terms of academic success constituted control

and experimntal groups. The study was carried out in the second semester of 2010-2011 academic years. The participants of this research included 73 (36 in experimental and 37 in control group) students from department of elementary mathematics education, who were taking courses from the researchers.

2.2. Data collection and analysis

In this research, a teaching material presented in web environment was prepared in order to enable students practice problem based learning activities. Blackboard Learning Administration System that enables students design learning materials on web was used for this purpose. In our day, many universities (*For instance; Hacettepe, University of Cincinnati, University of Newcastle, University of Leicester, Ohio University, and University of Cambridge*) use Blackboard Learning Administration System which is used for problem based learning practices.

In the study, online problems that were qualified enough to develop prospective teachers' analysis and synthesis abilities were prepared. After problems were created, 3 experts' opinions were taken. On the bases of feedbacks, problems were re-shaped and presented to prospective teachers. Problems were discussed in 2 or more sessions for 2-3 hours, that were generally organized successively, sometimes with a few days off for free study. Prospective teachers worked individually and within a group. Academic success evaluation form in this study was prepared by researchers. While preparing the evaluation form, questions that are used in Teacher Selection Examination for Anatolian High Schools, whose validation-reliability are ensured, are analyzed and 20 of them were chosen for the study. In order to evaluate the reliability of the test, it was conducted on 68 randomly chosen 4th and 5th grade students of Mathematics Education. According to the reliability analysis that was made with SPSS 16.0 program, Cronbach Alpha reliability coefficient was found to be .81. This value was the desired level and was accepted to be sufficient (Büyüköztürk, 2006). In order to determine attitudes towards mathematics, 5 point likert-typed attitude scale towards mathematics developed by Üzel (2007) was used. Factor loads of the items in the scale varied between 0.454 and 0.730. Total Cronbach Alpha reliability coefficient was found to be .88. This result shows that the scale is reliable. Both in the control and experiment group, the topic were "derivative practices". The goal was to define the changes in students' success in mathematics and their attitudes towards it in a way that can be associated to "derivative practices" at the end of the process.

t-test is used for related and unrelated samples in the analysis of research data. Statistical processes are made with the use of SPSS 16.0 package program. $p = .05$ meaningfulness level is taken as the basis in all statistical solutions.

3. Findings

This part of the research consist findings that are achieved at the end of statistical analysis of the data gathered by the methods which are used in solving the problem and interpretations about these findings.

The aim of the first sub-problem of the research is to see if there is a meaningful difference between the knowledge levels of the experiment and control groups in terms of developing prospective teachers' success in mathematics. T-test is made for unrelated samplings with the calculations by SPSS 16.0 package program. At the end of the pre-tests and last-tests of experiment and control groups, a difference occurrd in favor of experiment group as .85 and 16.2 points respectively. T-test points of unrelated samplings which are respectively $t = 0.876$ and $t = 4.02$. When p values are analyzed, there is not a meaningful difference between experiment and control groups in terms of mathematical success before the teaching; at the end of last-test, $p = .000 < .05$ which means that there is a meaningful difference in favor of experiment group (Büyüköztürk, 2006). This result shows that in terms of efficiency, PBeL based teaching is more effective that traditional teaching method. In order to assess the effect of this

efficiency on knowledge, difference between the average differences are analyzed. T-test is used for independent samples. In .05, meaningfulness level is $t=3.713$ and $p=.000 < .05$; so there is a meaningful difference in knowledge level which is supported by the findings. In other words, in terms of developing mathematics success, teaching based on problem based e-learning is more effective than the traditional teaching method.

The aim of the second sub-problem of the research is to see if there is a meaningful difference between the attitudes of prospective teachers' mathematics success in the experiment group educated with a PBeL based method and control group educated with traditional teaching method. "Mathematics Attitude Scale" is conducted and t-test is made in order to assess the attitudes of experiment and control group prospective teachers. Between the pre-attitude points of experiment and control group, there is a 3.22 points difference in favor of the experiment group. In order to see if this difference is meaningful, SPSS 16.0 package program is used and t-test is applied and it is found that $t = 0.898$. p value calculated in %95 confidence interval is found to be $p = .334 > .05$ which shows that difference between both groups' attitudes aren't meaningful. In other words, there is not a meaningful difference between experiment and control groups' attitude towards mathematics lesson before the experiment. In order to assess the changes of the experiment and control groups' attitude after the experiment, last attitude scales differences are taken into consideration. There is 11.52 points difference in favor of the experiment group in the last attitude points. In order to see if this difference is meaningful, t-test is used with SPSS 16.0 package program and $t = 2.120$. p value calculated in %95 confidence interval is found to be $p = .334 > .05$ shows that there is a meaningful difference between both groups' attitudes; and when the averages are taken into consideration, the difference is in favor of the experiment group. This result shows that PBeL based teaching affects attitudes towards mathematics more positively than traditional teaching method.

4. Discussion and conclusions

In this study, problem based e-learning teaching is made with prospective teachers. At the end of this teaching, prospective teachers' success on "Derivative Practices" and their attitudes towards mathematics are determined. At the end of analyzing the findings, it is found out that PBeL positively develops success and attitude towards mathematics. In his study, Günhan (2006) found that PBeL based teaching creates a positive attitude towards mathematics and increase the level of knowledge. In his study, Uslu (2006) mentioned that problem based learning method in mathematics teaching have a more meaningful positive effect on the attitude of students' attitude towards mathematics when compared to traditional method. In this sense, the study's findings are similar with the findings of the studies of Günhan (2006) and Uslu (2006). In this study, the result that prospective teachers develop positive attitude towards mathematics conflicts with Gürsul's (2008) study results which includes the information that difference between pre-attitude scale point and last-attitude scale points aren't statistically important (development level of the attitude towards mathematics). Similarly, this study's findings don't coincidence with Luck&Norton's (2004) study which has the result that PBeL based teaching doesn't increase success. At the end of the teaching in which problem based learning and e-learning approach is used together, prospective teachers had enough knowledge on learning and their attitude towards mathematics positively developed. In this context, it can be said that mutually complementary and supportive learning occurred. Similar studies can be carried out on the departments that educate secondary education mathematics teachers and possible contributions can be researched. Knowing PBeL based teaching's practicalability on other lessons in mathematics education license program is important in terms of understanding the effectiveness.

References

- Barrows, H. S. (1996). Problem-based learning in medicine and beyond: a brief overview. In *Bringing Problem-Based Learning to Higher Education: Theory and Practice*, edited by L. Wilkerson and W. H. Gijsselaers, pp. 3–12. San Francisco, CA: Jossey-Bass.
- Büyüköztürk, Ş. (2006). *Statistical handbook for social science data analysis, research design-SPSS applications, and comments*. Ankara: Pegem press.
- Çınar, Z. (14 Eylül 2010). Turkey and E-learning. Online: <http://www.makaleler.com/insan-kaynaklari-makaleleri/turkiye-ve-e-ogrenme.htm>.
- Çiftçi, S., Meydan, A., Ektem, I. S. (2007). The effect of applying problem based learning in social science teaching on students' achievement and attitudes. *Selçuk University Journal of Social Science Institute*. Volume: 17, pp. 179-190.
- Goodwin, Erika A. (2006). Gender and age-related differences in problem based learning in one athletic training education program. Ph.D. Dissertation. Union Institute and University.
- Göktaş, İ. & Kayri, M. (nd.) E-Learning And Challenges And Solution Proposals For Turkey. Yüzüncü Yıl University, *Journal of Electronic Educational Faculty*. II(II). Online: <http://efdergi.yyu.edu.tr>.
- Günhan, B. C. (2006). A research on applicability of problem based learning in elementary mathematics course. Ph.D. Dissertation. Dokuz Eylül University, Institute of educational Sciences.
- Gürsul, F. (2008). The effect of online and face-to face problem based learning approaches on students' attitudes towards mathematics. Yüzüncü Yıl University, *Journal of Educational Faculty*. V, (I), 1-19.
- Karasar, N. (2005). *Scientific Research Methods*. Ankara: Nobel Press.
- Luck, P. & Norton, B. (2004). Problem based management learning-better online?. *The European Journal of Open and Distance Learning (EURODL)*, issue 2004/II. Online: http://www.eurodl.org/materials/contrib/2004/Luck_Norton.htm (15.03.2012).
- Mayo, P., Donnelly, M.B., Nash, P.P., & Schwartz, R.W. (1993). Student perceptions of tutor effectiveness in problem based surgery clerkship. *Teaching and Learning in Medicine*, 5(4), pp. 227-233.
- Oberlander, J. & Talbert-Johnson, C. (2004). Using technology to support problem-based learning. *Action Teacher Educ.*, 25(4), pp. 48–57.
- Terzi, C. (nd.). Electronic Learning. Online: <http://sneg.turkcer.org.tr/eogrenme-nedir.pdf>
- Uslu, G. (2006). The effect of problem-based learning in secondary mathematics course on the levels toward attitudes about the course, academic achievement and persistence, Master thesis. Balıkesir university, Institute of science.
- Üzel, D. (2007). The effect of Realistic mathematics education on the achievement of 7th grade students, Ph. D. Dissertation, Balıkesir University, Institute of Science, Department of Mathematics Education.