THE EFFECT OF STUDENTS' INDIVIDUAL DIFFERENCES ON PROBLEM SOLVING SKILLS AND MOTIVATION IN PROBLEM-BASED LEARNING

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Abstract

This study investigates the effects of students' prior knowledge levels and learning approaches on their perceived problem solving skills and motivation in a computer supported Problem Based Learning (PBL) environment. A 3x3 factorial design was used to investigate the effects of students' prior knowledge levels and learning approaches. The experimental process of the study lasted 5 weeks and was carried out on 83 university students. The Scale of Approaches to Learning, the Scale of Motivation towards PBL, and the Prior Knowledge Test are developed by researchers, and the Problem Solving Inventory as developed by Heppner and Peterson were used. The collected data were analyzed by t test, One-Way ANOVA, Two-Way ANOVA for Mixed Measures and MANOVA. It was found that the levels of prior knowledge of the students and their learning approaches do not have an effect alone or combined on their perceived problem solving skills and motivation towards PBL. For this research group it can be stated that whatever learning approaches and level of prior knowledge they have, all the students have responded positively to the PBL in terms of perceived problem solving skills and motivation..

Keywords

Problem-based learning, Learning approaches, Problem solving skill, Motivation.

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PROBLEME DAYALI ÖĞRENMEDE ÖĞRENCİLERİN BİREYSEL FARKLILIKLARININ PROBLEM ÇÖZME BECERİSİ VE GÜDÜLENMEYE ETKİSİ

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Özet

Bu araştırmada bilgisayar destekli Probleme Dayalı Öğrenmede (PDÖ) üniversite öğrencilerinin önbilgi düzeylerinin ve öğrenme yaklaşımlarının problem çözme becerileri ve güdülenmelerine olan etkileri incelenmiştir. Araştırmada 3x3 faktöryel desen kullanılmıştır. Araştırmanın 5 hafta süren deneysel işlemleri, "Eğitsel Yazılımların Tasarımı Geliştirilmesi ve Değerlendirilmesi" dersini alan 83 üniversite öğrencisi üzerinde yürütülmüştür. Araştırmada veri toplama aracı olarak araştırmacılar tarafından geliştirilen "Öğrenme Yaklaşımları Ölçeği", "Probleme Dayalı Öğrenmeye Yönelik Güdülenme Ölçeği", "Önbilgi Testi" ve Heppner ve Peterson tarafından geliştirilen "Problem Çözme Envanteri" kullanılmıştır. Verilerin çözümlenmesinde t testi, tek faktörlü ANOVA, tekrarlı ölçümler için iki faktörlü ANOVA ve MANOVA gibi parametrik test teknikleri kullanılmıştır. Elde edilen sonuçlara göre, PDÖ uygulamasının öğrencilerin problem çözme becerilerini geliştirmede ve güdülenme düzeylerini artırmada önemli bir etkiye sahip olduğu belirlenmiştir. Öğrencilerin önbilgi düzeylerinin ve öğrenme yaklaşımlarının problem çözme becerisine ilişkin algı ve güdülenmeleri üzerinde ortak etkilerinin bulunmadığı ortaya çıkarılmıştır. Bu bulguya dayanarak bu araştırma grubu için baskın öğrenme yaklaşımları ve önbilgi düzeyleri ne olursa olsun bütün öğrencilerin, problem çözme becerisine ilişkin algıları ve güdülenme açısından probleme dayalı öğrenmeden olumlu şekilde etkilendiği söylenebilir.

Anahtar Kelimeler

Probleme dayalı öğrenme, Öğrenme yaklaşımları, Problem çözme becerisi, Güdülenme.

INTRODUCTION

The historical underpinnings of problem-based learning (PBL) date back to the work of John Dewey (1963) at the University of Chicago and his commentary on experimental education (McDonald, 2002). Recognizing that Dewey's work could be used in medical school, Barrows, a physician and medical educator at McMaster University, wanted to develop methods of instructing physicians that fostered their own capabilities for reflection of school in ordinary life (McDonald, 2002). The medical faculty at McMaster University pioneered PBL in the 1960s as an innovative solution to make learning more relevant and effective. Since then, PBL has been implemented in several areas of higher education, including medicine, business, education, architecture, law, engineering, and social work, as well as in high school (Savery & Duffy, 1995; Wilson & Cole, 1996).

The process of PBL makes students more responsible for their own learning (Davis & Harden, 1998). Therefore, it can be stated that one of the most important elements which can affect this process is students' individual differences. However, since there are few studies related to this theme, the effect of individual differences on PBL process is still vague.

In literature, there are some studies stating that PBL encourages a deep learning approach and students who have a deep learning approach are more successful than ones who have a surface learning approach (Newble & Clarke, 1986; Lai & Chu, 1997). According to PBL, the learning approaches of students are considered as important individual differences.

Tiwari et al. (2006) have studied the effect of PBL on learning approaches of students in clinic nursing education. The findings of the study show that PBL is effective in encouraging students to adopt a deep learning approach. This finding was determined after students explained their PBL experiences with the help of the deep learning approach's principles. These findings show similarities with the findings of the previous studies (Newble & Clarke, 1986; Waters & Johnston, 2004).

Charlin, Mann and Hansen (1998) stated four important principles related to PBL: 1) Students are the active processors of information, 2) Prior knowledge is activated and new information is built on it, 3) knowledge is acquired in a meaningful context; 4) Students have opportunities for elaboration and organization of knowledge. According to these principles it can be stated that prior knowledge is very important in PBL because students question what they already know (recall of prior knowledge) and then what they need to learn (new knowledge) in this process. At the end of this process prior knowledge is associated with new information. Therefore, in PBL it is important what students bring to the learning process. Prior knowledge may affect the students' behav-

ioral characteristics when they understand what the problem is and generate solutions.

Osman and Hannafin (1994) analyzed the effect of the prior knowledge level and motivational questions on factual learning and problem solving. Students in the experiment group asked motivational questions were more successful. This finding is quite important since it shows that the activation of prior knowledge facilitates the students' problem solving skills.

Since the learning process occurs around a problem in PBL, the problem solving skills of the students are important in the efficiency of this process. Gallagher, Stepien, and Rosenthal (1992) conducted a study in which they aimed to investigate the effect of PBL on students' problem solving skills and compared students who were educated with PBL with ones in a control group. At the end of the study it was stated that the students educated with PBL were using problem solving phases more effectively than those in the control group.

Increase in students' motivation is regarded as PBL's aims as well as its advantages. Motivation is about willingness of students to spend time and struggle to fulfill their responsibilities and use their skills. According to Lepper (1988) various learning tasks which help students understand how they apply their skills in real life situations increase their motivation.

In the literature, there are findings which state that learning environment affects students' learning approaches. PBL facilitates students' motivation and encourages a deep learning approach. Students who have a deep learning approach are more successful than the ones who have a surface learning approach in PBL. PBL facilitates students' problem solving skills and activates prior knowledge. The students who have a high prior knowledge level use it to make plans, evaluate actions and focus on the task; however, the ones who have low prior knowledge spend more time looking for data, interpreting the information, and make plans unsystematically. In discovery learning, situated learning and collaborative learning approaches study the effect of prior knowledge on students' learning process; however, they do not carry out any study on the effects of prior knowledge in PBL. In a classroom designed for a deep learning approach the student who has limited prior knowledge and a surface learning approach will interpret the situation differently from the ones who have sufficient prior knowledge and deep learning approach (Boulton-Levis et al, 2001). However, it is surprising that there are not any studies in the literature which study these two individual differences in the scope of student centered learning. Therefore the present study is aimed at investigating the effect of students' prior knowledge level and learning approaches on their perception related to problem solving skills and motivation in computer supported PBL.

METHOD

Design

Students' prior knowledge level (low, medium, high) and learning approaches (deep, surface, achievement) are independent variables of the study. Dependent variables of the study are problem solving skill and motivation. A 3x3 factorial design was used to investigate the effects of students' prior knowledge levels and learning approaches.

The study group consisted of 83 pre-service teachers (35 female, 48 male) who were undergraduate university students in their eight semesters in the Departments of Computer Education and Instructional Technology, aged between19-23. They were enrolled in a Design, Development and Evaluation of Educational Software course.

Instruments

The Learning Approaches Questionnaire (LAQ) was used to measure each student's approach to learning on a scale ranging from deep, surface and achievement. The questionnaire comprised 39 items. Students responded to each item on a five-point Likert scale, where 1 point was given to "never true" and 5 to "always true". Subscale reliabilities ranged from 0.85 to 0.94.

The Questionnaire of Motivation towards Problem Based Learning (QMPBL), was used to measure the students' motivation. The questionnaire comprised 29 items. Students responded to each item on a five-point Likert scale, where 1 point was given to "never true for me" and 5 to "always true for me". The scores obtained ranged from 29 to 145. The alpha coefficient for the whole scale was 0.95.

The perception levels of the students' problem-solving skills were measured by using the *Problem Solving Inventory (PSI)* developed by Heppner and Petersen (1982), adapted to Turkish by Sahin, Sahin and Hepner (1993). The alpha coefficient for the whole scale was 0.90. PSI aims to assess the self-confidence and feeling of self-control of the individual in problem solving, as well as the way in which the individual approaches problem solving. The inventory comprised 35 items assessed on a Likert scale of 1-6 by the participant. "1" denotes "totally agree", "6" denotes "totally disagree". The items contain positive and negative judgments about problem solving, and the negative judgments are later reversed while the scores are being evaluated. Low scores indicate effectiveness as well as having behaviors and attitudes for successful problem solving. High scores indicate an inability to reach a successful solution when faced with a problem.

The Prior Knowledge Test (PKT), was used to measure the students' prior knowledge level. The test was an 18-item multiple-choice test developed by the

researchers. Items in the test were related to Evaluation of Educational Software. The internal consistency of the test was found by Kuder Richardson (KR20), which gave r=0.82 for the whole test.

PBL Implementation

PBL implementation lasted five weeks. Firstly, students were informed about PBL and pre-questionnaires were administered. Then students were introduced to a complex, ill-structured problem with no obvious solutions by means of computer supported instructional material. Students worked in small, heterogeneous groups to identify what additional information they needed based on the initially given facts. They then brainstormed ideas and hypotheses related to the problem, decided on the key issues, and identified the resources to be used. After these meetings each student conducted an independent search for information regarding issues related to the problem. The process of research and group discussion continued until all groups were satisfied that they had learned sufficient basic knowledge to solve the problem. The last week, study groups presented their report to the others and post-questionnaires were administered. Online discussion blocks were utilized for the group member to communicate outside of classroom. Throughout the process, the instructor monitored and facilitated group sessions and provided formative feedback.

RESULTS

Perceived Problem Solving Skill

The t-test, which was carried out to assess the significance of the mean scores of the students' PSI pre-test and post-test shows that the differences between PSI pre-test and post-test were significant [$t(82)=6.20$, $p<.00$]. The mean scores of the students before PBL were M= 84.41; however, it decreased to M= 76.16 after PBL. The score limit of the scale is between 32-192 and the mean score is 80. The scores of the scale being high demonstrated that the attendees fail in problem solving, the decreased scores of the post tests show that PBL has significant importance to the students' perceived problem solving skills.

Results of the two-factor ANOVA test, carried out to assess the differences of the means of the students' PSI pre-test and post-test according to their prior knowledge level, are given in Table 1.

Table 1.The ANOVA results of PSI pre-test and post-test according to PKL

Source	Sum of squares	df	Mean square	F	p
Between groups	27464.091	82			
Prior knowledge level (A)	115.059	2	57.530	.168	.845
Error	27349.032	80	341.863		
Within groups	8789.210	83			
Pre-test and post-test(B)	2784.148	1	2784.148	.37.629	.000
A*B	85.886	2	42.943	.580	.562
Error	5919.176	80	73.990		
Total	36253.301	165			

PKL: Prior Knowledge Level

It was assessed that students' perceived problem solving skills before and after PBL do not show significant differences according to their prior knowledge levels. In other words, having different prior knowledge levels and repeated measures factors do not have significant effect on students' perceived problem solving skills [F(2-80)=1.273, p>.05].

Results of the two-factor ANOVA test, which was carried out to assess the differences of the means of the students' PSI pre-test and post-test according to their learning approaches, are given in Table 2.

Table 2.The ANOVA results of PSI pre-test and post-test according to LA

Source	Sum of squares	df	Mean square	F	p
Between groups	26540.279	82			
Learning approach (A)	4251.449	2	2125.724	7.326	.001
Error	23212.643	80	290.158		
Within groups	8737.134	83			
Pre-test and post-test (B)	2732.071	1	2732.071	37.079	.000
A*B	**110.417**	**2**	**55.208**	**.749**	**.476**
Error	5894.646	80	73.683		
Total	35277.413	165			

LA: Learning Approaches

When Table 2 was analyzed, it was assessed that students' perceived problem solving skills before and after PBL did not show significant differences according to their learning approaches. In other words, adopting different learning approaches and repeated measures factors do not have significant effect on students' perceived problem solving skills [F(2-80)=.611, p>.05]. Means and standard deviation values of PSI pre-test and post-test results of the students according to prior knowledge level and learning approaches are given in Table 3.

Table 3.The MANOVA results of PSI pre-test and post-test according to the combined effects of PKL and LA

		Value	F	Hypothesis df	Error df	p
PKL*LA	Pillai's Trace	.058	1.142	4	74.00	.344
	Wilks' Lambda	**.942**	**1.142**	**4**	**74.00**	**.344**
	Hotelling's Trace	.062	1.142	4	74.00	.344
	Roy's Largest Root	.062	1.142	4	74.00	.344

PKL: Prior Knowledge Level, LA: Learning Approaches

As shown in Table 3, MANOVA results about the combined effects of prior knowledge level and learning approaches state that there is not a significant difference in terms of students' PSI pre-test and post-test scores [Wilks Lambda =.942, $F(4,74)= 1.142$, $p>0.05$].

Motivation

The t-test which was carried out to determine the significance of the difference between students' motivation towards PBL pre-test and post-test scores shows that the difference between QMPBL pre-test and post-test was statistically significant [$t(82)=-6.15$, $p<.00$]. While the mean scores of the students motivation toward PBL before PBL implementation were M= 114.57, after PBL implementation this number increased to M= 122.57. Results of the two-factor ANOVA test carried out to check if QMPBL scores of the students show significant difference in terms of prior knowledge level are given in Table 4.

Table 4 The ANOVA results of QMPBL pre-test and post-test according to PKL

Source	Sum of squares	df	Mean square	F	p
Between groups	16566.482	82			
Prior knowledge level (A)	56.885	2	28.442	.138	.871
Error	16509.597	80	206.370		
Within groups	3333.212	83			
Pre-test and post-test (B)	2539.212	1	2539.212	36.984	.000
A*B	**251.432**	**2**	**125.716**	**1.831**	**.167**
Error	542.568	80	68.657		
Total	19899.694	165			

PKL: Prior Knowledge Level

Table 4 shows, students' motivation toward PBL before and after PBL did not show significant differences according to their prior knowledge levels, in other words, having different prior knowledge levels and repeated measures factors

do not have significant effect on students' motivation toward PBL [F(2-80)=1.831, p>.05].

Table 5 The ANOVA results of QMPBL pre-test and post-test scores according to LA

Source	Sum of squares	df	Mean square	F	p
Between groups	16566.482	82			
Learning approach (A)	2054.764	2	1027.382	5.664	.005
Error	14511.718	80	181.396		
Within groups	8393.104	83			
Pre-test and post-test (B)	2649.105	1	2649.105	37.774	.000
A*B	**133.589**	**2**	**66.795**	**.952**	**.390**
Error	5610.41	80	70.130		
Total	24959.586	165			

LA: Learning Approaches

Results of the two-factor ANOVA test, carried out to assess the differences of the mean of the students' QMPBL pre-test and post-test according to their learning approaches, are given in Table 5. When Table 5 was analyzed, it showed that students' motivation toward PBL before and after PBL did not show significant differences according to their learning approaches. In other words, adopting different learning approaches and repeated measures factors do not have significant effect on the students' motivation toward PBL [F(2-80)=.952, p>.05].

Result of the MANOVA test which was carried out to analyze the combined effects of prior knowledge level and learning approaches on students' QMPBL scores is given in Table 6.

Table 6 The MANOVA results of QMPBL pre-test and post-test according to the combined effects of PKL and LA

		Value	F	Hypothesis df	Error df	p
PKL*LA	Pillai's Trace	.016	.298	4	74.00	.878
	Wilks' Lambda	**.984**	.298	**4**	**74.00**	**.878**
	Hotelling's Trace	.016	.298	4	**74.00**	**.878**
	Roy's Largest Root	.016	.298	4	74.00	.878

PKL: Prior Knowledge Level, LA: Learning Approaches

As it is shown in Table 6, MANOVA results which were carried out to analyze the combined effects of prior knowledge level and learning approaches, put forward that students' QMPBL pre-test and post-test scores do not have significant difference [Wilks Lambda =.984, F(74)= .298, p>.05].

DISCUSSION AND CONCLUSIONS

As a result of the study, it was determined that differences between the pre-test and post-test scores of the students' PSI are significant. This result was interpreted as PBL application having an important effect on facilitating students' perceived problem solving skills. This finding supports the theories and findings in literature such as: PBL facilitates students' problem solving skills; Neo's (2005) findings that a constructivist learning environment encourages problem solving skills; Smith's (2003) meta analysis which states that there is a positive relationship between PBL and problem solving skills. Previous studies show that various learning environments based on collaborative learning facilitate students' problem solving skills. According to these findings, it can be stated that the difference between students' problem solving pre-test and post-test are significant because it is one of the keystones of PBL and learning occurs around a constructivist learning environment and process of seeking solutions to the problems.

At the end of the study, it was determined that the difference between QMPBL pre-test and post-tests of the students is significant. This result infers that PBL application facilitates motivation of the students towards PBL. This finding also confirms the ideas in literature that PBL facilitates students' motivation. In the literature, there are findings which support that learning environment can be a positive influence on the motivation of the students. According to Lepper (1988), various learning tasks which help students to understand how to adopt their information and skills in real life can facilitate their motivation. Qualitative findings of Fergusson's study (2003) show problems take an important place in terms of students' motivation. According to Lambros (2004) students decide their learning needs by themselves to solve the problem in PBL. Students analyze the themes thinking that 'they should learn this'. Therefore, learning occurs with the help of individual interest. It makes it easier to keep the students interested, and helps them understand the content, and memorize the new information. At the same time it eradicates questions such as; 'Why do we have to learn this?' According to Cisneros et al (2002) students are freer in PBL to decide learning tasks in terms of individuals and as a group than traditional methods.

It has been determined that prior knowledge and dominant learning approaches of students have no significant effect on students' perceived problem solving skills and their motivations. When these two independent variables are examined to see whether they have a combined effect on students' perceived problem solving skills, it has been determined that there is not a significant difference between PSI pre-test and post-test scores. Students' PSI scores do not change due to a combined effect of prior knowledge level and learning approaches in advance of practicing and after this finding. According to this find-

ing, it can be stated that prior knowledge level and learning approaches of students do not have a combined effect on problem solving skill. In the PhD thesis by Fergusson (2003) it was found that student variables such as; sense of self–efficacy related to learning, meta-cognitive awareness and critical thinking are important predictors of their success in PBL. There is a positive relationship among the results of learning by directing oneself, sense of self-efficacy related to learning, cooperation and problem solving. However, prior knowledge level and learning approaches are tackled as student variables which are examined on problem solving skills in this research, and it has been determined that these two variables don't have an effect alone or combined on problem solving skill. For this research group it can be stated that whatever learning approaches and level of prior knowledge they have, all the students have responded positively to the PBL in terms of perceived problem solving skills.

It was determined that there is not a significant difference between prior knowledge levels and learning approaches on QMPBL pre-test and post-test scores. This finding shows that QMPBL levels of students do not change by being dependent on combined effects of prior knowledge level and learning approaches in advance of practicing and after this finding. According to this finding, it can be stated that prior knowledge level and learning approaches of students do not have a combined effect on students' motivation towards problem based learning. Prior knowledge level and learning approaches are tackled as student variables effects of which are examined on QMPBL in this research and it has been determined that these two variables do not have any effect alone, nor do they have a combined effect on QMPBL. No matter what the dominant learning approaches and prior knowledge levels the students have in this research group, it can be stated that all of the students increased their motivation towards problem based learning throughout the activity. PBL groups were organized according to students' own wills in this study. This can be considered to be a situation which facilitates student motivation. Moreover, since students attended PBL activity for the first time it can be considered to be a variable which affects their motivation.

It was assessed that at the end of the PBL process whatever dominant learning approaches and prior knowledge levels students have, all increased their perceived problem solving skills. When it is thought that real life is a problem solving environment, it becomes obvious that students' problem solving skills should be facilitated. Therefore, PBL activities should definitely take place in classes to facilitate students' problem solving skills.

It was assessed that at the end of the PBL process whatever dominant learning approaches and prior knowledge levels students have, all of them increased their motivation towards problem based learning. The increase in their motivation towards the activity will make them willing to fulfill their responsibilities about learning and make them more active in this process; automatically, they

will be more successful. Therefore, PBL activities can be carried out in order to increase motivation of the students.

PBL application in this study was carried out with a computer supported learning environment. This made it easier to provide guidance for the students, and monitor student to student, and student to teacher interactions. Modern technology should definitely be used to develop PBL applications.

Suggestions in the light of these findings include:

- In this study, perceived problem-solving skills of the students were studied. In literature, there are findings that PBL can affect students' skills in transferring problem solving skills into real life situations. For following studies, problem solving skill and its transfer should be taken into consideration.
- It is a researchable ambiguity whether there will be significant difference between the groups which were assigned versus free-choice groups in terms of motivation.

In this study, the effect of students' individual differences in PBL was investigated. In the literature, recent discussions concern the way PBL should be guided or regulated (Kirshner, Sweller, & Clark, 2006; Schmidt, Loyens, Van Gog, & Paas, 2007). For following studies, the way in PBL (e.g. guided, unguided) should also be taken into consideration.

REFERENCES

Boulton-Levis, G. M., Smith, D.J.H., McCrindle, A.R., Burnett, P.C. & Campbell, K.J. (2001). Secondary teachers' conception of teaching and learning. *Learning and Instruction, 11*, 35-51.

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.

Cisneros, R.M., Salisbury-Glennon, J.D. & Anderson-Harper, H.M. (2002). Status of problem-based learning research in pharmacy education: a call for future research. *American Journal of Pharmaceutical Education. 66*, 19-26.

Davis, M. H. & Harden, R. M. (1999). Problem-based learning: A practical guide. *Medical Teacher, 20*(2), 317-322.

Dewey, J. (1963). *Education and experience*. New York: Collier.

Fergusson, J. Y. (2003). A Regression Analysis of Problem Based Learning Student Variables. Unpublished PhD, University of Nebraska-Lincoln.

Gallagher, S. A., Stepien, W. J. & Rosenthal, H. (1992). The effects of problem-based learning on problem solving. *Gifted Child Quarterly, 36*(4), 195-200.

Heppner, P.P. & Peterson, C.H. (1982). The development and implications of a personal-problem solving inventory. *Journal of Counseling Psychology, 29,* 66-75.

Kirschner, P.A., Sweller, J., & Clark, R.E. (2006). Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry based teaching. *Educational Psychologist, 41*, 75-86.

Lai, P. & Chu, C. K. (1997) Who benefits from problem-based learning? *Theory, Practice and Research, 21*, 148-160.

Lambros, A. (2004). Problem-Based Learning in Middle and High School Classrooms. California: Corwin Press.

Lepper, M. R. (1988). Motivational considerations in the study of instruction. *Cognition and Instruction, 5(4)*, 289-310.

McDonald, J. T. (2002). Using problem-based learning in a science methods course. *Annual International Conference of the Association for the Education of Teachers in Science.* Retrieved April 25, 2009, from http://eric.ed.gov/ERICDocs/data/ericdocs2sql/ontent_storage_01/0000019b/80/1a/1e/e8.pdf

Neo, M. (2005). Web-enhanced learning: engaging students in constructivist learning. *Campus-Wide Information Systems, 22*(1), 4-14.

Newble, D. I. & Clarke, R. M. (1986). The approaches to learning of students in a traditional and in an innovative problem-based medical school. *Medical Education, 20*(4), 267-273.

Osman, M. E. & Hannafin, M. J. (1994). Effects of of advance questioning and prior knowledge on science learning. J*ournal of Educational Research, 88*(1), 5-13.

Sahin, N., Sahin, N. H. & Heppner P. P. (1993). Psychometric properties of the Problem Solving Inventory in a group of Turkish University Students. *Cognitive Therapy and Research, 17* (4), 379-397.

Savery, J. R. & Duff, T. M. (1995). Problem-based learning: An instructional model and its constructivist framework. *Educational technology, 35*(5), 31-38.

Schmidt H G., Loyens S.M.M., Van Gog T. & Paas F. (2007). Problem-based learning is compatible with human cognitive architecture: commentary on Kirschner, Sweller, and Clark (2006). *Educational Psychologist, 42*, 91-97.

Smith, R.A. (2003). Problem-Based Versus Lecture-Based Medical Education: A Meta-Analysis of Cognitive and Noncognitive Outcomes. Unpublished PhD, Florida University.

Tiwari, A., Chan, S., Wong, E., Wong, D., Chui, C., Wong, A. & Patil, N. (2006). The effect of problem-based learning on students' approaches to learning in the context of clinical nursing education. *Nurse Education Today, 26(5), 430-438*.

Waters, L., & Johnston, C. (2004). Web-delivered, Problem-Based Learning in Organisational Behaviour: A New Form of C.A.O.S. *Higher Education Research and Development, 23*(4), 413-432.

Wilson, B. ve Cole, P. (1996). Cognitive teaching models. In D. Jonassen (Ed.), *Handbook of research for educational communications and technology*, (pp.601-633). Washington, DC: Association for Educational Communications and Technology.

GENİŞ ÖZET

Bilgisayar destekli Probleme Dayalı Öğrenmede (PDÖ) üniversite öğrencilerinin önbilgi düzeylerinin ve öğrenme yaklaşımlarının problem çözme becerileri ve güdülenmelerine olan etkilerinin incelendiği bu araştırma, 3x3 faktöryel desene göre planlanıp, gerçekleştirilmiştir. Önbilgi değişkeninin düşük, ota ve yüksek olmak üzere üç, öğrenme yaklaşımı değişkeninin ise derinlemesine, yüzeysel ve başarı odaklı olmak üzere üç düzeyi vardır. Araştırmanın 5 hafta süren deneysel işlemleri, "Eğitsel Yazılımların Tasarımı Geliştirilmesi ve Değerlendirilmesi" dersini alan 83 üniversite öğrencisi üzerinde yürütülmüştür. Araştırma için gerekli verilerin toplanması için araştırmacılar tarafından geliştirilen "Öğrenme Yaklaşımları Ölçeği", "Probleme Dayalı Öğrenmeye Yönelik Güdülenme Ölçeği", "Önbilgi Testi" ve Heppner ve Peterson tarafından geliştirilip, Sahin, Sahin ve Hepner (1993) tarafından Türkçeye uyarlanan "Problem Çözme Envanteri" kullanılmıştır. Verilerin çözümlenmesinde t testi, tek faktörlü ve tekrarlı ölçümler için iki faktörlü ANOVA yanında MANOVA testi kullanılmıştır.

Araştırma sonucunda, bir bütün olarak ele alındıklarında öğrencilerin Problem Çözme Becerileri (PÇB) sontest-öntest puanları arasındaki farkın anlamlı olduğu belirlenmiştir. Bu sonuç, PDÖ uygulamasının öğrencilerin problem çözme becerilerini geliştirmede önemli bir etkiye sahip olduğu şeklinde yorumlanmıştır. Bu bulgu, literatürdeki, PDÖ'nün öğrencilerin problem çözme becerilerini geliştirdiğine ilişkin bulgu ve iddiaları; Neo'nun (2005) yapılandırmacı öğrenme çevresinin problem çözme becerisini geliştirdiğine ilişkin bulgularını; Smith'in (2003) PDÖ'nün etkiliğine ilişkin yapmış olduğu meta analizin PDÖ ile problem çözme başarısı arasında olumlu bir ilişki olduğuna ilişkin bulgusunu destekler niteliktedir.

Araştırma sonucunda öğrencilerin PDÖYG öntest-sontest puanları arasındaki farkın anlamlı olduğu belirlenmiştir. Bu sonuç, PDÖ uygulamasının öğrencilerin probleme dayalı öğrenmeye yönelik güdülenmelerini artırmada önemli bir etkiye sahip olduğu şeklinde yorumlanmıştır. Bu bulgu literatürdeki, PDÖ'nün öğrencilerin güdülenmelerini artırdığına ilişkin iddiaları da doğrular niteliktedir.

Öğrencilerin önbilgi düzeylerinin ve baskın öğrenme yaklaşımlarının PÇB ve güdülenmeleri üzerinde anlamlı etkilerinin olmadığı belirlenmiştir. Bu iki bağımsız değişkenin öğrencilerin PÇB üzerinde ortak etkisinin olup-olmadığı incelendiğinde ise öğrencilerin PÇB sontest-öntest puanları üzerinde önbilgi düzeyi ve öğrenme yaklaşımlarının ortak etkisi bakımından anlamlı farklılık olmadığı belirlenmiştir. Bu bulgu uygulama öncesinden sonrasına öğrencilerin PÇB puanlarının önbilgi düzeyi ve öğrenme yaklaşımının ortak etkisine bağlı olarak değişmediğini göstermektedir. Bu bulguya göre öğrencilerin önbilgi düzeyleri ve öğrenme yaklaşımlarının problem çözme becerisi üzerinde ortak etkiye sahip olmadığı söylenebilir. Fergusson (2003) tarafından yapılan, çeşitli öğrenci değişkenlerinin öğrencilerin PDÖ sürecindeki başarılarının yordayıcıları

olup olmadığının incelendiği doktora tezinde, yapılan çoklu regresyon analizi sonucunda öğrenmeye ilişkin öz yeterlik algısı, bilişsel farkındalık ve eleştirel düşünme gibi öğrenci değişkenlerinin öğrencilerin PDÖ'deki başarılarının önemli birer yordayıcısı olduğu; öğrenmeye ilişkin özyeterlik algısı ile kendi kendini yönlendirerek öğrenme, işbirliği ve problem çözme sonuçları arasında olumlu bir ilişki olduğu saptanmıştır. Ancak bu araştırmada önbilgi düzeyi ve öğrenme yaklaşımları problem çözme becerisi üzerinde etkisi incelenen öğrenci değişkenleri olarak ele alınmış ve bu iki değişkenin problem çözme becerisi üzerinde tek tek etkilerinin olmadığı gibi ortak etkilerinin de bulunmadığı belirlenmiştir. Bu araştırma grubu için baskın öğrenme yaklaşımları ve önbilgi düzeyleri ne olursa olsun bütün öğrencilerin, problem çözme becerisinin gelişimi açısından probleme dayalı öğrenmeden olumlu şekilde etkilendiği söylenebilir.

Öğrencilerin PDÖYG sontest-öntest puanları üzerinde önbilgi düzeyi ve öğrenme yaklaşımlarının ortak etkisi bakımından anlamlı farklılık olmadığı belirlenmiştir. Bu bulgu uygulama öncesinden sonrasına öğrencilerin PDÖYG düzeylerinin önbilgi düzeyi ve öğrenme yaklaşımının ortak etkisine bağlı olarak değişmediğini göstermektedir. Bu bulguya göre öğrencilerin önbilgi düzeyleri ve öğrenme yaklaşımlarının probleme dayalı öğrenmeye yönelik güdülenmeleri üzerinde ortak etkiye sahip olmadığı söylenebilir. Bu araştırmada önbilgi düzeyi ve öğrenme yaklaşımları PDÖYG üzerinde etkisi incelenen öğrenci değişkenleri olarak ele alınmış ve bu iki değişkenin PDÖYG üzerinde tek tek etkilerinin olmadığı gibi ortak etkilerinin de bulunmadığı belirlenmiştir. Bu araştırma grubu için baskın öğrenme yaklaşımları ve önbilgi düzeyleri ne olursa olsun bütün öğrencilerin, uygulama öncesinden sonrasına probleme dayalı öğrenmeye ilişkin güdülenmelerinin arttığı söylenebilir.

Yapılan bu araştırma ile PDÖ uygulaması sonunda baskın öğrenme yaklaşımları ve önbilgi düzeyleri ne olursa olsun bütün öğrencilerin problem çözme becerilerinin geliştiği görülmüştür. Gerçek yaşamın da bir problem çözme alanı olduğu düşünüldüğünde öğrencilerin bu becerilerinin geliştirilmesinin önemi ortaya çıkmaktadır. Bu nedenle öğrencilerin problem çözme becerilerinin geliştirilmesi amacıyla değişik derslerde PDÖ uygulamalarına yer verilmesi önerilmektedir.

PDÖ uygulaması sonunda baskın öğrenme yaklaşımları ve önbilgi düzeyleri ne olursa olsun bütün öğrencilerin, probleme dayalı öğrenmeye ilişkin güdülenmelerinin artırdığı görülmüştür. Öğrencilerin etkinliğe ilişkin güdülenmelerinin artması, öğrenme ve öğrenme sorumluluklarını yerine getirme açısından daha istekli olmalarını, süreçte daha etkin rol almalarını sağlayacak ve dolayısıyla başarılarını olumlu yönde etkileyecektir. Bu nedenle öğrencilerin güdülenmelerini artırmak için PDÖ uygulamaları gerçekleştirilebilir.

Bu araştırmada PDÖ uygulaması bilgisayar destekli olarak gerçekleştirilmiştir. Uygulamanın bu şekilde yürütülmesi öğrencilere rehberlik sunulmasını, öğrenci-öğrenci ve öğrenci-öğretmen iletişimini ve öğrencilerin izlenmesini kolaylaştırmıştır. Bu nedenle PDÖ uygulamalarının gerçekleştirilmesinde yeni teknolojilerin sağladığı olanaklardan mutlaka faydalanılmalıdır.

Bu araştırmada öğrencilerin algıladıkları problem çözme becerileri ile de ilgilenilmiştir. Literatürde PDÖ'nün, öğrencilerin problem çözme becerilerini sınıftan gerçek yaşamdaki durumlara transfer edebilme becerilerini de etkileyeceğine ilişkin bulgular yer almaktadır. Bundan sonraki araştırmalarda problem çözme becerisinin yanısıra problem çözme becerisinin transferi de dikkate alınmalıdır. Araştırma gruplarının başkası tarafından belirlendiği ve çalışma gruplarının öğrncilerin kendileri tarafından belirlendiği grupların güdülenmeleri arasında fark olup-olmayacağı, yani grup etkileşiminin güdülenmeye olan etkisi incelemeye değer bir belirsizliktir. Literatürde bireysel farklılıkların PDÖ sürecine etkilerini inceleyen araştırmaların sayısı yok denecek kadar azdır. Bu araştırmada ise bireysel farklılık olarak yalnızca önbilgi düzeyi ve öğrenme yaklaşımları dikkate alınmıştır. Bundan sonra yapılacak araştırmalarda eleştirel düşünme becerisi ve öz yeterlik algısı gibi diğer bireysel farklılıkların etkisinin de incelenmesinde yarar görülmektedir.

YAZAR HAKKINDA

Halen Adnan Menderes Üniversitesi Eğitim Fakültesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü öğretim üyesi olarak çalışmakta olan Yrd. Doç. Dr. Şerife Ak, Ankara Üniversitesi'nde, aynı alanda, 2008 yılında doktora derecesini almıştır. Bilgisayar destekli eğitim uygulamalarında bireysel farklılıklar, probleme dayalı öğrenme, bilgisayar destekli öğrenme ortamlarının tasarımı ve teknolojinin eğitime entegrasyonu, yazarın ilgilendiği başlıca konulardır. İletişim Adresi: Adnan Menderes Üniversitesi Eğitim Fakültesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü Merkez Kampüs 09010 Kepez, Aydın.

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