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A META-ANALYSIS STUDY COMPARING PROBLEM BASED LEARNING WITH TRADITIONAL INSTRUCTION

PROBLEME DAYALI ÖĞRENME YAKLAŞIMI İLE GELENEKSEL ÖĞRETİMİN KARŞILAŞTIRILMASI: BİR META-ANALİZ ÇALIŞMASI

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Abstract

In this study, the efficiency of Problem-Based Learning (PBL) was compared with traditional methods. The effect size (ES) of PBL on academic achievement was calculated by using a meta-analytic method defined as drawing a general conclusion by analysing the data from a range of independent studies of similar subjects. Thus, 26 experimental studies were selected, which comply with the inclusion criteria determined with the help of research carried out between 2006 and 2013. The effect size of PBL on academic achievement was calculated as 1.302. According to Thalheimer and Cook's (2002) detailed level calculation,this value has a *very large* effect. The results of meta-analysis demonstrate that compared to traditional instruction methods, PBL has a positive effect on academic achievement.

Key Words: Problem-based learning, academic achievement, traditional method, meta-analysis, effect size.

Öz

Bu araştırmada probleme dayalı öğrenme (PDÖ) yaklaşımının etkililiğini geleneksel yöntem ile karşılaştıran çalışmaların meta-analizi yapılmıştır. Probleme dayalı öğrenmenin akademik başarı üzerindeki etki büyüklüğü benzer konularda birbirinden bağımsız ve çok sayıda yapılmış çalışmaların verilerini analiz ederek genel bir yargıya varma yöntemi olarak tanımlanan meta-analitik yöntem ile hesaplanmıştır. Bu amaçla 2006-2013 yılları arasında ilgili konuya ilişkin yapılan araştırmalardan belirlenen dâhil edilme kriterlerine uygun 26 adet deneysel çalışma meta-analiz için seçilmiştir. Araştırma sonucunda PDÖ'nün akademik başarıya olan etki büyüklüğü 1.302 olarak hesaplanmıştır. Bu değerin Thalheimer ve Cook (2002)'un ayrıntılı düzey sınıflamasına göre *çok geniş* etkiye sahip olduğu anlaşılmıştır. Ayrıca meta-analiz sonuçları PDÖ kullanımının geleneksel öğretim yöntemine göre akademik başarı açısından olumlu etki oluşturduğunu göstermiştir.

Anahtar Kelimeler: Probleme dayalı öğrenme, akademik başarı, geleneksel öğretim, meta-analiz, etki büyüklüğü.

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1. INTRODUCTION

Problem Based Learning (PBL) is based on a progressive approach which according to the view of John Dewey, is about introducing students to real life problems and giving them the opportunity to solve those problems (Dewey, 1996: as cited in Gökmen, 2008; Dolmans, De Grave, Wolfhagen, Vleuten, 2005). This learning style was introduced in medical education as an alternative to traditional instruction, because graduates were found to have knowledge but lacked the required problem solving skills to utilise this knowledge. We use it today in many fields including social sciences (Gallagher, Stepien, Sher, & Workman, 1995: as cited in Ward &Lee, 2002; Fatokun&Fatokun, 2013; Colliver, 2000; Savery& Duffy, 1995). PBL, which attaches primary importance to a student-centred quality (Akınoğlu&ÖzkardeşTandoğan, 2007) is now widely used in many parts of the world (HmeloSilver, 2004), and is a pedagogical approach based on the development of students' self-management skills. It enables them to understand theory and practice by getting to the heart of problems, and contributes to advanced cognitive skills such as creative thinking, problem solving, and communication (Major & Palmer, 2001). Learners who learn through PBL define their learning through triggers within the problems (Fatokun&Fatokun, 2013). With the help of these processes, they experience independent and self-oriented learning before discussing and correcting information from group discussions. It is right to call PBL an approach that uses appropriate problems to increase knowledge and understanding instead of characterising it as simply a method of problem solving (Awang&Ramly, 2008; Könings, Wiers, Wiel,&Schmidt, 2005). To put it another way, PBL produces solutions to problems by learners' working together to define and analyse existing problems (Peterson, 1997). Research shows that to some extent students' critical skills develop in group discussions aimed at solving problems in the PBL process (Tiwari, Chan, Sullivan, Dixon, & Tang, 1999; Parton & Bailey, 2008; Yoon, Woo, Treagust,&Chandrasegaran, 2014; Demirel&ArslanTuran, 2010).

PBL is successfully implemented in educational settings, as it develops the skills, meaningful learning, and advanced thinking of learners and encourages a satisfying learning performance (Tsai & Chiang, 2013). We should note the six basic features of PBL put forward by Barrows (1996). First, learning should be student-centred. Second, we should implement it in small groups under the guidance of a teacher. Third, the teacher should be in a guiding or directing role. Fourth, real problems should be included in the learning process without any preliminary preparation or study. Fifth, we should use problem-solving skills on the problems we encounter while accessing the required information. Finally, we should

obtain new information through self-oriented learning (as cited inDochy, Segers, Bossche,&Gijbels, 2003). In PBL, learners use individual effort to access the required information to research and solve a problem. As the problems encountered using this approach are real life ones, we provide the learner with information they can make use of in life, so we expect an increase in enthusiasm, motivation and interest throughout the learning process.

When we study the literature on PBL, the results suggest that it is effective in facilitating learning (Dochy et al., 2003; Teyyeb, 2013; Selçuk, 2010), providing real life competencies and increasing motivation (Hallinger& Lu, 2011; Major & Palmer, 2001; Norman & Schmidt, 2000; Smith et al., 2005 Colliver, 2000; Newman, 2001; Nandi, Chan, et al., 2000; Achuonye, 2010). The PBL approach is the subject of our study. It emphasises learning using real life problems, which the student unravels, discovers their causes and finds solutions using existing knowledge and competence.

2. METHOD

We undertake this study in order to determine the effect of PBL on the academic achievement and permanence scores of students using a meta-analytic effect size analysis. We make various definitions of meta-analysis such as the method of synthesising the findings of independent studies and comparing their results (Akgöz, Ercan, &Kan, 2004). We use an analytic procedure that involves making parametric estimates on the society by bringing together the results of studies carried out on the same subject in different places and at different times (Şahin, 1999), or by calculating the effect size value and having a summary result that combines the findings of previous studies (Kınay, 2012). Meta-analysis has some common features such as generating the problem in terms of collecting, encoding, analysing and interpreting data (Cooper & Hedges, 1994a: as cited in Walker & Leary, 2009). In this study, we seek to answer the question "What is the effect of PBL on the academic achievement of students?"

2.1. Collecting the Data

In this study masters' and PhD theses concerning the PBL were made use of. The data collection was made by searching the "National Thesis Centre of Turkish Higher Education Council" and by using the "Google scholar" search engine using the following key words; "*problem-based learning environments, problem-based learning and academic achievement, problem-based learning, the effect of problem based learning"* in both Turkish and English.

93 theses; 87 Masters' and six PhDs were found as a result. These studies comply with the inclusion criteria so they were included in the study. We use a pre-test-post-test control group, study the effect of the PBL approach on the academic achievement of students, include the sample size (n), mean (X) and standard deviation (sd) values belonging to experimental-control groups and we test and implement it in Turkey between the years 2006 and 2013. We eliminated all studies that lacked the prerequisites required for meta-analysis study, and selected 26 theses.

2.2. The Method of Encoding

We encode the identifying information and quantitative data in a summary table. We present both general and specific information to identify each study and to explain the detail. We present the data we obtained in this study as "study identity", as the name of the author, year of publication, type of publication, instructional level and course type, subject, sample size and the duration of implementation (weeks) (Appendix 1). We fix the descriptive statistics using the sample size, the mean, and standard deviation data to be used in the meta-analysis calculation as "study data".

2.3. Dependent Variables

We determine the effect size of the PBL approach included in meta-analysis, by using a calculation based on academic achievement scores as the dependent variable. We define effect size in various forms such as the standardised value for various means of measurement concerning each of the studies (Bernard et al., 2004) or an index value used to determine how effective is the case to be studied (Küçükönder, 2007). The fact that the scales and measurement results differ from each other necessitates obtaining a standard value. Thus, it is essential to interpret the findings correctly using standard values following the calculation of effect sizes.

2.4. Study Characteristics

We define the independent variables belonging to meta-analysis as study characteristics. These characteristics are the level of education of the students, the courses on which we implement the study, type of publication, year of study, volume, standard deviation and mean values of the samplings.

2.5. Data Analysis

We analyse the data in this study using the meta-analysis method. The main aim is to combine the effect sizes of experimental studies, in other words, to calculate the differences between the mean scores of experimental and control groups (Hunter, &Schmidt, 1990: as cited in Acar, 2011). The effect size in experimental studies indicates the effect strength of the result reached when the factor exists compared to the result reached when the factor does not exist (Şahin, 1999). In this study, we calculate the effect size value using the "Cohen *d*" method. We obtain the effect size "d" by dividing the difference between the mean scores of the two groups into total standard deviation (Cohen, 1992). In this study, the effect size values are given according to Thalheimer and Cook's (2002) detailed level classification (-0.15 < Cohen's d < 0.15 *negligible;* 0.15 < Cohen's d < 0.40 *small;* 0.40 < Cohen's d < 0.75 *medium;* 0.75 < Cohen's d < 1.10 *large;* 1.10 < Cohen's d < 1.45 *very large and* 1.45 < Cohen's *d huge*).

We make inferences to analyse the effect coefficients calculated for each study based on fixed effects and random effects models (FEM/REM). We use Comprehensive Meta-Analysis (CMA), MetaWin statistics and Microsoft Excel 2010 to find the effect sizes and variances belonging to each of the studies and to compare the groups.

3. FINDINGS

We analyse 26 theses using meta-analytic analysis regarding a PBL approach in learning environments. In Table 1, we provide the statistics showing the level of education, subject areas, implementation period, type of publication, course type in which the study was implemented, year when the study was carried out, frequencies and percentages of these studies. When we examine the level of education in Table 1 we can see that most of the studies were carried out in secondary schools (50%), 26.92% at undergraduate level, 15.38% at high school with only a few studies in primary schools (7.69%). Most of the studies were carried out in the field of science (61.54%) with 16 studies and five studies in the field of each mathematics and the social sciences (19.23%). When we consider the implementation periods, we can see that most of the 26 studies examining academic achievement were carried out in five to six week periods (26.92%).

When we consider the course type in Table 1, we can see that most of the studies were carried out in Mathematics (23.08%) followed by Science and Science and Technology with

five studies each (19.23%). There are three studies in Geography and Physics (11.54%), two in Chemistry (7.69%), one in English and Life Sciences (3.85%).

Table 1. Frequency and Percentage Values of the Studies Including Data Regarding the Academic Achievement Scores of Using a PBL Approach in Learning Environments

Variable	(f)	(%)	Variable	(f)	(%)			
Level of Education			**Type of Publication**					
Primary	2	7.69	Master's Thesis	22	84.61			
Secondary	13	50	PhD Thesis	4	15.38			
High	4	15.38	**Course Type, Year, Frequency and Percentage Values**					
Undergraduate	7	26.92	**Course Type**	**(f)**	**(%)**	**Year**	**(f)**	**(%)**
Subject Areas			Science	5	19.23	2006	1	3.85
Science	16	61.54	Science and Tech.	5	19.23	2007	3	11.54
Mathematics	5	19.23	Mathematics	6	23.08	2008	3	11.54
Social Sciences	5	19.23	Geography	3	11.54	2009	4	15.38
Implementation Period (Weeks)			Physics	3	11.54	2010	7	26.92
2-4	6	23.08	Chemistry	2	7.69	2011	6	23.08
5-6	7	26.92	English	1	3.85	2012	2	7.69
7-8	5	19.23	Life Sciences	1	3.85			
9-18	5	19.23						
Not specified	3	11.54						

In Table 2, we show the homogenous distribution value, the mean effect size and confidence intervals in the effect models regarding theacademic achievement scores of the studiesincluded in meta-analysis. We can say that according to the fixed effects model, there is a positive effect on academic achievement of using materials in learning environments with a value of 0.939 effect size. Because of the homogeneity test, we found the Q_B statistical value to be 305.381. We accept the critical value as 37.652 from the χ2table at a 95% confidence interval with 25 degrees of freedom. As we found the Q_B statistical value (305.381) higher than the critical value (37.652), we can claim that the distribution of effect sizes is heterogeneous.

Table 2. Homogeneous Distribution Value, Mean Effect Size, and Confidence Intervals in the Effect Models Regarding theAcademic Achievement Scores of the Studies

Model Type	N	Z	Q_B	ES	95% Confidence Interval	
					Lower Limit	Upper Limit
FEM	26	17.361	305.381	0.939	0.833	1.045
REM	26	6.745	46.537	1.302	0.924	1.680

Since the distribution in this study is heterogeneous, we try to prevent possible mistakes resulting from a heterogeneous sampling by making analyses complying with the random effects model. Therefore, we compare the efficiency of instruction using PBL with the instruction performed without using PBL according to the random effects model. We analyse the data in the 26 theses included in the meta-analysis using the random effects model with 0.193 standard error and at a 95% confidence interval, the upper limit being 1.680, the lower limit being 0.924 and the effect size1.302. We can say that the effect size value is in the very large effect interval according to the classification of Thalheimer and Cook (2002), and thus the use of PBL in learning environments has a positive effect on academic achievement.

3.1. The Efficiency of Using the Problem Based Learning Approach in Accordance with the Implementation Periods of Studies

We classify the studies as 2-4 weeks, 5-6 weeks, 7-8 weeks, and 9-18 weeks in order to determine whether the effect size of using PBL differs according to the implementation periods of the studies. Where the study implementation period is not given or given as course hours we classify this as the fifth group with the note "not specified". We show the results of analyses according to the groups in Table 3.

Table 3. Effect Sizes According to the Study Implementation Periods

Implementation Period	N	ES	95% Confidence Interval for Effect Size	
			Lower Limit	Upper Limit
2-4	6	1.056	0.241	1.871
5-6	7	0.775	0.019	1.531
7-8	5	1.485	0.591	2.378
9-18	5	2.491	1.565	3.417
Not specified	3	0.916	-0.240	2.073
Total	26	1.308	0.913	1.702

Q_B=9.139 Z=6.494 df=4 p=0.058

According to the results of the analyses in Table 3, we observe the highest effect size in the 9-18 weeks implementation period with the value 2.491 and the lowest in the 5-6 weeks implementation period with the value 0.775. As a result of the homogeneity test, we calculate the Q_B statistical value as 9.139. We accept the critical value as roughly 4.488 from the $\chi 2$ table at 95% confidence interval with the degree of freedom four. As the calculated homogeneity value (9.409) is higher than the critical value (4.488), we can say it has a heterogeneous distribution. Keeping this in mind, we can claim that there are no significant differences between the groups formed when the studies included in meta-analysis are

grouped according to their implementation periods and we consider their effect sizes (Q_B = 9.139; p=0.058). In the light of our findings, academic achievement in the courses taught using PBL does not differ according to the implementation periods of PBL. We can claim that PBL has a similarly large effect in all the groups.

3.2. The Efficiency of Using Problem Based Learning According to Subject Areas

We classify the courses into three groups; Science (Physics, Chemistry, Science, Science and Technology); Mathematics (Mathematics) and Social (Geography, English, Life Sciences, Turkish) to determine the effect of the courses in which the studies were carried out on total effect size. We show the results of analyses according to these groups in Table 4.

Table 4. The Effect Sizes ofthe Courses According To Subject Areas

Subject Areas	N	ES	95% Confidence Interval for Effect Size	
			Lower Limit	Upper Limit
Science	15	1.323	0.819	1.826
Mathematics	6	0.785	-0.003	1.574
Social	5	1.888	1.009	2.768
Total	26	1.303	0.921	1.685

Q_B=3.361 Z=6.683 df=2 p=0.186

According to the results in Table 4, we observe the highest effect size in courses in the Social group with the value 1.888. We observe the lowest in courses in the Mathematics group with the value 0.785. As a result of the homogeneity test, we calculate the Q_B statistical value as 3.361. We accept the critical value as roughly 5.991 from the χ2table at 95% confidence interval with the degree of freedom 2. As the Q_B statistical value (3.361) we calculate in this study is lower than the critical value (5.991), we accept the homogeneity hypothesis of the distribution of effect sizes in the Fixed Effects Model. We can claim the distribution to be homogeneous and can say that there are no significant differences in terms of effect sizes (Q_B=3.361; p= 0.186) among the subject area groups. Therefore, there is no significant difference between the subject area groups on academic achievement when using PBL.

3.3. Results of Analyses Concerning Permanence Scores of Studies Included in Meta-Analysis

When we consider the sum of the seven Masters theses, where the permanence scores of students in learning environments using PBL are compared with those in traditional learning environments, the experimental group consists of 256 students and the control group

257. We analyse the general characteristics of the studies and effect sizes using the sampling size, standard deviations, and mean scores of the studies. In Table 5, we provide the homogeneous distribution value, mean effect size and confidence intervals according to the effect model concerning the permanence scores of the theses included in meta-analysis as a result of using the related approach in the learning environment.

We can see the results of the analyses carried out in accordance with the fixed effect model in Table 5. We calculate that the permanence scores of academic achievement are better for PBL, than those obtained for traditional instruction with the standard error 0.092; the upper limit of 95% confidence interval being 0.612 and the lower level 0.252 having an effect size of 0.432. We accept this effect size as a medium effect according to the classification made by Thalheimer and Cook (2002). As a result of z test computations performed for statistical significance, we find z=4.707. Thus, we can say that the analysis was significant with the p=0.000 value in hand.

Table 5. Homogeneous Distribution Value, Mean Effect Size, and Confidence Intervals in the Effect Models Regarding the Permanence Scores of the Studies Included in Meta-Analysis

Model Type	n	Z	p	Q_B	df	ES	95% Confidence Interval	
							Lower Limit	Upper Limit
FEM	7	4.707	0.000	73.188	6	0.432	0.252	0.612
REM	7	1.736	0.083	7.917		0.592	-0.076	1.260

As a result of the homogeneity test, we calculate the Q_B statistical value as 73.188. From the $\chi 2$ table at 95% confidence interval, we find the critical value to be 12.592 with 6 degrees of freedom. We observe that the Q_B statistical value (73.188) exceeds the critical value of $\chi 2$distribution ($\chi 2_{(0.95)}$=12.592) having 6 degrees of freedom. In the light of this data, we determine the effect size distributions of the studies to be heterogeneous according to the fixed effect model. Therefore, we also compare the efficiency of permanence scores of PBL according to the random effects model, as it is possible that mistakes were destroyed in the heterogeneous samples due to data analysis using the random effects model instead of the fixed effects model.

As a result of random effects modelanalysis, we discover that the permanence scores of academic achievement using PBL are better than those where traditional instruction methods are used, with a standard error of 0.341; the upper limit of 95% confidence interval being 1.260, lower limit -0.076 and mean effect size 0.592. As a result of z test calculations realised for statistical significance, we find that z=1.736 and p=0.083. We conclude that

according to the random effects model, there is no significant difference in the permanence scores of students using PBL in the learning environment.

4. DISCUSSION AND CONCLUSIONS

According to data obtained from 26 research studies in this meta-analysis study including Masters and PhD theses in Turkey, and from examining the use of PBL in learning environments, there is a positive effect on academic achievement when taught using PBL. Thalheimer and Cook (2002), classify this effect as *very large*. This demonstrates that using PBL the efficiency level with respect to academic achievement is high. We obtain this result from research carried out nationally, which is supported by international literature and a number of different studies. We exclude Demirel and Turan, 2010; and Deveci, 2002 from the analysis but there are parallel results to those of the analysis by Akınoğlu andÖzkardeşTandoğan, 2007;Selçuk, 2010; Nafees, Farooq, Tahirkheli and Akhtar 2012. Dochy et al.,(2003) examined many studies carried out at an international level using meta-analysis and conclude that in the learning environments where PBL is used academic achievement is higher than found when using other approaches.Moreover Batdı's (2014) meta-analytic research about the effect of Jigsaw technique on academic achievement of students showed parallel results that thejigsaw technique has high efficiency level on academic achievement of students.

In this meta-analysis, we analyse whether or not the effect size differs according to implementation periods, subject areas and permanence scores. We split the studies into five different groups in terms of their implementation periods; 2-4, 5-6, 7-8, 9-18 weeks and *not specified*. When we examine the effect sizes of the groups, we observe that all the groups have positive values; we can see the highest effect size in 9-18 weeks of implementation with the value 2.491 and the lowest effect size in 5-6 weeks of implementation with the value 0.775. In terms of subject areas, the effect sizes in all three groups - science, mathematics, and social - are positive, the highest effect size being in courses grouped under *social* with the value 1.888 and the lowest effect size in courses grouped under *mathematics* with the value 0.785. The efficiency level of using PBL in all three levels of education falls into the category of "very large effect" according to the classification of Thalheimer and Cook (2002). On the other hand, we can say that there are no significant differences in terms of effect sizes according to the implementation periods, and the effect of using PBL in the courses mentioned in terms of academic achievement does not differ according to implementation periods. Hence, we observe that PBL has a very similar large effect in all groups. In previous

meta-analysis studies of different subjects in Turkey, we examine whether or not the effect size differs according to the implementation periods. Çapar's study (2011) determines that effect sizes do not differ according to implementation periods.

When we exclude the mean effect sizes belonging to the seven studies which include the permanence scores of students in the meta-analysis and calculate in accordance with the random effects model, we discover that permanence scores for PBL are better than those where traditional instruction methods are used with a standard error of 0.341; the upper limit of 95% confidence interval is 1.260 and the lower level -0.076, having a mean effect size of 0.592. We accept this effect size as "medium", according to the classification of Thalheimer and Cook (2002). When we examine the values of mean effect sizes of the studies included in meta-analysis, and include analysis results regarding the permanence scores, we calculate them at insignificant levels in two studies (Korucu, 2007; Akın, 2009), at small levels in one study (Sifoğlu, 2007), at medium levels in another study (Uslu, 2008), at large levels in two other studies (Çelik, 2010; Uygun, 2010) and at an excellent level in another study (Benli, 2010). When we consider the results of the analysis, we find that using PBL in learning environments positively affects the permanence scores of students. However, in a study examining the permanence scores of students using PBL, it was determined that there was no significant difference in terms of the results of permanence test (Korucu, 2007). The reason there was no significant difference in permanence about this disputable subject is that the permanence test was implemented just before the study, so there are doubts about the external validity of the study (Dinçer&Güçlü, 2013). However, according to the findings of studies in general, a constructivist learning approach is more successful than traditional instruction with regard to the permanence scores of students.

From our experiments and from examining the studies in terms of academic achievement and permanence, we recommend the encouragement of PBL in learning environments. We suggest that teachers use this approach carefully as it has a high effect on students' academic achievements. In this research, we study the efficiency level of PBL with respect to academic achievement and permanence. In future meta-analysis studies, we recommend the examination of the efficiency of this approach in terms of the attitudes of students. This study is limited in its findings, as it only includes Masters and PhD theses from Turkey. A more comprehensive study could be carried out, if data from abroad was included and if we examined different types of publications.

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APPENDIX 1. Meta-Analysis Effect Coefficients and Summaries of Studies

Author(s)/ year of publication	Test Type	Study Code and Type	Field of study (Course)	Level of Education of the Sampling	Conceptual Subject	Period of Exp. (Week)	City of the study	Mean Effect Sizes of Studies and Confidence Intervals		
								ES	Lower Limit	Upper Limit
Tavukçu (2006)	A	T_{MT}-1	Science	Secondary	Genetics	8	Zonguldak	1,575	1,074	2,076
Karaöz (2008)	A	T_{MT}-7	Science and Tech.	Secondary	Force and Movement	6	Muğla	1,681	0,979	2,383
Uslu (2008)	A	T_{MT}-8	Mathematics	High	Possibility	3	Balıkesir	1,828	1,101	2,556
Sifoğlu (2007)	A-P	T_{MT}-12	Science	Secondary	Inheritance	4	Ankara	0,381	0,101	0,662
Tandoğan (2007)	A	T_{MT}-13	Science	Secondary	How do Objects React When Force is Applied?	10	İstanbul	0,633	0,074	1,093
Korucu (2007)	A-P	T_{MT}-15	Science	Secondary	Journey to the Inner Structure of Matter	5	Konya	-1,139	-1,697	-0,581
Koçak (2008)	A	T_{MT}-24	Geography	High	Demographic Properties of Turkey	4	İstanbul	1,152	0,494	1,810
Alagöz (2009)	A	T_{PhD}-26	Geography	University	Environment	9	Ankara	4,122	3,256	4,984
Şalgam (2009)	A	T_{MT}-36	Physics I	University	Newton's Laws of Movement	4	İzmir	1,270	0,775	1,766
Akın (2009)	A-P	T_{MT}-38	Mathematics	Secondary	Fractions	6	İzmir	0,581	0,012	1,149
Özsarı (2009)	A	T_{MT}-39	Mathematics	Primary	Natural Numbers and Measurement	10	İzmir	0,707	0,133	1,281
Kuşdemir (2010)	A	T_{MT}-47	Chemistry	High	Mixtures	9	Hatay	6,462	5,109	7,814
Çelik (2010)	A-P	T_{MT}-51	Science and Tech.	Secondary	Matter and Temperature	5	Ankara	0,625	0,016	1,233
Benli (2010)	A-P	T_{MT}-52	Science Lab.	University	Boiler Scale	8	Ankara	2,182	1,581	2,783

Şahin (2011)	A	T_{MT}-53	Physics	University	Electric Circuits	8	Erzurum	0,365	-0,082	0,812
Altunçekiç(2010)	A	T_{PhD}-54	Physics	University	Temperature and Heat	6	Ankara	0,987	0,458	1,517
Uygun (2010)	A-P	T_{MT}-55	Mathematics	Secondary	Environment and Area	6	Ankara	1,070	0,548	1,593
Yıldız (2010)	A	T_{MT}-57	Science and Tech.	Secondary	Granular Structure of Matter	8	İstanbul	0,486	0,040	0,932
Akın (2010)	A	T_{PhD}-58	English	University	Pre-intermediate Language Level	-	Ankara	2,254	1,498	3,010
Ayvacı (2011)	A	T_{MT}-61	Mathematics	Secondary	The Concept of Equation	$10^{c.h.}$	Kastamonu	0,183	-0,244	0,610
Özdil (2011)	A	T_{MT}-62	Mathematics	Secondary	The Area of Tetragonal Regions	$16^{c.h.}$	Kastamonu	0,417	-0,151	0,986
Çetin (2011)	A	T_{MT}-63	Life Sciences	Primary	The Theme "Yesterday, Today, Tomorrow"	6	İzmir	1,664	1,062	2,266
Tozo (2011)	A	T_{MT}-66	Geography	High School	Concepts on Regional Problems	4	Ankara	0,514	0,043	0,985
Moralar (2011)	A	T_{MT}-69	Science and Tech.	Secondary	Matter and Temperature	4	Edirne	1,296	0,587	2,005
Kaçar (2012)	A	T_{MT}-70	Science and Tech.	Secondary	Granular Structure of Matter	7	İzmir	3,021	2,182	3,861
Aka (2012)	A	T_{PhD}-71	General Chemistry-II	University	Acids and Bases	9	Ankara	1,790	1,281	2,299

$T_{MT:}$ Master's Thesis $T_{PhD:}$ Doctoral Dissertation A: Academic Achievement Test P: Permanence Test $^{c.h.}$: Course hour