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How Candidate Teachers Use Learning Strategies in Physics: the Effects of Gender and Department

Öğretmen Adaylarının Fizikte Öğrenme Stratejilerini Kullanımları: Cinsiyet ve Anabilim Dalının Etkileri

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Abstract

In this study, it is aimed to examine how candidate teachers use learning strategies when learning physics and the effects of gender and department variables on the use of learning strategies. 212 candidate teachers from Dokuz Eylül University, Buca Education Faculty, Departments of Secondary Science and Mathematics Education and Elementary Education were involved in the study. The data were collected using the revised "Learning Strategies Scale for Physics Learning (R-LSSPL)". R-LSSPL consists of 39 items and they are divided into four dimensions as "elaboration", "organization", "rehearsal", and "monitoring comprehension". The data obtained from the scale were analyzed using mean, standard deviation, one-way multivariate ANOVA statistical techniques and follow-up tests. When candidate teachers' frequency of use of learning strategies was examined, it was found out that they "sometimes" use these strategies. The results of the research indicated that there are statistically significant differences among students' averages according to gender and department variables of R-LSSPL factors. The findings of this study were discussed based on the literature and suggestions were made on the use of learning strategies when learning physics.

Keywords: Learning Strategies, Physics Education, Mathematics Education

Özet

Bu çalışmada, öğretmen adaylarının fizik dersini öğrenirken öğrenme stratejilerini kullanımları, cinsiyet ve öğrenim görülen anabilim dalı değişkenlerinin öğrenme stratejilerinin kullanımları üzerindeki etkilerini incelenmesi amaçlandı. Araştırmaya Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi, Ortaöğretim Fen ve Matematik Eğitimi Bölümü ve İlköğretim Bölümü'nden toplam 212 öğretmen adayı katılmıştır.

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Bu araştırmada veriler, revize edilmiş "Fizikte Kullanılan Öğrenme Stratejileri Ölçeği (R-FKÖSÖ)" ile toplanmıştır. R-FKÖSÖ toplam 39 madde içermekte olup bu maddeler "işleme", "örgütleme", "devir" ve "kavramayı yönetme" olmak üzere dört boyuta dağılmıştır. Ölçekten elde edilen veriler ortalama, standart sapma, tek-yönlü çok değişkenli Varyans Analizi ve izleme testleri kullanılarak analiz edilmiştir. Öğretmen adaylarının fizikte öğrenme stratejilerini kullanım sıklıkları incelendiğinde, genel olarak bu stratejileri kullanım sıklıklarının arasıra olduğu belirlenmiştir. Analiz sonuçları, FKÖSÖ faktörleri bakımından cinsiyete ve anabilim dalı değişkenlerine göre, öğrencilerin ortalama puanları arasında istatistiksel olarak anlamlı farklılıklar olduğunu ortaya koymaktadır. Bu çalışmada, elde edilen bulgular ilgili literatüre dayalı olarak tartışılmış ve fizik öğretiminde öğrenme stratejilerinin kullanımına yönelik öneriler sunulmuştur.

Anahtar Kelimeler: Öğrenme Stratejileri, Fizik Eğitimi, Matematik Eğitimi

1. INTRODUCTION

The term "learning strategy" has been defined by many researchers. Weinstein and Mayer (1986, p. 315) define learning strategy as "behaviors and thoughts that a learner engages in during learning and that are intended to influence the learner's encoding process". Weinstein and Mayer (1986) divide learning strategies into eight major categories. Each category includes methods designed to influence certain aspects of the encoding process to facilitate one or more types of learning outcome and performance. The categories are:

1. Basic rehearsal strategies – in which one simply repeats the names of items in an orderly fashion.
2. Complex rehearsal strategies – include strategies such as copying, underlining, or shading class notes.
3. Basic elaboration strategies – strategies in which one forms a mental image or sentence related to items in each pair for a paired-associate list of words.
4. Complex elaboration strategies – include processes such as paraphrasing, summarizing, or describing how new knowledge relates to existing knowledge.
5. Basic organizational strategies – involve strategies such as grouping or ordering the items to be learned from a list or out of a text.
6. Complex organizational strategies – include strategies such as framing a passage or forming a hierarchy.
7. Comprehension monitoring strategies – involve checking for comprehension failures. Metacognitive strategies are involved in comprehension monitoring strategies.
8. Affective and motivational strategies – are related to creating, monitoring, and controlling an effective learning environment.

When physics education literature was examined, it was seen that the number of studies on learning strategies were few and that the research was divided into two groups. The first group of research aimed to specify the use of strategy (e.g. Wee,

A. TS, Baacquie, B.E., & Huan, A.CH.,1993; Sezgin Selçuk, G., Çalışkan, S and Erol, M., 2007); and the second group intended to determine teaching of these strategies (e.g. Koch and Eckstein, 1991; Koch, 2001; Rouet, J. F., Vidal-Abarca, E., Erboul, A. B. & Millogo, V., 2001; Sezgin Selçuk ,G.,Şahin, M.& Açıkgöz, K.Ü., 2011). This research is about the use of learning strategies in physics and a) candidate teachers' use of strategies, and the effects of b) students' gender and c) department variables on the use of strategy.

2. METHOD

The research is a cross-sectional study and survey method was used. The independent variables of the study are gender and department; and the dependant variable of the study is the use of learning strategies in physics. The control variable of the research is the class level of students.

2.1. Participants

212 candidate teachers (taking physics in 1st and 2nd years) from Dokuz Eylül University, Buca Education Faculty, Departments of Secondary Science and Mathematics Education (i.e., Physics, Secondary Mathematics Education and Chemistry) and Elementary Education (i.e., Elementary Science Education, Elementary Mathematics Education and Primary School Education) were voluntarily involved. 60.8% (n=129) of the participants were female and 39.2% (n=83) were male candidate teachers.

2.2. Data Collection Tool

In this study, the data were collected using the "Learning Strategies Scale for Physics Learning" revised by the researchers. The "Learning Strategies Scale for Physics Learning" was first developed by Sezgin Selçuk (2004) to determine the learning strategies students use when learning physics. This version of the scale was 5-point Likert-type with "Always, Frequently, Sometimes, Rarely, Never" options. It had 46 items and consisted of 7 dimensions. The revised scale was applied to a sample of 360 people at university level for statistical operations. The revised "Learning Strategies Scale for Physics Learning (R-LSSPL)" consisted of 39 items and divided into four groups as "elaboration (18 items, α=.90", organization (8 items, α=.77)", "rehearsal (7 items, α=.77", and "monitoring comprehension (6 items, α=.78)". The Cronbach's Alpha reliability coefficient of the revised scale was ,93. The items on the scale were graded as 5, 4, 3, 2, 1 starting with the "Always" option. The sample items which belong to the subscale of R-LSSPL are as below:

- *Elaboration:* "I learn subject matter by relating it to daily life;" "I always compare what I have just learnt to my existing knowledge."

- *Comprehension monitoring:* "When I cannot answer a question or solve a problem, I always think of what could be the reason for that;" "I try to notice what knowledge I lack."
- *Rehearsal:* "I always review my lecture notes the same day, either orally or by rewriting them;" "I always go over the example problems that my instructor solved in class, and try to solve those again."
- *Organization:* "I draw charts in order to understand the relationship between concepts;" "To comprehend a case in physics, I either draw its picture or a diagram."

2.3. The Analysis of the Data

The data obtained from the revised "Learning Strategies Scale for Physics Learning" were analyzed using means (M), Standard Deviation (SD), equal interval scale evaluation, one-way multivariate ANOVA, and follow-up tests (i.e. Variance Analysis and Bonferonni multiple comparison test for each dependant variable). They were analyzed using SPSS 11.0 program. The significance level of all the statistical tests used in this study was chosen as α=.05.

3. FINDINGS

3.1. Candidate Teachers' Use of Learning Strategies in Physics

In order to determine how often candidate teachers use learning strategies in physics, R-LSSPL and the averages of the grades they got from the subscales and standard deviation were calculated. The results are given in Table 1.

Table 1. Descriptive Statistics of the Revised "Learning Strategies Scale for Physics Learning" Subscale Scores

Sub-scales	N	Minimum	Maximum	M	SD
Elaboration	212	1.22	4.83	3.14	.66
Comprehension monitoring	212	1.00	4.67	3.13	.78
Rehearsal	212	1.29	5.00	3.36	.71
Organization	212	1.38	4.88	3.34	.73
Total	212	1.28	4.56	3.22	.57

Equal interval scale evaluation was done to find out the frequency of the use of the strategies on the basis of the subscales. The distribution of the scores according to the options is as follow: Very often (5.00–4.20), Often (4.19–3.40), Sometimes (3.39–2.60), Rarely (2.59–1.80) and Never (1.79–1.00). As a result, it is found out that the frequency of the use of the strategies is "Sometimes".

3.2. The Effects of Gender on the Use of Strategy

The average values of the dependant variables which are related to the use of strategies (see Table 2) were compared using one-way MANOVA according to the gender variable.

Table 2. Descriptive Statistics of Subscale Scores of Revised Learning Strategies Scale for Physics Learning According to Gender Variable

Sub-scales	**Gender**	**N**	**M**	**SD**
Elaboration	Female	129	3.06	.67
	Male	83	3.27	.60
Comprehension monitoring	Female	129	3.07	.80
	Male	83	3.22	.73
Rehearsal	Female	129	3.50	.68
	Male	83	3.16	.72
Organization	Female	129	3.44	.75
	Male	83	3.18	.68

When MANOVA results were examined, it was found out that there is a statistically significant difference among students' average scores in terms of gender [Wilks' Lambda (λ)=.799, $F_{(4, 207)}$=13.048, p=.000]. Because MANOVA *F* value was found to be statistically significant for dependant variables in general, one-way ANOVA analyses were done in order to examine how averages according to the gender differ for each dependant variable. The significance level for an average difference was corrected as α= .0125. According to gender, rehearsal ($F_{(1, 210)}$=11.781, p= .001) and organization ($F_{(1, 210)}$=6.356, p= .0012) subscales of one-way ANOVA results indicate a significant difference in favor of female students.

3.3. The Effects of Department on the Use of Strategy

Average values of the dependant variables related to strategy use (see Table 3) are compared according to the department variable using one-way MANOVA.

Table 3. Descriptive Statistics of Subscale Scores of Revised Learning Strategies Scale for Physics Learning According to Department Variable

Sub-scales	**Department**	**N**	**M**	**SD**
Elaboration	Physics	43	3.17	.73
	SME	32	3.35	.49
	Chemistry	34	3.08	.64
	ESE	30	2.96	.72
	PSE	35	3.01	.68
	EME	38	3.23	.59
Comprehension	Physics	43	3.02	.83
	SME	32	3.30	.81

monitoring	Chemistry	34	3.08	.63
	ESE	30	2.97	.84
	PSE	35	3.35	.75
	EME	38	3.07	.77
Rehearsal	Physics	43	3.13	.77
	SME	32	3.64	.61
	Chemistry	34	3.34	.45
	ESE	30	3.15	.86
	PSE	35	3.72	.71
	EME	38	3.23	.63
Organization	Physics	43	3.39	.87
	SME	32	3.61	.60
	Chemistry	34	3.40	.59
	ESE	30	2.83	.74
	PSE	35	3.35	.75
	EME	38	3.37	.59

Note: SME: Secondary Mathematics Education; EME: Elementary Mathematics Education; ESE: Elementary Science Education; PSE: Primary School Education

According to the department factor, MANOVA results indicate that there are significant differences among students' use of strategies [Wilks' Lambda (λ)=0.746, $F_{(20,\ 674)}$=3.121, p=0.000]. According to the results of the one-way ANOVA, in the rehearsal ($F_{(5,206)}$=4.868 p=0.000) and organization ($F_{(5,206)}$=4.214 p=0.001) subscales, there are significant differences between the departments on the use of strategies. The significant level for an average difference was (0.05/4) α=0.0125 and Bonferroni correction was made (to prevent the first type of errors). During these operations, α was determined as α=0.002. According to Bonferonni multiple comparison test (Table 4), it was discovered that there was a significant difference between physics teaching and primary school education (p=0.003) departments in the rehearsal dimension; and in the organization dimension there was a significant difference between mathematics teaching and elementary science teaching departments (p=0.000). When Table 3 is examined, it is seen that the rehearsal strategies are used frequently by primary school education department students but rarely by physics department students; and organizational strategies are used frequently by secondary school education students but rarely by science education students.

Table 4. Results of Bonferroni Test According to Department

Sub-scales	**Department**	Physics	SME	Chemistry	ESE	PSE	EME
Rehearsal	Physics					0.003*	
	SME						
	Chemistry						
	ESE						
	PSE	0.003*					
	EME						
Organization	Physics						
	SME				0.000*		
	Chemistry						
	ESE		0.000*				
	PSE						
	EME						

Note: SME: Secondary Mathematics Education; EME: Elementary Mathematics Education ; ESE: Elementary Science Education; PSE: Primary School Education

*$p \leq 0.002$

4. DISCUSSION

In order not to decrease the internal validity of the research, voluntary candidate teachers who participated in the lessons were chosen for the sample group. In order not to decrease the external validity of the research, it is told to the candidate teachers during the data collection process that there is no need to write their names down on the measurement form and that the measurement will only be used for research purposes.

In this research, it is found out that candidate teachers who form the sample group "sometimes" used the strategies in general and under each subscale. As a result, candidate teachers do not use effective learning strategies (elaboration, organization, and comprehension monitoring) frequently. According to the gender variable, female students use strategies under the rehearsal dimension (i.e., memorizing, reviewing, and copying) more often than the male students. This finding supports the results of Wee and the others' (1993) studies. Wee and the others (1993) observed the physics exam performances of a group of university students in Singapore and their use of learning strategies. According to the results of this research, Wee and the others found out that female students were less successful than the male students in exams and that this failure was caused by rare use of independent learning strategies by female students. In their articles, Kahle ve Lakes (1983) mentioned that female students define learning science as memorizing a set of events and explained that in order to learn science, memorizing would be enough.

Success purposes of female students are higher than male students according to some research (e.g., Yılmaz and Huyugüzel-Çavaş, 2007). From this point of view, we can say that female students prefer to use rehearsal strategies more often in order to be successful in class.

In this study, rehearsal strategies are frequently used by primary education department students, whereas they are rarely used by physics department students. The reason for this difference might be high school physics lesson experiences of primary school education students. Students' frequent use of rehearsal strategies was an expected result of the study since the students' level of physics lessons was low. Organization strategies are mostly used by secondary education mathematics teaching department students; and this may source from the education they get in branch lessons. In other words, instructors might be using activities that reinforce the use of this type of strategies in branch lessons.

5. CONCLUSION

As a result, candidate teachers "sometimes" use learning strategies in physics lessons; and according to R-LSSPL factors, there are significant differences among students' average scores in terms of gender and department variables. Because this research is a cross-sectional study, there are some limitations. The research is done at a random time during the educational term. This situation may create a different result when the research is redone at a different time. Therefore, the results of this research shouldn't be overgeneralized.

The following suggestions can be made in the light of this research: (1) Factors that might affect candidate teachers' use of strategies should be determined. (2) More research should be done to examine the relationship between gender and strategy use in physics lessons. (3) The use of learning strategies in physics lessons should be searched in depth with a larger sample group and more departments. (4) Candidate teachers' use of learning strategies in physics lessons should be examined in relation with variables like level of class, success, attitude, and self-competence. (5) Educational applications can be done in order to increase the use of high rank learning strategies (elaboration, organization, and monitoring comprehension).

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