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Evaluating Primary School Students' Deep Learning Approach To Science Lessons

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ABSTRACT

This study examines the variables which help direct students to a deep learning approach to science lessons, with the aim of guiding programmers and teachers in primary education. The sample was composed of a total of 164 primary school students. The Learning Approaches to Science Scale developed by Ünal (2005) for Science and Technology lessons as a four-point Likert scale was used in the research. It was found that the students who preferred a deep learning approach decreased in number with a higher grade level, enjoyed answering science questions and used the internet for research purpose. Moreover, a deep learning approach to science lessons is related to enjoyment of science lessons and the attitude of finding science lessons necessary.

Keywords:
Learning approaches, deep learning, science education, primary school

Introduction

As a concept, learning approach is defined as the interaction between the student and the learning task, information processing style, perception of learning, establishment of interaction with the environment, and manner of reaction revealing personal characteristics and preferences (Biggs, (a), 1987 p.3; Entwsitle, 1986, Dart, Burnett, Purdie, Boulton-Lewis, Campbell. & Smith 2000; Ekinci, 2008, p. 9; Ünal & Ergin 2008; Veznedaroğlu & Özgür 2005).

In effective learning, although two kinds of learning approaches came to the forefront: *surface* and *deep learning approach*, later the achievement approach, which was related to the effective use of time and place to increase success, was added by Biggs. *Deep* learning is defined by behaviors related to remembering what is learned for a long time, applying knowledge to new situations, inferring new meanings and generating new ideas, associating concepts to daily experiences, establishing relationships between incidents and results, and examining correct principles of thought of discussions, while *surface* learning is defined as quickly forgetting what is learned, not holding discussions using correct principles of thought, understanding a limited amount of knowledge, memorizing only the required information to pass tests, and seeing learning as an extrinsic load (Biggs, 1987, p. 10; Biggs et al., 2001; Dart et al., 2000; Entwiste and Ramsden 1982, p.18, Entwistle, 1986, p.1, 1991; Ellez &Sezgin 2002, Sezgin-Selçuk, Çalışkan & Erol 2007; Ekinci, 2009; Ünal & Ergin, 2008;).

Personal characteristics (gender, grade, age, etc.), subject area and content, learning environment, interest in the subject, and the nature of the education play an important role in the students' learning approaches and due to the effect of these and other such variables, students prefer a deep or a surface approach (Ak 2008; Aydoğdu & Ergin, 2010; Biggs 1987a, p.11, 1987 b, p.99; Ekinci, 2008, p.41, Ernwistle 1982:21; Ünal 2005; Nelson Laird, Shoup, Kuh & Schwarz, 2008,).

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Deep learning approach is one of the main objectives of the science program so that students can associate their knowledge with daily life and form a questioning and inquiring viewpoint (The Ministry of National Education and the Ministerial Committee for Educational Discipline, 2006, p.9). It is known that science lessons are effective in elementary education for the students to know their environment, to benefit from nature efficiently, and to improve their competency for scientific thinking (Gezer, Köse & Bilen, 2006). Furthermore, they are also effective in offering students the opportunity to scientifically examine the environment in which they live and to gain appropriate attitudes by exposure to everyday problems which they may encounter. Science and Technology lessons are important as much for learning as for organizing and developing programs of effective variables for the deep structuring of students' knowledge.

Research to assess learning approaches in our country has been seen to focus mostly on higher education (Beşoluk & Önder, 2010; Ellez & Sezgin, 2002; Koçak & Yücel, 2009; Sezgin-Selçuk et al., 2007;). This study investigated the variables that can have an effect on *deep approaches* to science lessons in the early years of primary education. Therefore the answers to the following questions were examined;

1. Does the *deep learning approach* of the students show any differences according to gender, school grade year, doing Science tests, taking extra Science lessons at courses outside school, owning a computer, and doing research on the internet?

2. Is there a relationship between deep learning approach and attitude toward Science?

Methods

Research Design

Since it was aimed to determine primary school students' learning approaches based on students' opinions and to evaluate those with respect to several variables, a relational screening model was used in the research.

Sample

The research sample consisted of a total of 164 students selected at random from two primary schools in Hurriyet and Ataevler neighborhoods in Osmangazi and Nilüfer Districts of Bursa: 57 6th grade students (28 girls, 29 boys), 57 7th grade students (27 girls, 30 boys) and 50 8th grade students (27 girls, 23 boys).

Procedure

The Learning Approaches to Science Scale developed by Ünal (2005) for Science and Technology lessons as a four-point Likert-type scale compatible with Entwistle and Ramsden's (1982, p. 245) learning approach scale was used in the research (Appendix 1). The scale included two sub-dimensions: the deep learning approach (10 items) and the surface learning approach (12 items). As the total points obtained from the scale increased, the *deep learning* approach increased; as the points decreased, the *surface learning approach* increased. In this study, the deep learning dimension was evaluated. Following the analysis made to determine the reliability level of the scale, the Cronbach alpha internal consistency coefficients of the collected data were found to be 0.78 for the science learning approach measurement and 0.78 for the deep learning approach.

In order to determine the attitudes of the students toward Science lessons, the Science attitude scale (Geban et al, 1994) taken from the study by Ünal and Ergin (2006) was used (Appendix 2). The scale was divided into three sub-dimensions: *Enjoyment of Science lessons* – the interest shown in Science lessons, *Necessity of Science lessons* – the value and importance given to Science lesson, *Aversion to Science lessons* – being worried and nervous in Science lessons (İlkörücü-Göçmençelebi, 2007). After determining the reliability level of the Science Attitude Scale, the Cronbach alpha internal consistency coefficients of the collected data were found to be 0.92 for the Science attitude scale, and in the sub-dimensions, 0.87 for enjoyment of Science lessons, 0.80 for necessity of Science lessons, and 0.80 for aversion to Science lessons.

Ekinci (2008) gathered the factors affecting the learning approach preference characteristics under five categories, namely personal characteristics, personality characteristics, subject area, past educational experiences and learning-teaching environment. In this study, from personal characteristics were chosen the variables of gender and class level, from personality characteristics were chosen the variables of attitude

toward science and enjoying doing tests, and from the characteristics of learning and teaching environment were chosen the variables of having a computer, using the Internet and taking extra lessons and two Science teachers in two primary schools were asked for their opinions on these variables. These items have the characteristics of independent variables according to the sub-problems of the study These variables can be important for students' achievement of science education and future research on achievement applying hierarchical models should take this finding into consideration (Table 1).

Table 1. Frequency distribution

		N	%
Gender	Female	82	50.0
	Male	82	50.0
Grade/age	(Grade 6) 13 years	57	34.8
	(Grade 7) 14 years	57	34.8
	(Grade 8) 15 years	50	30.5
Attendance of extra science lessons in addition to school	Attends	95	57.9
	Does not attend	66	40.2
Behaviors in science tests	Enjoys very much	72	44.7
	Does not enjoy	89	55.3
Research on the Internet related to science homework	Extensive research	56	34.1
	Little or no research	102	62.2
Computer ownership	Yes	137	83.5
	No	22	13.4

Data Analysis

For the data analysis, the SPSS (11.5) programme, t-test, one-way ANOVA correlation and Hierarchic Regression analysis were used.

Findings

As a result of the variance analysis (ANOVA) made by taking the variable of the students' grade into account (Table 2), no statistically significant difference was found in the *deep learning approach to science*. According to the results of the post hoc test carried out to determine the grades where differences occurred, it was found that the students in grades six and seven had more of a preference for a *deep learning approach to Science* compared to the grade eight students and the *deep learning approach to Science* preference rate of the grade eight students was seen to be lower than that of the grade six students (Figure 1).

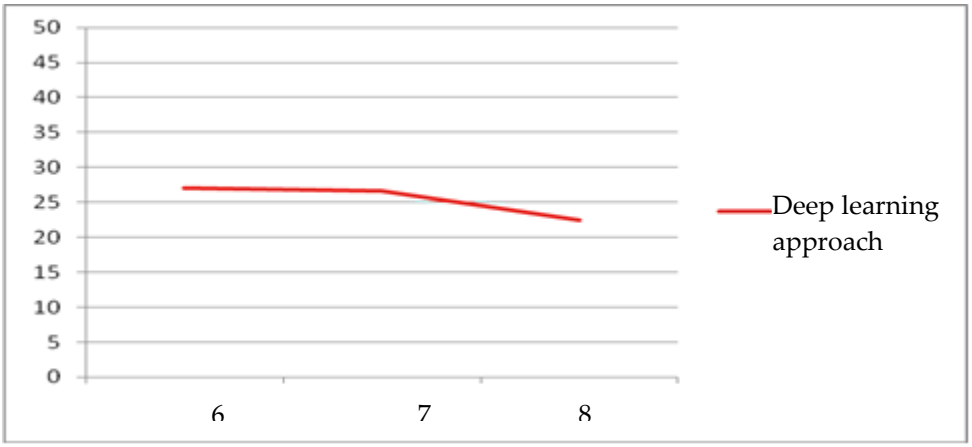

Figure 1. Mean Science deep learning approach according to grade

Table 2. Variance analysis

Variables	Grade	$\overline{X}$	s.s	F	p	Post Hoc
Deep learning	Grade 6	27.05	4.12	12.336	0.000*	8<6 8<7
	Grade 7	26.65	5.98			
	Grade 8	22.52	5.21			

* p<0.05 **Turkey Post Hoc test was used

According to the results of t-test performed to analyze the relationship between the students' *deep learning approach to Science* and research on the Internet and doing tests on science subjects, the difference was significant at p<0.05 level. As seen from Table 3, it was found that the students who did research on the Internet often tended to prefer a deep learning approach more than the students who enjoyed doing science tests.

Table 3. T-test analysis

			$\overline{X}$	**s.s**	**t**	**p**
Behaviors in science tests	Learning approaches to science (n= 161)	enjoys very much	65.30	6.91	7.460	0.000*
		does not enjoy	56.59	7.59		
	Deep learning approach (n=161)	enjoys very much	28.47	4.43	7.460	0.000*
		does not enjoy	22.95	4.84		
Use of the internet for research	Learning approaches to science (n= 158)	Often	63,.32	7.89	3.795	0.000*
		Occasionally	59.04	8.37		
	Deep learning approach (n=158)	Often	27.64	5.37	3.795	0.000*
		Occasionally	24.39	5.02		

*p<0.05

According to the Pearson coefficients, there is a significant relationship between the students' learning approach to Science points and their attitudes to Science. According to the Pearson correlation coefficients calculated between the sub-factor points of *deep learning approach to Science* and the sub-factor points of *attitude to Science*, a direct correlation was found between the students' *deep learning approach* and *enjoyment of Science lessons* and *necessity of Science lessons*, whereas an inverse correlation was found between the students' *deep learning approach* and *aversion to Science lessons* (Table 4).

Table 4. Correlation between *Science learning approaches* and *Deep learning approaches* and attitudes to Science

	Attitude to science	Enjoyment of science lessons	Necessity of science lessons	Aversion to science lessons
Learning approaches to science (n=164)	0.798*	0.761*	0.689*	-0.629*
Deep learning approach (n=164)	0.788*	0.774*	0.689*	-0.577*

*p<0.05

According to the results of the t-test performed to analyze the relationship between the students' *deep learning approach to Science* and gender, taking private science lessons outside school, and owning a computer, no statistically significant difference was determined (p>0.05).

In order to determine which variables are more effective in explaining the students' *deep learning approach*, the hierarchical regression analysis was performed (Table 6). In the hierarchical regression analysis, the deep learning approach was taken as the dependent variable and the variables of gender, grade, doing tests, taking extra science lessons outside school, owning a computer, and research on the internet included

in the first group and those of enjoyment, necessity, and aversion – in other words, the students' attitudes toward science lessons included in the second group were taken as independent variables. Thus, it was aimed to determine the extent of the contribution that the variable groups added hierarchically to the explained variance. Definitions of the independent variables used in the study are given in Table 5.

Table 5. Regression analysis variables and definitions

Variable group	Independent variables	Variable type	Definition
Group 1 variables	Gender	Dummy	Female 1, male 0
	Grade 6	Dummy	Grade 6 -1, Grade 7 and 8 - 0
	Grade 7	Dummy	Grade 7 - 1, Grade 6 and 8 - 0
	Attendance at extra lessons	Dummy	Attendance 1, Non-attendance 0
	Behaviors in answering science multiple choice tests	Dummy	Enjoys solving tests 1, Does not enjoy solving tests 0
	Computer ownership	Dummy	Owns a computer 1, Does not own a computer 0
	Using the internet for research	Dummy	Frequent use of internet for research 1, Occasional use of internet for research 0
Group 2 attitude to science	Enjoys science	Constant	
	Finds science necessary	Constant	
	Aversion to science	Constant	

The regression models estimated by considering the variables in Table 6 are shown in the table below.

Table 6. Results of hierarchical regression analysis

Variables	**Dependent variable:** Deep learning					
	Model 1			**Model 1**		
	B	**Beta**	**P**	**B**	**Beta**	**p**
Constant	20.705		0.000	10.137		0.000
Gender	0.950	0.087	0.172	0.449	.041	0.380
Grade 6	3,843	0.333	0.000*	1.050	.091	0.127
Grade 7	3.210	0.278	0.000*	0.957	.083	0.149
Extra lessons	1.569	0.141	0.042*	0.750	.067	0.180
Computer ownership	-2.228	-0.151	0.027*	-1.364	-.092	0.064
Behaviors in answering science multiple choice tests	4.422	0.400	0.000*	1.782	.161	0.002*
Internet usage	2.549	0.220	0.001*	1.683	.145	0.003*
Enjoyment				0.378	.394	0.000*
Necessity				0.356	.274	0.000*
Aversion				-0.081	-.055	0.384
F	14.044		0.000	33.252		0.000
R^2		0.39			0.69	
R^2 variation					0.30	

*p<0.05

Judging from the *F*-statistic values and *p* values demonstrating the observed significance level in the table, it was seen that the regressions separately set up were significant in general. The R^2 value was found to be 0.39 in the first model set up for the deep learning approach and 0.69 in the second model. The variables added to the second model and used to assess the attitude toward science increased the explanation power of the model by 0.30. Consequently, it is seen that certain definite explanatory variables included in the model explain 69% of the students' deep learning approach.

In the first model set up for deep learning approach, the variables of grade six and seven students for doing tests and research on the internet were found to be statistically significant. Therefore, these variables

occupy an important place in the students' deep learning approach. In other words, it can be inferred that grade six and seven students prefer a deep learning approach more than grade eight students, and those who enjoy doing tests and often use the internet for research prefer a deep learning approach more when studying science subjects.

In the second model set up for deep learning approach, as a result of additional variables, the first group variables of doing tests and research on the internet were found to be statistically significant. Furthermore, variables of enjoyment and finding science lessons necessary, which show the students' attitudes toward science, were also statistically significant. Thus, the students adopting a deep learning approach are those who enjoy the lessons and find the lessons necessary.

Discussion and Implication of Findings

When the findings of the study were evaluated, no significant difference was found between the female and the male students in terms of the deep approach to learning science. This conforms to the findings obtained in the study by Ünal and Ergin (2008) on grade seven and eight students. In the study by Eklund-Myrskog and Wenestam (1999) investigating variables affecting primary school students' learning approaches, no difference was found between the genders in terms of the learning approaches. In addition, studies measuring learning approaches from the aspect of a deep learning approach to science have found no significant differences between genders, not only at elementary school level but also at university level (Ellez & Sezgin 2002). In conclusion, it can be stated that the deep approach to learning science does not vary according to gender, which is a personal variable.

The current study showed that the students' learning approaches differed according to their grade levels. Similar studies have also reported that the variable of grade affects students' learning approaches (Ekinci 2009; Ellez & Sezgin 2002; Sezgin-Selçuk et al., 2007). The findings of the current study indicated that the mean deep learning approach decreased in the eighth grade (Figure 1). In other words, it was noticeable that there was a tendency for a lower preference for a deep approach to learning science as students got older. The reason for this might be the High School Entrance Exam held at the end of the eighth grade. This could be discouraging students of this age from employing a deep learning approach due to exam anxiety and graduating from primary school.

It is known that teachers prefer multiple-choice questions more than other types in elementary school science and technology lessons (Gündüz, 2009). According to the results of the current study, students who prefer a deep learning approach to science tend to solve more multiple-choice questions. However, we believe that it should not be thought that the success of the students in multiple-choice questions depends on their preference for a deep learning approach. In the study, the students were asked whether they enjoyed doing tests, and it was found that they preferred a deep learning approach to a surface learning approach in the subjects in which they are interested. Nelson Laird et al. (2008) and Entwistle (1986, p. 13) found in their studies that multiple-choice tests have an effect on students' preferring surface learning approach. As success achieved in multiple-choice questions is most important in student evaluations, it will be significant in the preference of a deep learning approach and willingness to do tests. Thus, although students have moved away from a deep learning approach in the eighth grade, the success they achieve in multiple-choice questions gives the impression that they are close to a deep learning approach for the subject. The findings of the study also show that 57.9% of the students give importance to learning science by taking extra lessons outside school. Extra lessons are found to have a direct influence on achievement in science and also have indirect influences on science achievement (Mohandas, 2000). However, this does not affect the students' preference for a deep learning approach and does not contribute to significant learning as a result of a deep learning approach.

Although 83.5% of the students participating in the study own a computer, only 34.1% of them use the internet for research (Table 1). No relationship was determined between owning a computer and deep learning approach. Moreover, students who preferred a deep learning approach were seen to be those who used the internet for research ($X=27.64$).

Since the 2005–2006 academic year, computer lessons have been included as an optional lesson in the elementary syllabus from the first grade to the eighth grade. This allows students to efficiently benefit from

computers and lesson content on the internet. The Science and Technology syllabus states that students should benefit from computers and other communication technologies to improve scientific thinking (The Ministry of National Education and the Ministerial Committee for Educational Discipline, (2006:20). In a study by Yılmaz and Orhan (2010) investigating the relationship between elementary school students' internet use frequency and learning approaches, it was determined that more students who used the internet for homework preferred a deep learning approach to a surface learning approach. However, the same study showed that more students who spent more time on the internet other than for educational purposes preferred a surface learning approach. In a study by Kıncal and Ulutaş (2009) of grade eight students, it was reported that the success of the students increased with the frequency of using computers as a learning tool. In conclusion, it can be seen that there are differences between computer owners according to the intended use of the computer. Therefore, as the contributions of research on learning approach associated with the internet will be different, it is thought that research which will be conducted on deep learning approaches associated with the internet will cover program targets.

According to the results of the study, a deep learning approach to Science lessons is related to the attitudes of enjoying science lessons and finding science lessons necessary (Table 6). The students' learning approaches depend on their attitudes toward the subject (Ünal & Ergin 2006), and a deep learning approach is thought to be related to effective and desired learning attitude, whereas surface learning approach is related to ineffective and undesired learning attitude (Duff & McKinstry 2007). From this standpoint, directing the students to deep learning approach will be possible by creating learning environments that encourage the students to develop positive attitudes toward the subject.

The study shows that the learning approach changes according to age. It was concluded that students who preferred a deep learning approach enjoyed tests and used the internet for research. Furthermore, it was discovered that the students' positive attitudes toward science lessons positively affect their preference for a deep learning approach.

We believe that by taking into account that student' preferences for deep or surface learning approaches are revealed at an early age allows them to be managed and will be useful in the design of educational syllabuses. We also think that the consideration of learning preferences will be useful for teachers in the assessment and evaluation of students.

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Appendix 1: Learning Approach to Science Scale

SOMETIMES TRUE = **ST** USUALLY TRUE = **UT** ALWAYS TRUE= **AT** NEVER TRUE = **NT**

1.	I only study the science subjects which the teacher explains in the classroom.	T	T	T	T
2.	I regularly do my science homework, without the need to be reminded.	T	T	T	T
3.	Studying science is as much fun as watching a movie or playing a game.	T	T	T	T
4.	I solve related problems until I understand a science subject.	T	T	T	T
5.	I study science subjects by memorizing them.	T	T	T	T
6.	I enjoy answering difficult questions on science subjects.	T	T	T	T
7.	Studying too much science is unnecessary.	T	T	T	T
8.	I spend most of my free time finding out more information about the interesting subjects we discuss in science lessons.	T	T	T	T
9.	Time hangs heavy on my hands in science lessons.	T	T	T	T
10.	It is unnecessary for me to learn the subjects not included in the science exams.	T	T	T	T
11.	When I try to understand new science subjects, I relate them to real life situations to which they might apply.	T	T	T	T
12.	I establish cause and effect relationships about the subjects I learn in science lessons.	T	T	T	T
13.	I don't read more than necessary when I do my science homework.	T	T	T	T
14.	Usually, I don't think about the importance of the subject I read about in science.	T	T	T	T
15.	I draw new meanings from what I learn in science lessons.	T	T	T	T
16.	I try to find another way to learn the subject that the teacher explains in science lessons.	T	T	T	T
17.	I start to worry if I inadequately answer the first question in science exams.	T	T	T	T
18.	I get bored when I have to do homework or projects about science.	T	T	T	T
19.	I expect to be told exactly what I am going to do in science homework.	T	T	T	T
20.	I get bored when studying science.	T	T	T	T
21.	In order to understand science subjects, I take notes while reading.	T	T	T	T
22.	I don't remember to do science homework unless someone reminds me.	T	T	T	T

Appendix 2: Science Attitude Scale

	Totally Agree	Agree	Some what	Disagree	Totally Disagree
Science is a field which I like very much.					
I enjoy reading science books.					
Science has a very important place in daily life.					
I enjoy solving science problems.					
I like to learn more about science subjects.					
I feel worried when science lessons start.					
Science is important to better understand the natural events in our environment.					
I wish science lessons were longer.					
I get bored when studying science.					
I like to learn more about daily events related to science subjects.					
Science lessons are important to improve our way of thinking.					
I enjoy science lessons.					
I find science lessons unlikable compared to other lessons.					
Participating in discussions about science subjects doesn't appeal to me.					
I like to allocate a considerable part of my studying time to science lessons.					