Effects Of Context Based Learning On Students' Achievement and Attitudes In Biology

Biyolojide Yaşam Temelli Öğrenmenin Öğrencilerin Başarı ve Tutumlarına Etkisi

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Abstract

The aim of this study is to determine effect of "context based learning approach" towards student's biology success and attitudes on biology course. This study was applied to two groups' first grade students that include 53 students in control group that designed on traditional learning approach and 41 students in experimental group that designed on context based approach by the same teacher over a period of 8 weeks in department of primary teacher training. Achievements test prepared for each biology subjects and attitude test towards biology courses were used as means of collecting quantitative data, interview form which includes open ended questions were implemented as means of collecting qualitative data. Multiple choice academic science achievement test and attitude test towards biology were given to both groups as pre-tests and post-tests. Interview form which includes open ended questions was given only experimental group after context based learning. The result of analysis shows that there is a meaningful difference between context based learning approach and traditional learning on student's success and attitudes towards biology. The results of interview form which was implemented on experimental group in order to support obtained findings are in favour of our study.

Keywords: *Context based learning approach, Achievement, Attitude, Biology lesson, Primary Teacher Training students.*

Özet

Bu çalışmanın amacı, biyoloji öğretiminde yaşam temelli öğrenme yaklaşımının öğrencilerin başarılarına ve tutumlarına etkilerini araştırmaktır. İlköğretim sınıf öğretmenliği bölümünden seçilen 41 kişilik deneysel gurupta yaşam temelli öğrenme yaklaşımı, 53 kişilik kontrol gurubunda geleneksel öğrenme yaklaşımı aynı öğretmen tarafından sekiz haftalık bir periyotta uygulanmıştır. Nicel veri toplamak için her biyoloji konusu için hazırlanan başarı testi ve tutum testi, nitel veri toplamak için açık uçlu sorulardan oluşan görüşme formu kullanılmıştır. Her iki gruba ön ve son test olarak akademik başarı testi ve tutum testi uygulanmıştır. Görüşme formu ise sadece deney gurubuna etkinlikten sonra uygulanmıştır. Analiz sonuçları yaşam temelli öğrenme ve geleneksel öğrenme grupları arasında öğrencilerin başarıları ve tutumları

açısından anlamlı bir farklılığın olduğunu göstermiştir. Görüşme formunun sonuçları da elde edilen bu bulguları desteklemiştir.

Anahtar Kelimeler: *yaşam temelli öğrenme yaklaşımı, başarı, tutum, biyoloji dersi, sınıf öğretmenliği bölümü öğrencileri.*

1. Introduction

Biology conceptions are often far more difficult for students to grasp than biologists imagine. Furthermore, there is common for students to retain misconceptions. These misconceptions are highly resistant to change and, consequently, traditional teaching is seldom effective. Naive and "magical beliefs" act like filters and so can allow disconnected facts and ideas through, but block out a deeper understanding of methods and world-view. In case we are resembled our education a ladder, unfortunately, many students do not see the connection between the successive rungs. They are not told and do not discover why or where they are climbing. Before long they develop vertigo. Often they jump or fall off the ladder before they reach the top. All they take from the experience is distaste for science (Schwartz, 2006).

To improve the quality of the teaching-learning process as well as the learning outcomes, primarily the nature of learning has to be considered. Many learning theories and models have been developed by using different approaches to learning until today. Throughout the world, over the past 20 years or so, science education has faced a number of inter-related problems: Overload, Isolated Facts, Lack of transfer, Lack of relevance, adequate emphasis. Each of these problems poses a series of challenges. A major address to these challenges has been through the use of "context" as the basis for curriculum design and classroom teaching. For this to be successful, the educational model that embodies the meaning of "context" must be such that it provides an effective answer to the associated curricular and social problems (Gilbert, 2006).

In its related noun "contextus", the word expresses "coherence", "connection", and/or "relationship". A context must provide a coherent structural meaning for something new that is set within a broader perspective (Gilbert, 2006).

Context based approach has been widely used a lot of country: United Kingdom, USA, Germany, Israel, Netherlands et al. (Pilot and Bulte, 2006; Gilbert, 2006; Bennett and Holman, 2003). The trend towards context-based approaches is apparent across the whole spectrum of age range from primary through to university level. The aims of context based learning are motivation, uptake of science subjects, learning of science ideas, and the desire to produce adult citizens who are scientifically-literate (Bennett and Holman, 2003).

Contexts include personal, social, economic, environmental, technological and industrial applications of science. Contexts are normally selected on the basis of their relevance to students' everyday life, as perceived by teachers and educators. For example, ideas about Newton's Laws of Motion introduced in the context of traveling by bicycle or ideas about organic chemistry might be introduced by looking at research into the development of medicines (Bennett, et al. 2005b). Context is structured around commu-

nity issues related to biology rather than around predetermined biological concepts. For example, AIDS, influenza used as a context to develop an extensive range of foundation biology, including structure properties, reproductive cycles, viral diseases, type of virus. Students learn their biology through real-life contexts. Television news, newspaper reports and even crime and other dramas on TV and film, all provide examples of biology in context based learning approach. These include the health risks of smoking, genetic counseling, global warming, GM crops, DNA fingerprinting, the spread of pathogens, the destruction of natural habitats, drug abuse in sport, and recreational drug use. The contexts chosen for the course are topical and of interest to students, but are also enduring (SNAB).

Advocates of context-based courses often cite two particular features which should enhance the understanding of scientific ideas. The first of these is the motivational aspect of the approach: if students can see the point of what they are studying, they will engage with the materials and they are likely to learn more effectively. The second relates to the 'drip feed' approach: the revisiting of ideas at different points in a course provides more opportunities for students to develop their understanding of scientific ideas (Bennett and Holman, 2003).

Context based learning approach give students a significant degree of autonomy over the learning activity. Examples of 'active learning' activities include small-group discussions, group and individual problem-solving tasks, investigations and role-play exercises. The use of 'student-centered', 'active learning' approaches also stimulates interest and motivation (Bennett, et al. 2005b).

Bennett and Lubben (2006) indicate that students adapted to the context-based approach develop levels of understanding of chemical ideas comparable with those taking more conventional courses. Holman and Pilling (2004) suggest that the context based course succeeded in increasing students' interest. The results are backed up by a comparison of the two groups of students' performance: the average mark was 48.5% with the traditional course in 2000 and 61.3% with the context based course in 2001. Murphy and Whitelegg (2006) indicate that a context-based or humanistic approach is successful in enhancing student motivation, retention and achievement. Ramsden (1997) compares the performance on a range of diagnostic questions of students following both a context-based approach and a more traditional approach to high school chemistry. The study shows that there is little difference in levels of understanding, but that there appear to be some benefits associated with a context-based approach in terms of stimulating students' interest in science. Gutwill-Wise (2001) worked with university students following introductory chemistry courses. He compared students who had followed the context-based approach with matched groups of students who had followed a traditional approach to chemistry. The study found that in both institutions students who had followed the context-based approach emerged with a better understanding of chemistry than their peers who had followed a traditional approach. Özay-Köse and Çam-Tosun (2013) investigated the effects of context-based learning approaches to teaching biology on students' achievement and scientific process skill. It was observed in the results that there was a meaningful difference between context based learning and traditional in learning on student's success and student's scientific process skill. Williams, Anderson

and Day (2007) investigated effects of context-based learning approaches to nursing students' knowledge and scientific process skill. There was a significant positive increase in CBL students' attitudes toward personal aging from the first to fourth years of the program. This suggests that CBL learning fosters an inner maturity toward personal aging.

Most of studies about context based learning are related to chemistry courses. However, there are very few studies on the biology course in the literature.

The aim of this study is to determine effect of context based learning towards student's biology success and attitudes on biology course.

Research hypothesizes

1- H_1: there is a significant difference between the intervention group (experimental group) and the control group in the amount of change that occurs over time in the undergraduates' achievements of the chosen five biology topics.

$H_{0:}$ there is not a significant difference between the intervention group (experimental group) and the control group in the amount of change that occurs over time in the undergraduates' achievements of the chosen five biology topics.

2- H_1: there is a significant difference between the intervention group (experimental group) and the control group in the amount of change that occurs over time in the undergraduates' attitudes toward biology.

$H_{0:}$ there is not a significant difference between the intervention group (experimental group) and the control group in the amount of change that occurs over time in the undergraduates' attitudes toward biology.

Variables

1-Dependent Variables: achievement in five biology subject, attitude

2-İndependent Variables: context based learning, traditional teacher centred instruction

2. Method

Design

In the research, mixed research design which consists of interview form with open ended questions and quasi-experimental non-equivalent pre test- post test control group was used.

Procedure

The data from the subjects were collected in the following manner:

Two weeks ago from the treatment, the achievement tests developed by the researchers and attitude test towards biology were administered to experimental and control

groups as pre-test. While used only the traditional teacher centred instruction in the control group, context-based learning was used in the experimental group. The traditional instruction was based on lecturing in class. It was not designed explicitly to facilitate conceptual understanding or conceptual change. All treatment was completed by the same teacher in 8 weeks (two lecture hours per week and a lecture hours is 50 min). One week later after the treatment with respect to the corresponding topic, the achievement test of these topics was administered to both control and experimental group as post-test.

After 8 week, attitude test towards biology was administered to experimental and control groups as post-test.

Interview form which includes open ended questions was given only experimental group after context based learning in order to investigate their perceptions in more detail about context based learning. These questions aimed to explore the phenomena which could not addressed through the instruments.

Contexts

The contexts require quite simple that students may meet in daily life. Contexts are structured around social and environmental issues related to biology rather than around predetermined biological concepts. For example, AIDS, influenza used as a context to develop an extensive range of foundation biology, including structure properties, reproductive cycles, viral diseases, type of virus. The activities began with contexts. Questions and problems connection with contexts were offered students. Small group sessions, large group workshop, laboratory working, individual researches, team working, short demonstrations and video-clips were used in lesson as a different kind of context. The activities finished generalization and students' feedback. In Table.1, topics' contexts, concepts and time are showed.

Table.1. Topics' contexts, concepts and time

	Topics	Contexts	Basic concepts	Time
System-I	Virus	Alive and lifeless discussion, aids disease	Structure properties, reproductive cycles, viral diseases, type of virus	1. Week
	Bacteria	They are almost everywhere!, making of yogurt	Structure properties, reproductive cycles, type of bacteria, economy of bacteria	2. Week
	Fungi	Ecologic workers, making of bread	Body structure, reproductive cycles, type of fungi, fungi in ecosystem	3. Week
	Movement system	Asimo run robot	Type and function of skeletons, muscle. Mechanism of movement.	4. Week
	Digestive system	Obesity, cows that eat green gress and produce white milk	Organs of digestive system, main stages of digestion	5. Week
System-II	Circulatory system	Heart attack, heart massage	Structure of heart and blood vessel, blood circulation	6. Week
	Respiratory system	Smoke	Structure of lungs, breathing, gas exchange.	7. Week
	Excretory system	Dialyzer, kidney stone, drink beer frequently urinate	Structure of kidney, nephron and urine, main stages of excretory,	8. Week

Participants

This study was applied to two groups' first grade students that include 53 students in control group and 41 students ranging age of 17 to 19 in experimental group in department of primary teacher training in Bayburt Education Faculty of Bayburt University. Classes were randomly assigned as experimental (class 1) and control (class 2) group.

Data collection tools

1-Measuring Students' achievement of the five biology topics

Students' achievement of biology was measured using the five multiple choice test developed separately for each topics by researchers. The tests were piloted with a group of students in department of primary teacher training in Bayburt Education Faculty of Bayburt University. Then modifications were made in terms of language and design of the test. The virus test has 0. 7172, the bacteria test has 0. 7776, the fungi test has 0. 6476, the system-I has 0. 7824, the system-II has 0. 7158 α reliability coefficient. This level of reliability coefficient obtained for the achievement test indicated that the test could be considered satisfactorily reliable (McMillan and Schumacher 2001). The validity of multiple choice academic science achievement tests were supplied by two professors of science education and three science teachers. The five biology topics tests have totally 107 questions and any question is a one point. The range of possible total scores for achievement test is between 0 and 107.

2- Attitude towards biology test

The scale of attitude towards biology was developed by Pekel (2005) a 5-point Likert type scale in the form of "strongly agree, agree, undecided, disagree and strongly disagree" consisting of 15 items with reliability of 0.83.

3- Interview with students

A qualitative questionnaire was conducted in order to understand students' perceptions about the context based learning. There were 6 open ended questions in the questionnaire. These questions' answers were coded and these coded were converted into scores in results section. According to students' answer, coded are produced. Four of codes the most repeated by different students are selected.

3. Results

1-Undergraduates' achievements of the five biology topics

Repeated measures MANOVA was conducted to assess if there was a difference between participants in the intervention group and participants in the control group over time in the amount of change in their scores on the biology achievements. Before the analysis, it was checked whether the assumptions of repeated measures MANOVA were met. Box's M test for the homogeneity of the covariance matrices indicated that the homogeneity of the variance matrices of dependent variables was met (Box's M = 82.36; F=1.32; df1=55, df2=23936; p= 0.056>0.05). In addition, Levene's test for homogene-

ity of variances showed that the variances can be assumed as homogeneous because of the significance levels ranging from 0.056 to 0.81.

To determine which levels of dependent variables these differences are, follow-up ANOVAs (Test of within subject contrasts) for each dependent variable (see Table 2) were conducted. As can be seen from the table, the main effect of time (change from pre test to post test) is significant for all five dependent variables and also the interaction between group and time are statistically significant for all dependent variables. This indicates that the change over time is associated with the intervention. The values of η^2 (eta squared) for time main effect and interaction effect indicating the practice significance of the factor or interaction change from 0.116 to 0.866. The lowest values, 0.116 and 0.197, belong to the topic fungus and bacteria in the time-group interaction, respectively. The corresponding Eta values are 0.34 and 0.44 which are about medium and large effect sizes, respectively.

Table 2. Test of within subject contrasts

		Sum of Square	Freedom degree	Mean of Square	F	p	η^2
Time	Virus	1550.739	1	1550.739	415.378	0.000	0.819
	Bacteria	2056.735	1	2056.735	595.269	0.000	0.866
	Fungus	286.468	1	286.468	74.927	0.000	0.449
	System1	1413.872	1	1413.872	406.034	0.000	0.815
	System2	2306.354	1	2306.354	492.696	0.000	0.843
Time* Group	Virus	144.714	1	144.714	38.763	0.000	0.296
	Bacteria	77.801	1	77.801	22.518	0.000	0.197
	Fungus	46.106	1	46.106	12.059	0.001	0.116
	System1	205.298	1	205.298	58.957	0.000	0.391
	System2	638.29	1	638.290	136.355	0.000	0.597

A t test was used to see if experimental group and control group attitudes toward biology. First, to explore whether there is a significant difference between experimental and control groups with respect to attitudes toward biology prior to the treatment, t test was performed. The findings are given in Table 3.

Table 3. Between experimental and control groups students' pre test scores

Group	N	X	df	t	P
Experimental Group	41	47.81	5.70	-0.073	0.942*
Control Group	53	47.93	7.22		

T test showed no significant differences between experimental and control groups. Pre practice, Mean pre test of experimental group is calculation as 47. 81 and mean pre test of control group is 47. 93.

The differences among experimental and control groups on post practice were measured by t test. The results are given in Table 4.

Table 4. Between experimental and control groups students' post test scores

Group	N	X	df	t	P
Experimental Group	41	45.38	7.13		
Control Group	53	37.13	4.87	4.327	0.000*

The p-value 0.000, less than 0.05, indicates that there is significant different between experimental and control groups. An attitude toward biology of experimental group is higher than attitudes toward biology of control group.

3-Interview with students

A qualitative questionnaire was conducted in order to understand students' perceptions about the context based learning. There were 6 open ended questions in the questionnaire. Open ended questions, codes and students' numbers are in Table 5.

Table 5. Open ended questions, codes, students' frequency and percent

Open Ended Questions	Codes	Frequency	%
1) How did the new method implemented in your biology course affect your learning? Explain your response.	-Raising retention of learning	6	14.6
	-Making learning and understanding easy	11	26.8
	-Enhancing need of scientific research	3	7.3
	-Making the biology study fun	3	7.3
2) What did the new teaching method affect your attitude towards biology? Explain your response.	-It affected positively	7	17
	-This course with new method is not boring	7	17
	-It developed my interest and attitudes toward course	14	34.1
	-It helped me engage the course	4	9.7
3) What activities or the cases did you impress? How?	-The stories	14	34.1
	-Team working	7	17
	-Visual materials used in the course	5	12.1
	-Research activities	4	9.7
4) Did the course make contribution you? How?	-Yes	30	73.1
	-No	2	4.8
	-It only helped me to pass the biology examination	6	14.6
	-It contributed to enhance my learning obtain information	11	26.8
5) Do you think that there still are the issues and concepts you could not learn in the course but you wish to learn? Explain your response.	-No	14	34.1
	-Yes	2	4.8
	-Yes, some concepts.	1	2.4
	-The bacteria issue	1	2.4
6) Is there any suggestion or saying you would make about the implementation?	-The number of home works should be raised.	1	2.4

4. Discussion

The purpose of this study was to investigate the effects of context-based approaches to teaching biology on students' understanding and attitudes towards biology have been comparative in nature, looking at the understanding of selected scientific ideas demonstrated by students who have followed context-based courses and students who have followed more conventional courses.

In all cases, changes significant at the 0.05 level occurred in students' achievement and attitudes towards biology. Interviews confirmed these results.

In accordance with the first research hypothesis, there are significant differences between experimental and control group students regarding their academic achievement. Repeated measures MANOVA revealed that there are significant differences in favour of experimental group students (Table.2). Time * Group has statistically significant F ratios for five biology subject (virus F=38.763, p=0.000, partial η^2=0.296; bacteria F=22.518, p=0.000, partial η^2=0.197; fungi F=12.059, p=0.001, partial η^2=0.116; system-I F=58.957, p=0.000, partial η^2=0.391; system-II F=136.355 p=0.000, partial η^2=0.597). This result shows that, students' knowledge about five topics increased by context-based approach in experimental group. This increase may be the result of contexts used by experimental group students. Because contexts are stories connected with daily life, contexts facilitate biology' learning for students. Stories impress students and stories' remembrance is easier. Student, remember story, think concepts in story and connect others concepts. Furthermore, team work, discussion and researches provide to structure knowledge correctly. Results obtained from interview question supported it (Table.5). The positive outcomes of implementing a context-based approach from this study' qualitative test suggest that context-based approaches help students easily understanding, learning and retention:

> "*I think that this method significantly affected retention of what I learned. Reviewing the issues and concepts in the course, I could bear in my mind them easily and imagine powerfully*".
>
> *"I think that it enabled us to learn more easily the biology".*
>
> *"Active learning activities in the course eased my learning and comprehension of the biology issues and concepts".*
>
> *"The narratives that are read at the beginning of the lesson had a positive effect on my learning".*

context-based approach create opportunities in the classroom for connections between biology concepts and the real world:

> *"It helped me engage actively in the course that the situations and the stories were chosen from real-life incidents that had been related to the biology. Therefore, I think it affected positively my learning"*

context-based approaches help students' team working and research:

> *"I think that it was helpful for me because during team working, especially, we were obliged to study extensively the issues".*
>
> *"I think that the researches had a positive effect on my learning".*

Context-based approach is gaining popularity throughout the world. The results of this investigation support the findings of several recent studies. Nentwig et. all. (2007) examines context based learning two areas: the teaching and learning situation in the classroom and the professional development of the participating teachers. Initial evaluation results indicate positive effects in both areas.

According to Swan and Spiro (1995), in context based course, the answer to criticisms common to most introductory science courses was not less science but better placement of the science: more recognition of how students develop and use contextual information, the better to integrate the detailed scientific material into a coherent whole. In another study, context-based approach has been practiced in teaching several control engineering courses in a university with promising results, particularly in view of student learning performances (Dong, 2005). Gutwill-Wise (2001), Holman and Pilling (2004), Bennett and Lubben (2006), Murphy and Whitelegg (2006) indicate that students who had followed the context-based approach emerged with a better understanding of science than their peers who had followed a traditional approach.

In accordance with the second research hypothesis, there is difference between these groups regarding attitudes towards biology. First, there isn't a significant difference between experimental and control groups with respect to attitudes toward biology prior to the treatment and p=0.942 (Table 3.). The differences among experimental and control groups on post practice were measured by t test. There are significant differences in favour of experimental group students p=0.000 (Table 4.). Context based approach provides a formula for increasing the attitude of a traditionally dry subject. Students' attitude and enjoyment of their science lessons are generally increased when they use context-based materials or follow context-based courses. Context based materials have an important effect about students' attitudes toward biology in addition to students' success. The positive outcomes of implementing a context-based approach from this study' qualitative test suggest that context-based approaches help students attitudes' increasing:

> "*I believe that it enabled me to warm the biology and facilitated my understanding of the biology"*
>
> *"I believe that it was helpful for me because the method got the issues and concepts in the course liked me and I intimately learned them*
>
> *The narratives included in the course ensured that I was not bored at all. Moreover, they both increased my interest and enabled me to pay attention to the course*
>
> *"I think that it considerably increased my interest to the course".*
>
> *"I believe that it helped us to get rid of prejudges of the course".*

Context-based materials help students see and appreciate more clearly links between the science they study and their everyday lives (Bennett, 2003). Students' motivation to learn is enhanced through the use of contexts as starting points and that they foster their interest in further study in the subject (Bennett, et. all. 2005a). Ramsden (1997) shows that there appear to be some benefits associated with a context-based approach in terms of stimulating students' interest in science. Students enjoyed the context based course, found the context interesting and the presentation helpful (Potter and Overton, 2006). Context-based course is defined to be more interesting and challenging to teach, perhaps because it provides a better opportunity to learn more about daily biology.

5. Conclusions

The main objectives at the start of this study were, on the one hand, to increase students' biological achievement, and, on the other, increase students' positive attitude toward biology. The context based approach is regarded as being appropriate to achieve these objectives. We found that students in experiment group emerged with a better understanding of biology than their peers in control group. Attitudes surveys and interviews found that students in experiment group were more positive about the course than students in control group. They enjoyed the experience, found the subject matter interesting and found the presentation helpful. They thought that the learning method was effective, especially in comparison to the more traditional. Moreover, context based approach encourages group work and some additional skills such as discussion, problem-solving, individual researches, team working and self directed leaning skills. We are encouraged by the results of the context based approach and believe it provides a formula for increasing the attitude and understanding of a biology subject without sacrificing rigor or quality of learning. Context-based approach has demonstrated their utility and is generally well established.

As a result of these findings, it may advise to teach of biology using context materials. Because increasing attitude and understanding for learning biology is the reason for using this approach, appropriate contexts for students should be selected. Context based approach must introduced teachers by in-service training seminars and student teachers during university education. Biology should be presented to the student not only as a body of knowledge, but also its influence on the students' personal life and the society in which he/she lives. However, questions concerning the impact on student achievement, long-term understanding, and attitudes toward science should continue to engage the attention of science education researchers.

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