FIRST REPORT ABOUT AN E-LEARNING APPLICATION SUPPORTING PBL: STUDENTS' USAGES, SATISFACTIONS, AND ACHIEVEMENTS

Erol GURPINAR
Akdeniz University Faculty of Medicine Department of Medical Education 07059 Dumlupinar Bulvari Campus, Antalya TURKEY.
e-mail: erolgurpinar@akdeniz.edu.tr

Nese ZAYIM
Akdeniz University Faculty of Medicine Department of Biostatistics and Medical Informatics Antalya TURKEY

Ciler Celik OZENCI
Akdeniz University Faculty of Medicine Department of Histology and Embriology Antalya TURKEY

Mustafa Kemal ALIMOGLU
Akdeniz University Faculty of Medicine Department of Medical Education Antalya TURKEY

ABSTRACT
The purpose of the study was to determine applicability of e-learning in problem based learning (PBL) by investigating its usage and acceptability among students and its effect on academic achievement.

The study was carried out among first year medical students of Akdeniz University, Turkey. A web-based learning environment (WBLE) including various learning resources was prepared for students to use throughout self-study period of a PBL module carried out in 2006-2007 academic year. Data were collected to determine WBLE usage rates, its effect on academic achievement, and satisfaction with it. First, computer log files were examined to determine "users" and "nonusers" of the WBLE and its usage frequency per student. Second, a questionnaire was delivered at the end of the PBL module to determine acceptability of WBLE among students. Finally, PBL exam scores of the WBLE users and nonusers were compared to investigate the effect of WBLE on academic achievement.

Of the 174 first year medical students, 137 used the WBLE in their self study period throughout the PBL module. Mean login number per student was 16.8. The questionnaire was completed by 94.8% of the students. Sixty six percent of the participants were satisfied with the WBLE. End-of-module PBL exam scores of WBLE users were found slightly but not significantly higher than those of nonusers.

This the first study investigating applicability of e-learning in PBL modules. High usage rates and student satisfaction in our study may be encouraging and promising for wider application of e-learning in future PBL performances.
Keyword: Medical education, E-learning, Problem based learning, Web-based Learning.

INTRODUCTION

There are some corner stones in the history of medical education such as start of discipline based education (PBL) in 1910s, system based education in 1950s and problem based learning (PBL) in 1970s (Boelen, 2002; Gurpinar, 2005; Hamad, 1994). Since 1990s, a new approach called "e-learning" is gradually being adopted by higher education institutions including medical schools (Ruiz et al., 2007)**.** E-learning is defined as realizing the teaching and learning process, while teacher and students are in different places, with the help of internet and computer technology (Bayram, 2008; Grundman et al., 2000). E-learning aims to enhance self responsibility to learn and also supports individuals to gain lifelong learning attitudes (Cook, 2006). Today in medical education, e-learning is used to support other instructional methods asynchronously (Jorge, 2006).

Initial applications of e-learning in medical education were in teaching basic sciences. In the course of time, clinical departments such as the Departments of Radiology or Emergency Medicine have started to use e-learning in their instructions as a supportive method and this application has become more popular in clinical teaching (Heidi, 2002). The first paper in this field was on an e-learning application in Public Health training, which was published in 1992. Since then, hundreds of descriptive and comparative studies have been reported in the literature. The results of previous studies have generally shown that e-learning makes a contribution to student learning (Clyde, 2006). Motivation to learn and student performances among medical students are also known to be higher in e-learning based training methods in medical education (Jorge et al, 2006). There are some studies showing that the knowledge gained by e-learning is better embedded in learner's memory and used more properly than the knowledge gained by traditional ways (Jorge et al, 2006). Previous comparison studies

also suggest that students supported with e-learning activities show higher academic performance than students in traditional teaching (Rıdgway et al, 2007; Taradi et al, 2005; Horton, 2000).

The literature shows that medical students are also highly satisfied with e-learning and they wish to see this method as a part of their education. In addition to satisfaction, some of the advantages of e-learning mentioned by the students in the literature are its contribution to student self development, self assessment opportunities, and faster access to educational resources (Citak et al, 2007; Edirippulige et al 2006; Corte et al 2005; Thakore et al 2006; Gotthardt, 2006; Yaghoubi, 2008).

Although the literature is rich in terms of the articles describing e-learning applications in basic sciences and clinical clerkships, the information about e–learning activities in PBL process is missing. However, PBL is a method harmonizing preclinical and clinical information together; therefore it deserves a separate point of view. Regarding the fact that PBL is totally student centered any application that facilitates accessing knowledge and self- studying should be highly appreciated by the students. In order to test this hypothesis, students were provided with a WBLE throughout a PBL module and answers were sought to the following research questions:

What are the students' usage patterns, satisfaction level and perceptions of the WBLE?
What is the effect of the WBLE on students' academic achievement?

METHODS

Setting

A hybrid curriculum as a mixture of PBL modules and traditional classes has been followed in the first two years of medical education in Akdeniz University School of Medicine since 2002. Basic medical sciences are being taught in an integrated programme composed of five thematic blocks in each year. The courses of different disciplines are integrated on the organ system based themes in these blocks. Each block takes 8 weeks and the first weeks are allocated to PBL modules. PBL weeks are totally devoted to PBL activities and free of other traditional classes. A "module committee" composed of experts of different disciplines which are associated with topics of the module is assigned for each module. Three half-day PBL discussion sessions in small groups, laboratory and field studies, clinical skill practices, and supportive theoretical conferences take place throughout the PBL week. In the time remaining from afore mentioned activities, students try to achieve theoretical information to solve problems they faced in the discussion sessions. With this purpose, the most common resources they use are electronic or printed books and journals recommended by the module committee. At the end of each PBL module, the module committee prepares an examination including multiple choice and clinical reasoning questions and the students sit for this exam a few days later than the last PBL discussion session.

A WBLE was developed to be used in the last PBL module of year 1. The main theme of the block was *urogenital system* and the clinical case mentioned in the PBL scenario was an *infertility case*. The module committee determined the content of the WBLE and prepared and/or provided relevant resource documents to be used in students' self-study process. The WBLE composed of six main sections:

- Online documents (text, lecture notes and presentations),
- Links to websites including some relevant audiovisual material,
- Online dictionary of medical terms, online atlas of anatomy and histology,
- A special section called "Ask an expert" was available for students to ask some questions to clarify some points or deepen their understanding on the topic,
- Links to general search engines such as "Pubmed" or "Google".
- Test yourself

The WBLE was accessible from both inside and outside of the campus via internet. Students used their student identification number to login the learning environment. This made it possible to record students' usage logs of the learning environment.

The researchers informed the students about how to access, login and use the WBLE. It was also emphasized that the students were free to use or not to use the learning environment.

Subjects

A total of 174 first year medical students were asked to complete a questionnaire including items on usefulness of substructures of the WBLE and perceptions of the students on it. The students, who completed the questionnaire properly, formed the study group. Owners of the incomplete questionnaires were ignored in all calculations except for academic achievement comparisons.

Materials

Students completed a questionnaire composed of two main sections. In the first section, some independent variables that might be effective on students' satisfaction with their e-learning experience were asked such as gender, availability of computers and internet connection in living place, frequency and affinity of computer use in daily life, and frequency and overall duration of reference to the current e-learning programme. The second section of the questionnaire was composed of 16 statements to be responded to on a 5-point scale (1= strongly disagree, 5=strongly agree). Students' satisfaction level of the WBLE was determined regarding their agreement level with the statement "I'm satisfied with the WBLE" inside the 16-item questionnaire. The reliability coefficient of the questionnaire was 0.81.

In order to investigate the effect of the WBLE on students' academic achievement, the current (the fifth) PBL exam score of each student was compared to mean score of previous four PBL exams in that academic year. Additionally, the students who did or did not use the WBLE were determined from log files and the current PBL exam scores of users and nonusers were compared. Student-*t* test, paired samples t test and Mann Whitney U test were used in all statistical comparisons.

RESULTS

The results of the study are presented in three sections: a) students usage patterns of the web-based learning environment, b) students' satisfaction with and perceptions of web-based learning c) effect of the WBLE on students' academic achievement.

a) Students' usage patterns of the WBLE

The WBLE was visited 2303 times by the study group. Total number of the students visiting the WBLE is 137 and the mean number of visits per student is 16.8. On the other hand 37 (21.2%) of the participating students never visited the web page of the programme. Based on the analysis of the log records, "Documents" and "Web Sites" sections were the most visited sections whereas "Ask an Expert" section was the least visited section of the WBLE (Table 1).

b) Students' Satisfaction and Perceptions of the WBLE.

A total of 165 students (study group) properly completed the questionnaire to declare their views on e-learning application. Participation rate was 94.8% and 63.4% of the study group were male. Approximately half of the participants (50.3%) live in a separate house, while the remaining live in private or public dormitories. Majority of the students (85.5%) have a computer and (55.6%) have internet connection facilities in the place they live. A considerable number of the participants (87.9%) enjoy dealing with computers and internet, and (50.9%) use computers regularly in their daily life (Table 2).

Consistent with the results of the log records analysis, "The documents" and "links to websites" sections of the WBLE were the most frequently rated sections as useful with a ratio of 68.3% and 65.8% respectively. "Ask an expert" was rated as the least useful section of the e-learning application (Table 3).

The overall mean satisfaction score was 3.65 (SD ± 1.22). While, 66.0% of the students strongly agreed or agreed, 15.0% were neutral with the statements. None of the students' demographics (gender, living place, computer ownership, etc.) was found effective on students' satisfaction with web-based learning environment. The satisfaction level of the students who referred to the sections "The documents", "links to websites", "online dictionary and atlas" and "search engines" were found higher than those of the students who did not refer to these sections (Table 4).

The distribution of the answers to the other statements is shown in table 5. The first three statements receiving most "agree" or "strongly agree" ratings from the students are *"my knowledge and skills on computers and internet were enough to use the e-learning programme effectively"* (80.4%), "*I would like to benefit from similar e-learning programmes in future PBL modules*" (79.2%), and *"After this experience, I will use internet more often to access scientific information"* (75.7%) (Table 5).

c) Effect on academic achievement.

The mean scores attained from the current PBL exam by users and nonusers of the WBLE were 125.53 (± 13.82) and 121.45 (± 14.15) respectively and there was no statistically significant difference between them (t=-1.582 p=0.115). The mean scores attained from the previous four PBL examinations and from the current PBL exam were 114.0± 10.0 and 125.53 ± 13.82 in users and 113.28 ± 9.58 and 121.45 ± 14.15 in nonusers respectively. There was a significant difference between the mean scores of previous and the current PBL exam scores (respectively, t=10.269, p=0.00 and t=3.189, p=0.00).

DISCUSSION

In the current study, a positive effect of e-learning on student learning performance was observed via exam scores. It was found that the exam performance of the students in the PBL module supported by e-learning was significantly higher when compared to previous performances in PBL modules without e-learning support. The mean score of the e-learning users was found slightly higher than that of non-users in the examination performed at the end of studied PBL module; however the difference was not statistically significant. One of the reasons for positive support of e-learning to student performance may be higher learning motivation among the study group. Since great majority of the students enjoy spending their time with computers and internet, studying with the tools they like and competently use, could increase their motivation to learn.

Adults are commonly well satisfied with education methods supported by e-learning facilities possibly due to their appropriate nature to adult learning principles. Consequently, e-learning based education is generally preferred to other traditional methods by the individuals who had an experience with e-learning (Jorge et al, 2006; Horton, 2000). In the present study, two third of the students were highly satisfied with their e-learning experience. Their satisfaction may be explained by selections they made on some statements in the questionnaire. For example the statements *"it was easier to access knowledge via website than searching it in the library via books"*, *"the WBLE was helpful to reach my learning objectives" and "it was enjoyable to learn via the website"* were agreed by 71.2%, 64.9% and 60.1% of the students respectively. Additionally more than half of the study group found e-learning time saving and contributing to exam success. In summary, possibility of accessing more knowledge easily and enjoyably in a shorter time period without any dependence to classroom, teacher and certain time schedules might have caused high student satisfaction with the WBLE.

As expected, the most common visited section of the WBLE was *"The documents"* section, since it serves the purpose of the programme as the main source of knowledge and information. Consistent with the results of the other studies (Koontz 2006), "test yourself" section was commonly visited by the students. The lowest concern was to *"Ask an expert"* section. The reason for this may be the students' suspect to receive prompt answers from the experts or their preferences of different online communication facilities such as synchronous tools.

The reason for 37 students who never visited the WBLE may be lack of computers or internet connection in their living places, shortage of computers in *Faculty of Medicine*. Although majority of the students used the e-learning application effectively and wished to see similar applications in the future, we believe that some more investments are needed to give equal opportunities to all students, since current computer and internet facilities in the university do not exactly meet the demand. Generalization of the current findings and application of e-learning in problem based medical education are highly questionable because of differences between resources of the universities, student profiles, computer and internet services. However, the results of the study encourage that e-learning applications can be used effectively to support students' learning in PBL.

The first limitation of the study is about the classification of the participants as "programme users" and "non-users". These groups in the present study were formed spontaneously without any intervention. This was a risk, since non-user group might have been composed of students who generally showed less interest to all kind of training activities and who demonstrated lower levels of academic achievement. Consequently, the end of course exam scores of these two groups would be naturally different. In order to cope with this problem, the previous and current PBL exam scores of the students were also compared. The other obvious limitation was the inequality of opportunity among students, which arose from lack of enough number of computers. More controlled and detailed experimental research is needed to gain more evidence about the effects of the WBLEs on learning and perspectives of medical students in PBL.

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Table 1. Students' Usage Patterns of the WBLE according to Log Records.

Web-Based Learning Resources	**Number of Visits**	**% Total**
Documents	710	44.3
Web Sites	361	22.7
Search Engines	109	6.7
Online Atlas, Dictionaries	139	8.7
Ask an expert	84	5.3
Test Yourself	197	12.3
Total	1600	100.0

Table 2. Demographics of the Participants

Variables	**n**	**%**
Gender		
Male	104	63.4
Female	60	36.6
Living place		
Home with family	41	24.8
Separate house	83	50.3
Dormitory	41	24.8
Availability of a computer in the living place		
Available	141	85.5
Unavailable	24	14.5
Availability of internet connection in the living place		
Available	90	55.6
Unavailable	72	44.4
Frequency of computer use		
Everyday	84	50.9
More than once a week	67	40.6
A few times in a month	11	6.7
Never	3	1.8
I like computers and internet		
Yes	145	87.9
No	20	9.7

Table 3. Students' Perceptions on Usefulness of Resources in the WBLE

Sections	**Useful (%)**	**Not sure (%)**	**Not useful n (%)**	**Total n**
Documents	110 (68.3)	8 (5.0)	43 (26.7)	161
Links to web sites	106 (65.8)	12 (7.5)	43 (26.7)	161
Test yourself	102 (63.8)	46 (28.8)	12 (7.4)	160
Links to Search engines	70 (43.8)	10 (6.3)	80 (50.0)	160
Online dictionary-atlas	39 (24.7)	15 (9.5)	104 (65.8)	158
Ask an expert	11 (7.0)	13 (8.3)	133 (84.7)	157

Table 4. Relation between independent variables and student satisfaction with WBLE

Variables	Satisfaction score over 5 (mean± SD)	*t*	*p*
Gender			
Male	3.47±1.21	-2.342[a]	0.086
Female	3.94±1.18		
Living place			
Home with or without family	3.63±1.21	-0.331 [a]	0.741
Dormitory	3.71±1.29		
Availability of a computer in the living place			
Available	3.68±1.21	-0.75 [b]	0.453
Unavailable	3.47±1.27		
Availability of internet connection in the living place			
Available	3.52±1.29	-1.452 [a]	0.149
Unavailable	3.81±1.11		
Frequency of computer use			
Once a week or less	3.64±1.22	-0.587 [b]	0.557
More than once a week	3.81±1.25		
I like computers and internet			
Yes	3.67±1.22	-0.830 [b]	0.406
No	3.46±1.18		
Documents			
Used	3.87±1.17	-3.066 [a]	**0.003**
Unsure or not used	3.17±1.20		
Links to websites			
Used	3.92±1.23	-4.004 [a]	**0.000**
Unsure or not used	3.02±1.12		
Online dictionary-atlas			
Used	4.05±1.11	-2.355 [a]	**0.020**
Unsure or not used	3.52±1.18		
Ask an expert			
Used	4.30±1.22	-1.933 [a]	0.053
Unsure or not used	3.60±0.94		
Links to Search engines			
Used	3.97±1.18	-3.110 [a]	**0.000**
Unsure or not used	3.34±1.20		

a Student- t test
b Mann-Whitney U test

Table 5. Students' Perceptions Regarding the WBLE

Statements	**Strongly Agree + Agree**	**Neutral**	**Disagree + Strongly Disagree**	**Total**
	n (%)	**n (%)**	**n (%)**	**n**
My knowledge and skills on computers and internet were enough to use the WBLE programme effectively	123 (80.4)	10 (6.5)	20 (13.1)	153
I would like to benefit from similar e-learning programmes in future PBL modules	122 (79.2)	11 (7.1)	21 (13.6)	154
After this experience, I will use internet more often to access scientific information	115 (75.7)	19 (12.5)	18 (11.8)	152
I have already used internet resources to reach learning objectives in previous PBL modules.	116 (75.3)	13 (8.4)	25 (16.2)	154
I would like to benefit from similar e-learning programmes in courses other than PBL modules.	113 (73.4)	14 (9.1)	27 (17.5)	154
It was easier to access knowledge via website than searching it in the library via books	109 (71.2)	25 (16.3)	19 (12.4)	153
I experienced some technical difficulties while using this programme	103 (67.3)	12 (7.8)	38 (24.8)	153
I am satisfied with the WBLE.	101 (66.0)	23 (15.0)	29 (19.0)	153
The WBLE was helpful to reach my learning objectives	100 (64.9)	24 (15.6)	30 (19.5)	154
It was enjoyable to learn via the WBLE.	92 (60.1)	33 (21.6)	28 (18.3)	153
I used some additional resources (library, books, journals etc.) other than the WBLE to reach my learning objectives	86 (56.6)	19 (12.5)	47 (30.9)	152
The WBLE enhanced my motivation to learn	73 (47.7)	47 (30.7)	33 (21.6)	153
The resources inside the WBLE were enough to reach my learning objectives.	67 (43.8)	40 (26.1)	46 (30.1)	153
It was stressful to find a computer	33 (22.0)	20 (13.3)	97 (64.7)	150
It took too much time to learn via the WBLE	28 (18.4)	35 (23.0)	89 (58.6)	152
The WBLE will not contribute to my exam success	26 (15.8)	38 (23.0)	89 (53.9)	153