EFFECTS OF COMPUTER BASED LEARNING ON STUDENTS' ATTITUDES AND ACHIEVEMENTS TOWARDS ANALYTICAL CHEMISTRY

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ABSTRACT
The aim of this study was to compare the effects of computer-based learning and traditional method on students' attitudes and achievement towards analytical chemistry. Students from Chemistry Education Department at Dokuz Eylul University (D.E.U) were selected randomly and divided into three groups; two experimental (Eg-1 and Eg-2) and a control (Cg). In teaching analytical chemistry topics, two different computer based methods - new analytical chemistry learning software called *HEHAsit* (Method A) and a Microsoft Excel program (Method B)- were prepared by us and applied to Eg-1 and Eg-2, respectively. Whereas the last group (Cg) was taught by the traditional method (Method C). In the comparison of the effects of the three methods, we developed an attitude questionnaire and an achievement test related to Analytical chemistry, and applied to students in all three groups. Students' attitudes towards computers were also tested by a computer attitude test developed by us. As a result of the study, significant differences between control group and both experimental groups and between experimental groups on computer attitudes and analytical chemistry attitudes were found. Furthermore, analytical chemistry achievement in experimental groups was significantly higher from the control group.

KEY-WORDS: *interactive learning, computer assisted learning, simulation, acid-base titration, analytical chemistry*

INTRODUCTION

Computer-based learning is becoming more and more widespread and it has been important especially at difficult subjects in science for over two decades. Nowadays by using computers researchers studying on molecular chemistry, medical chemistry, accounting molecular orbital are managed to ease collecting and processing data and gain speed (Zielinski & Swift, 1997).

Successful professional educators are not confronted replacing traditional applications with new ones. Gilbert (1996) indicated that instructors must avoid being impatient for integrating information technology in learning and teaching. It is not possible to wait that the replacement of the traditional education completely with an information technology assisted method of instruction in a single semester. Therefore, it can be used the combination of computer technology with traditional method and constituting gradual process instead of a quick change.

Computer is a device, which presents wonderful opportunities for learning and teaching processes. Using to teach, manage, show and communicate made the computer unique compared the other learning devices. However, it has not been used instead of textbook, laboratory and lecture in universities (Tielemans & Collis 1999).Computer has used to be produced for teaching, manage, show and communicate, but other devices, which are used to learn, are less effective than computer.

Computer -based learning (CBL) is a method, which use computer in learning media, strengthening students' motivation and education process. It gives opportunities to both students and teachers to learn by their speed and combine active learning with computer technology. Collette & Collette (1989) explained that using computer increase motivation and desire to lectures and laboratory in the process of learning.

There are a lot of important reasons for using computer and World Wide Web in chemistry education. Educator not only can gather many materials from various centers. But also they can get text, graph, audio, video, picture, animation and simulation in the same media to students. Many studies also supported the idea that computer-based learning has positive effect on students' achievements and attitudes (Aiello & Wolfe, 1980; Burns & Bozeman, 1981; Chang, 2002; Russell et all, 1997; Sanger & Greenbowe, 2000).

The aim of this study is to understand the importance of CBL in analytical chemistry education and its effect on students` attitudes and achievements.

METHOD

Chemistry Teaching Department students of Buca Education Faculty of Dokuz Eylul University (Izmir-Turkey) voluntarily participated in this study. The participants were divided into three groups randomly; experimental group-1 (Eg-1), experimental group-2 (Eg-2) and control group (Cg).

Likert-scale items to measure computer attitudes and analytical attitudes developed and applied as a pretest and posttest. At the same time analytical achievement exam was applied for determining the level of students' analytical chemistry achievement. Then each learning methods was used only one group for teaching acid base titration: the first one was computer-based learning process (Method A), called *HEHAsit*, prepared with Visual Basic, applied to Eg-1, the second process was (Method B) prepared on Microsoft Excel, applied to Eg-2 and the third one was traditional method (Method C), applied to Cg.

HEHAsit thought eg-1 students for 8 hours. *HEHAsit* learning software includes texts, pictures, audios, videos, animations and simulations, in addition to an interactive graph-drawing feature. Eight sequential phases were followed while HEHAsit software has been preparing:

-Determining purpose: Students can read acid base titrations' texts, draw the graphs, study experiments in simulation imaginary laboratory and watch the video which show acid base titration experiments.
-Selecting hardware: Computer must have monitor, keyboard, mouse, speaker and sound blaster for completely operating HEHAsit interactive learning program.
-First planning: The text of HEHAsit included acid-base titration. In addition to this researchers wrote titrimeter analysis, pH, pOH, buffer solution, conjugate acid base pairs and indicators in text. In this section, titles and page order were designed.
-Designing: Researchers put simulation, video, audio, animation and pictures when it necessary and then pages view and background colors were designed.
-Programming and coding: Computer programmer wrote the codes of interactive graph program. First videos, text animations and pictures were prepared and the researchers put in interactive graph program.
-Arrangement screen: Screen view, graph size and animations arranged in the design of software.
-Pilot Study: Researchers tested the design of software on 57 students to understand their opinion, criticism and expectation about software. In terms of the pilot study number of titration sample and critical point on titration graph increased.
-Evaluation: Software was evaluated with 195 analytical chemistry students. After that, changes of students' attitudes toward analytical chemistry were carried out.

Method B does not include pictures, videos, audios, animations and simulations. At the same time, these students attended to traditional method lecture to get extra knowledge. Before beginning study, worksheets were given to students not only to teach Excel accounting program but also to help researchers to follow students` studies. Excel tutoring took two hours.

Measures

-**Analytical Chemistry Attitudes Scale (ACAS):** ACAS is applied for measuring the interest and attitudes of students toward analytical chemistry. Each item in scale did not include more than one idea. ACAS included 25 positive and 25 negative questions. This scale was applied to 142 students. A descriptive analysis was conducted for each variable and correlation tests were performed among variables. After the evaluation, questions 1, 2, 35 and 38 were ignored because their correlation numbers were negative and/or near zero. Cronbach α-reliability coefficient was 0.97 and validity coefficient was 0,95 after removing low-correlation questions for ACAS. Finally ACAS was used as a pretest and posttest

-**Computer Attitudes Scale (CAS):** CAS is applied for measuring the interest and attitudes of students to computer. Each item in scale was not included more than one idea. CAS was included 60 questions, 30 positive and 30 negative. This scale was applied to 142 students. Correlation test were used to analyze the data. After the evaluation, questions 1, 9, 14, 32, 38, 44 and 52 were canceled because their correlation numbers were negative and/or near zero. . Cronbach α-reliability coefficient was 0.93 and validity coefficient was 0,90 after removing low-correlation questions for CAS.

-**Analytical Chemistry Achievement Exam (ACAE):** The purpose of this test was to measure the achievement of students. 9 questions included in the test. Three questions had long answers; six questions had short answers. One of the short answer questions was multiple-choice, one was true false, 4 questions were completing (filling in blank) test.

The data were analyzed using SPSS statistics program. Paired samples t-test was used to investigate significant differences between pre- and post- test in the groups and one-way ANOVA was used to fix significant differences between groups. *p* values were considered in order to understand significant differences between groups and in the groups:

RESULTS

Analytical Chemistry Attitudes Scale (ACAS): Results of analytical chemistry attitudes scale for Cg, Eg-1 and Eg-2 presented in table-1. The test showed that there were not any differences between control groups pre- and post-test on students' attitudes toward analytical chemistry [$t(64) = 1,15$, $p = .0153$], however there were significant differences between experimental groups [$t(66) = -4,43$, $p = .001$] for Eg-1 and [$t(65) = -3,63$, $p = .0005$] for Eg-2 .

Table 1.Analytical Chemistry Attitudes Test Results

Group		N	$\overline{X}$	S.D	δ	t	P
CG	Pretest	64	149,26	25,25	6,52	1,15	0,153
	Posttest	64	147,20	24,85	6,41		
EG-1	Pretest	66	167,61	22,65	6,28	-4,43	0,001
	Posttest	66	172,61	23,19	6,43		
EG-2	Pretest	65	161,30	25,11	7,94	-3,63	0,005
	Posttest	65	164,50	24,73	7,82		

Computer Attitudes Scale (CAS): The results of computer attitude scale for Cg, Eg-1 and Eg-2 are presented in Table.2. There is no significant differences between control groups' pre- and posttest. However, there is a significant difference between experimental groups.

Table 2. Computer Attitudes Test Results

roup		N	$\overline{X}$	S.D	δ	t	p
CG	Pretest	64	185,60	21,40	5,52	1,89	0,080
	Posttest	64	175,33	19,73	5,09		
EG-1	Pretest	66	198,53	27,02	7,49	-2,67	0,020
	Posttest	66	205,46	26,15	7,25		
EG-2	Pretest	65	189,40	24,50	7,74	-3,03	0,014
	Posttest	65	194,10	25,76	8,14		

Analytical Chemistry Achievement Exam (ACAE): Analytical chemistry achievement test analysis for Cg, Eg-1 and Eg-2 is presented in Table3. Significant differences were found t between pre- and post-test for all groups. Maximum difference found in Eg-1 while minimum difference found in Cg.

Table 3. Analytical Chemistry Test Result

Group		N	$\overline{X}$	S.D	δ	t	p
CG	Pretest	64	31,62	5,87	1,46	-7,93	0,000
	Posttest	64	53,43	12,51	3,12		
EG-1	Pretest	66	31,46	10,08	2,79	-10,50	0,000
	Posttest	66	72,46	11,52	3,19		
EG-2	Pretest	65	28,40	6,23	1,97	-8,49	0,000
	Posttest	65	62,10	13,74	4,34		

DISCUSSION

In this study, students' attitudes toward analytical chemistry and achievement on analytical chemistry (acid-base titration) depending on computer-based learning, and traditional teaching methods compared. The computer program that used in computer-based method was presented on http://www.enderyilmaz.com. SPSS program was used to analyze the data.

Although significant and positive changes were found on students' attitudes toward analytical chemistry in method A and B, the results show no significant differences in Cg students' attitudes toward analytical chemistry in traditional teaching method. These results show similarities with previous studies (Kulik & Kulik, 1991; Yates, 2000a, 2000b; Richard & Foust, 2001; Yalçınap, 1993).

The results of analytical chemistry test presented students who were thought by method A and method B, were more successful than the students who were thought by method C. Students' interest and attention can easily attract with multimedia applications in computer. In addition, knowledge is not forgotten because number of using sense organs is increased in learning process. It can be concluded that computer based education is more effective than traditional methods on students' attitude towards analytical chemistry. This finding is consistent with previous studies (Akcay et all, 2003).

Eg-1 showed more success than eg-2 in analytical chemistry exam because of the number of multimedia applications in method A. Simulations and graphs in HEHAsit program were more attractive to students than Excel sheets. Also, Bank (2001) explained that interactive questions were more attractive. The simulations in HEHAsit programs are not similar to the reality and excite the students' imagination. Also Merrill et all (1986) indicated to change amount of closed realty as to effect on phenomena. A lot of computer simulations are not close high degree however using text, graph, animation and sound effect are more important.

Another important benefit to simulation is saving money and time. Students who used method A did the experiment, which needs more money and time, in a shorter time and lower cost. The similar results from different studies were cited (Kulik et all, 1985; Waller & Foster, 2000).

Because of requiring study with computer in using learning methods, students' attitudes were investigated towards computer. Consequently significant differences were found for students who used method A and method B but there is no significant difference observed for students who used method C. This result showed that students who study with computer hesitation and abstention remove at business life after the university education.

The software like HEHAsit program is possible to produce at a lot of chemistry master and found a lot of space in the universities. For example, in United Stated, Virtual Titrate version 1.5-simulation program was designed for second grade chemistry students in Wisconsin-Madison University. This program can be used very easily on internet web page service by students (http://hamers.chem.wisc.edu/chapman/Titrator/). Furthermore, Bruno Herrera's created acid base titration simulation in Southern California University (http://chemmac1.usc.edu/bruno/java/Titrate.html). Many simulation and animation prepared by Bruce Berne et al. are being presented at Colombia University's web page (Berne,).

Universities for both distant education and formal education in Turkey must prepare the education software.

HEHAsit program is the most appropriate to use for universities because experts must work together while preparing the programs. Consequently if using computer and internet become widespread at every education level especially at university education, the quality of education could increase.

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