

THE EFFECT OF WEB-BASED PROJECT APPLICATIONS ON STUDENTS' ATTITUDES TOWARDS CHEMISTRY

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ABSTRACT

Students perform intensive web-based applications during their education. One of these is project-based application. In this study, the effect of web based project applications on students' attitudes towards chemistry has been investigated. 42 students attending Hacettepe University, Faculty of Education, and Department of Chemistry Education have been participated in these applications. Attitude Scale towards Chemistry has been administered before and after applications. The application has been started with displaying the chosen simulation experiments with the computer program called CCI-Project (Creative Chemistry on the Web) ETH (Eidgenossische Technische Hochschule-Zurich).

When the simulation experiments have been displayed, students have been assigned in groups of 3-4 randomly. Totally 11 Web Based Projects have been prepared. Each of the teams has determined a project question related to their given simulation experiment. When teams have completed their projects, they have presented them by using power-point. Researchers have videotaped project presentations. After presentations, project presentations have been displayed consecutively and discussed in class.

Researchers have evaluated each team's projects by "Project Sufficiency Form". While students' scores of Project Sufficiency Form have been accepted as their project performance, both their final grades and project performance score have been accepted as student performance. Using paired-samples t-test has compared pre- and post-test results of attitude scale and a statistical difference has been found. Also a relationship between students' attitudes and performance has been examined by using regression analyze.

Keywords: Microteaching method; project based learning; student performance; attitude towards chemistry

INTRODUCTION

Web technology is only one alternative among the wide range of available media for helping people learn (Boisvert, 2000). According to (Sabry & Baldwin, 2003), increasingly, web technology is used for learning interaction and is becoming commonplace in educational institutions (Nielsen NetRatings, 2002; McGraw-Hill, 2002, Whittington and Campbell, 1998; Collis et al, 2000).

Web-based Learning is a method of computer-supported teaching. Several researchers have studied the effects of computer based environments on student learning and have shown it to be effective in facilitating conceptual understanding and mastery of both content and process (Friedler et al., 1990; Leonard, 1990; Lunnetta and Hofstein, 1981; Rivers and Vokell, 1987). Excessive use of unassisted or unguided exploratory activities could impede learning, since learning through discovery in a computer environment generally provides greater gains for high ability students and greater losses for low ability students (Berger et al., 1984).

According to Arasasingham et al., (2005) an obvious advantage of Web-based software materials is the ability to concurrently present multiple representations to visualize chemical phenomena. The materials can provide logical links between various representations to aid students' understanding. Students can be given exercises and exploratory activities that require them to convert one form of representation to another, to reflect on the underlying meaning of the representation, and to see how representations function to support the solution of quantitative problems. Web-based learning environments can also foster process skills, facilitate guided problem solving, and model expert problem-solving strategies. Appropriately designed software materials can help students build mental links to strengthen their logical framework of conceptual understanding and to achieve mastery level understanding of chemical concepts. Three categories of web-based learning interaction;

- **Learner-Information (L-I):** According to Moore, (1989), we use "Information" instead of "Content" to indicate a wider and broader meaning to include the information that is specific to course material (content) and/or non-course material. For example this can include the learner searching the web for information relevant to their learning task or interacting with a virtual lecture
- **Learner-Tutor (L-T):** According to Moore, (1989), this type of interaction is considered to be highly desirable and can take several forms, including one-to-one, many-to-one, or one-to-many. According to Garrison, (1990), some studies found that learners who interacted regularly with their instructor were more motivated and had better learning experiences
- **Learner-Learner (L-L):** According to Garrison, (1990), in some studies, learners who interact on a regular basis with other learners were found to be more motivated and had better learning experiences Learner-Learner interaction can take several forms: asynchronously (non-real time) through using, for example, email or discussion boards, or synchronously (real time) using, for example, conferencing and chat programs (Sabry and Baldwin, 2003).

These three categories of interaction can play an important role in making the learning process interactive (Sabry and Baldwin, 2003). In Web-Based Project Applications students have a significant voice in selecting the content areas and nature of the projects that they do. There is considerable focus on students understanding what it is they are doing, why it is important, and how they will be assessed. All of these learner-centered characteristics of project-based learning contribute to learner motivation and active engagement. A high level of intrinsic motivation and active engagement are essential to the success of a project based learning lesson.

- **Project based learning is learner centered and intrinsically motivating.**
- **It encourages collaboration and cooperative learning.**
- **It requires students to produce a product, presentation, or performance.**

- It allows students to make incremental and continual improvement in their product, presentation, or performance.
- It is designed so that students are actively engaged in "doing" things rather than in "learning about" something.
- It is challenging, focusing on higher-order knowledge and skills (Moursund, 2005).

According to Moursund, (1999) the project-based learning model is a basis teaching model of computer based education applications that emphasizes technology usage as a tool. It accepts the main steps of the project preparation process were as follows:

1. Determining the goals
2. Determining and defining the subject to be studied
3. Building the teams (groups of 5)
4. Determining the characteristics of the final report and the presentation
5. Drafting a time frame
6. Deciding on the checkpoints
7. Drafting the assessment measures and their levels of adequacy
8. Collecting data
9. Gathering and reporting data
10. Submitting and presenting the project (Moursund, 1999).

Barak and Dori (2005), in their study in which they wanted to enhance achievement of university chemistry students with the information-assisted project-based learning have been contributed to students' investigation of real life problems in a scientific manner as a student centered. In this study, while the students who were in the experimental group have taken responsibility for the individual information technology projects, the students who were in the control group have solved traditional problems. The projects have included the demonstration of molecular models with computer, the explanation of some scientific events and the researches about chemistry theories. It has been found that the performances of students who participated to project-based learning applications in posttest and their final achievement were higher than the students' of the control group. Namely, the project-based learning, which was enriched with information technologies, has enhanced the freshman students' understanding of chemical concepts, theories and molecule structures. Toolin (2004), in his study in which the project-based learning approach were applied, the efforts of 6 high school and secondary school teachers who applied innovative teaching methods and strategies have been explained. Especially the factors, which affected the application of project-based learning approach in science teaching and learning, have been examined. Lou (2004), in his study that was about the solving of complex problems between collaborative groups in project-based online lectures, has examined the interaction between collaborative groups. The groups that consisted of 3-4 students have been formed. After the mini online lectures that hold 2 weeks, classmates have divided into groups. Data has been obtained from online lecture dialogs and project performances. The results have showed that the collaboration become impressive in the design of online lectures, the individual student success, group project performance. Land and Grene (2000), in their study that was about project-based learning in www, the students' operation of research and integration of the knowledge resources in the introductory education technology in the telecommunication unit has examined. 9 pre service teachers have participated to this study. They have been asked to prepare projects and integrate Internet to curriculum. Students have searched for their projects during 4 weeks in computer laboratories. It has searched that at which²²² dimension students integrated www into their projects.

As a data collection tools, loud thinking protocols, videotapes, project documents and questionnaires have used. At the end of the study, students have prepared projects with the usage of new technology.

THE AIM OF THE STUDY

The aims of the study are given below:

- Determining the effect of web based project applications on students' attitudes towards chemistry,
- Determining the relationship between students' attitudes towards chemistry and students' performance.

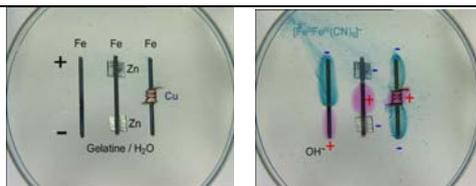
METHOD AND PROCEDURES

In the extent of the study, web based project applications have been conducted with 42 students attending to Hacettepe University, Faculty of Education, Department of Chemistry Education. Prior to the applications, students have filled Attitude Scale towards Chemistry as a pre test. They have been assigned to groups of 3-4 randomly. The applications have been started by displaying the chosen simulation experiments with CCI-Project (*Creative Chemistry on the Web*) ETH (*Eidgenossische Technische Hochschule-Zurich*) computer program. Some examples of the simulation experiments have been displayed in Appendix A. The chosen experiments have been related to daily life chemistry topic. The applications have been conducted with the guidance of the researchers and in a discussion setting with question-answer method. After displaying of simulation experiments, a simulation experiment has been given to each of teams by researchers. Each of teams has asked to search for their given experiment and collect information about experiment and determine a project question related to their own simulation experiment. Each of teams has search for their own experiment via Internet. After that, teams' project preparation process has controlled step by step in determined check points by researchers. Some of the teams have suggested experiments to solve their project questions and conducted these experiments in laboratory setting and these laboratory process videotaped by them. Totally 11 web based projects have been prepared by teams.

At the end of the application, teams have presented their own projects by using power point program. Also their project presentations have been videotaped by researches. After all the presentations have completed, students have watched the videotapes and discussed the presentations. After applications the researchers have evaluated teams' projects with Project Sufficiency Form and Attitude Scale towards Chemistry has been administered as a posttest. While students' scores of Project Sufficiency Form have been accepted as their project performance, both their final grades and project performance score have been accepted as student performance. Pre- and post test results of Attitude Scale towards Chemistry have been compared with paired sample t-test and a statistically significant difference in favor of the post test has been determined.

Also the relationship between students' attitudes and their performance has been investigated by regression analysis. Figure: 1 displays some of the students' project questions related to the simulation experiments.

1. Preparation and Detection of CO	
Procedure of the Experiments	Chemical basis of simulation experiment
 <p>Sodium formiate is mixed with concentrated sulphuric acid in a gas generator and formic acid is released. When heated, due to the hygroscopic action of the concentrated sulphuric acid, the formic acid is split into water and carbon monoxide. The gas is bubbled through a yellowish solution of PdCl₂. Following an induction period, jet black metallic palladium is formed.</p>	<p>Carbon monoxide is prepared in the laboratory by the dehydration of formic acid, with carbon monoxide being formed as its anhydride. However, under normal conditions it does not react with alkaline substances.</p> <p>This experiment shows the production in the laboratory of carbon monoxide from sodium formiate and concentrated sulphuric acid, and its subsequent detection through its reduction of PdCl₂.</p> $\text{HCOONa} \xrightarrow{\text{H}^+} \text{HCOOH} \xrightarrow{\text{H}_2\text{SO}_4 \text{ (konz.)}} \text{CO} + \text{H}_2\text{O}$ $\text{CO} + \text{PdCl}_2 + \text{H}_2\text{O} \longrightarrow \text{CO}_2 + \text{Pd (s)} + 2 \text{HCl}$
<p>Content of Student Project <i>Silence killer Carbon monoxide?</i></p> <ul style="list-style-type: none"> • Respiratory System • Hemoglobin and its' structure • Transfer of Oxygen and Carbon dioxide • Carbon monoxide • Carbon monoxide poisoning 	
2. Corrosion of iron in gelatin	
Procedure of the Experiments	Chemical basis of simulation experiment

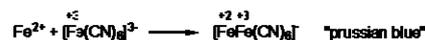


The experiment shows three different examples of the corrosion of iron by the formation of local elements. There are three iron nails in a Petri dish each of which has been prepared in a different way. The lower tip of the left-hand nail has been annealed in a Bunsen flame. The middle nail is lying on two small pieces of zinc leaf while the right-hand one has been wound with copper wire. In both latter cases, parts of the elements are in close contact. A hot gelatine solution is poured into the dish. Within a short time the gelatine sets and corrosion processes start to occur.

In order to make the reaction visible, phenolphthalein und $K_3[Fe(CN)_6]$ (red prussiate of potash) have been added as indicators. The areas around the cathodes soon become red due to the colour of the basic form of phenolphthalein. After some time, a deep blue colour ('Prussian Blue') develops around the iron anode due to the reaction of the iron complex with Fe^{2+} ions that have been liberated. In real time the video covers an experiment lasting about 12 hours.

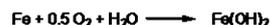
Corrosion is the reaction of a material with its environment that causes a measurable change in the material resulting in damage (cracks, holes, pitting). Most corrosion processes are of an electrochemical nature, which is caused by the formation of a galvanic element. When two metals are in contact in an electrolyte solution such as, for example, water containing dissolved CO_2 (rain water), a local element forms at the point where they touch. The less noble metal (the anode, or negative pole, of the galvanic cell) dissolves (corrodes) while oxygen is often reduced to OH^- ions at the surface of the nobler metal (the cathode, or positive pole, of the galvanic cell). The potentials $E^\circ (Cu^{2+} / Cu) = + 0.35 V$ und $E^\circ (Fe^{2+} / Fe) = - 0.44 V$ indicate that copper forms the cathode and iron the anode in the local element found in the right-hand nail.

The reaction at the electrode and the subsequent reaction can be written as follows:



OH^- - ions colour phenolphthalein red

The overall corrosion process (without the subsequent reaction) reads:



Content of Student Project

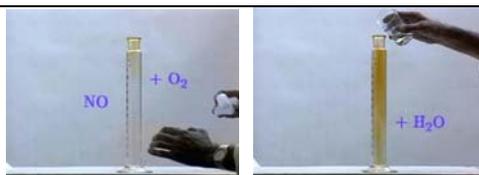
What is Corrosion? What should be done to prevent Corrosion?

- The importance of corrosion
- Corrosion types
- Prevention of corrosion
- Teaching corrosion at college level

3. Oxidation of NO by Atmospheric Oxygen

Procedure of the Experiments

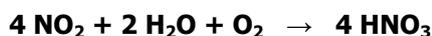
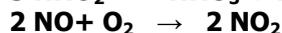
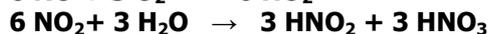
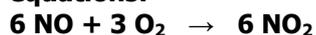
Chemical basis of simulation experiment



This experiment shows a gas jar filled with NO. The onset of oxidation of the colorless nitric oxide to the brown nitrogen oxide can be observed at the upper end of the cylinder when it is opened to the air. A rapid decoloration accompanied by the formation of nitric acid occurs with the addition of water to the brown gas under shaking of the cylinder.

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The reaction is described by the following equations:



Both NO (a) and NO₂ (b) are radicals.



Content of Student Project

What is the role of greenhouse gases on global warming?

- Greenhouse gases
- Greenhouse effect
- The effect of greenhouse gases on global warming
- Climate changes
- The reasons of climate changes
- The results of greenhouse effect

4. Nylon 66

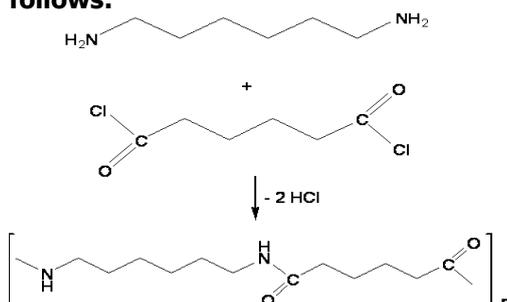
Procedure of the Experiments

Chemical basis of simulation experiment



A beaker is filled with a solution of adipic acid dichloride in tetrachloromethane. This is carefully overlaid with a solution of hexamethylene diamine in water. A thin polymer skin forms at the interface between the two solutions. This is pulled from the solution with a pair of tweezers and laid onto two wheels connected to a small electromotor. When the motor is switched on, it pulls a continuous thread of nylon 66 from the solution, till all the reactants have been consumed.

Carbonyl acid chlorides react with amines to produce carbonyl acid amides. Polyamides are produced through polycondensation when bifunctional reactants are employed. In this example, the polymer "nylon 66" is produced from adipic acid dichloride and hexamethylene diamine. The number stems from the fact that both reactants contain 6 carbon atoms in their chains. The synthesis progresses as follows:



Content of Project

What are environmental friendly plastics?

- Polymers
- Polymer types
- Plastics
- The structure of plastics
- General characteristics of plastics
- The usage of plastics in daily life (PTFE, PC, Nylon, PVC etc.)
- The recycling of plastics

5. Aluminothermic Preparation of Iron

Procedure of the Experiments

Chemical basis of simulation experiment



A flowerpot (or a crucible) is fixed to a stand with an iron ring and a tin vessel filled with sand is placed underneath.

A mixture of dry iron (III) oxide and aluminium granules is placed in the flower pot and overlaid with some aluminium and magnesium powder, the hole in the base of the flower pot having been covered with a filter paper.

A strip of aluminium ribbon is ignited in a burner and dropped into the crucible. After an induction period a violent redox reaction takes place. The liquid mass that forms then drops through the base of the flowerpot into the sand, where it forms a glowing regulus.

The reduction of iron (III) oxide to elementary iron by aluminium follows the following equation:



The energy released by this reaction amounts to $\Delta H = -730 \text{ kJ/mol}$. The principle of the reaction (Alumino-thermal processes) by Hans Goldschmidt, 1897) is also used for the reduction of other heavy metals oxides or where carbon reduction leads to carbide formation (Cr_2O_3 , MnO_2 , SiO_2 , TiO_2)

Content of Student Project

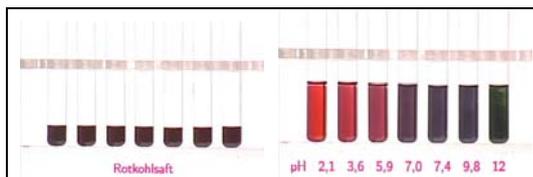
How can the rails be weld?

- Endothermic reaction
- Exothermic reaction
- Activation energy
- Enthalpy
- Redox reactions
- Aluminothermic reaction

6. Cabbage Juice - a pH Indicator

Procedure of the Experiments

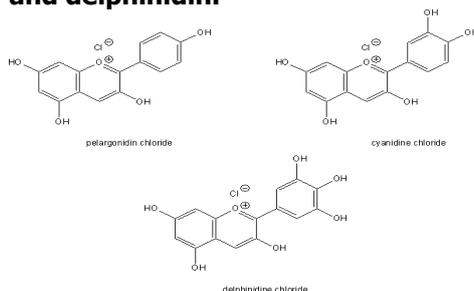
Chemical basis of simulation experiment



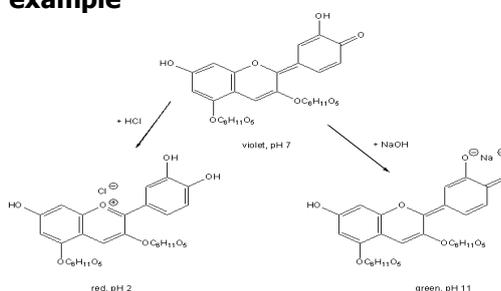
Seven test tubes contain an aqueous, blue-violet solution of an extract of red cabbage.

The addition of buffer solutions with step-wise increases in pH (pH 2.1 ... 12) colours the extract either towards red (acid solutions) or green (basic solutions).

Anthocyanin pigments are found not only in many berries, blossoms and flowers but also in red cabbage. The dye (anthocyanidin) is bound to glucose, or other monosaccharides, by glycosidic linkages. The name comes from the Greek words *kyaneos* (blue) und *anthos* (colour). The anthocyanins are derived from three basic structures - pelargonidin, cyanidin and delphinidin.



The colours of the anthocyanin pigments are pH-dependent and they appear red in the acidic and violet in the neutral regions, respectively. In a basic medium the colours vary from dark red through brown to green. The following scheme illustrates the acid-base reactions using the cyanins as an example



Content of Student Project

What are the natural indicators used in daily life?

- Indicators and their structures
- Types of indicators
- Characteristics of indicators
- The indicators used in daily life

7. Water Hardness and Water Softening

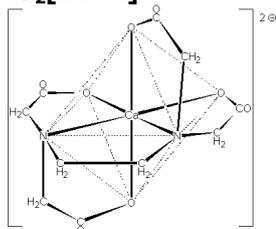
Procedure of the Experiments

Chemical basis of simulation experiment



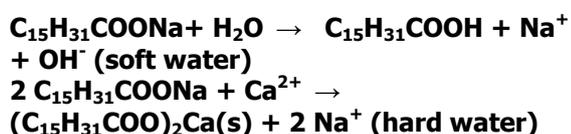
The experiment shows soapy foam formation in "soft" and "hard" water. From left, three test tubes are filled with distilled water, water containing calcium sulphate (water and gypsum) and water containing calcium bicarbonate. A soapy solution is added to the three test tubes. After shaking, foam forms in distilled water, while a poorly soluble precipitate is formed in the other two test tubes.

The second part of the experiment shows a method for water softening. The Ca^{2+} ions are masked by a complex-forming agent. This suppresses the precipitation of calcium stearate. Ethylene diamine tetraacetate (EDTA) is ideal for complex formation as it is a hexadentate chelating ligand. The figure illustrates the structure of the calcium complex.



The three test tubes are filled with the same solutions as in the first series. First, EDTA is added to the solutions containing calcium. Then soap is added and the solutions are shaken. Foam formation can now be observed in all three test tubes, in the absence of the formation of a precipitate.

River and spring water usually contains calcium salts, in particular calcium bicarbonate and calcium sulphate. If the calcium salt content is high, then we refer to "hard water", while "soft water" is low in calcium salts. The terms "hard" and "soft" stem from how the soapy water feels when it is used to wash with. Soaps are alkaline salts of weak organic fatty acids, which hydrolyse to produce alkaline solution, rendering the water slippery ("soft"). In "hard" water high in calcium content, the fatty acids precipitate as poorly soluble calcium stearate. No alkaline solution is produced.



We differentiate between "temporary" hardness, which can be removed by boiling, and is due to calcium bicarbonate, and "permanent" hardness due to calcium sulphate. Water softening can be accomplished through distillation, precipitation of the interfering cations (Ca^{2+} , Mg^{2+}), ion exchange, or removal of the ions as complexes.

How can be soap products? How does soap clean?

- Surface-active matter
- General characteristics of surface-active matters
- The mechanism of saponification
- Soaps and detergents
- Production of soap
- Cleanup function of soap and detergents

Figure: 1
Some of the simulation experiments and content of students' project

The Subjects

The study has been conducted with 42 students that were attending 4th Class of Hacettepe University, Faculty of Education, and Department of Chemistry Education in the 2006-2007 fall terms.

Instruments

Attitude Scale towards Chemistry

Attitude Scale towards Chemistry has been developed by Şimşek (2002) to assess students' attitudes towards chemistry course. It consists of 21 items and it is a five point likert type scale. The Alpha reliability coefficient of the scale has been found to be 0,82.

Project Sufficiency Form

This form has been developed by Yavuz (2006). It consists of 7 parts; Motivation Process, Project Question and Determination of Target and Behaviors, Planning Process, Collection of Knowledge, Organization of Knowledge, Written Report, Presentation (Poster or Electronic).

Computer Programmer

The computer program used to demonstrate experiments to students in the extent of application has been prepared by CCI-Project (Creative Chemistry on the Web) ETH (Eidgenossische Technische Hochschule-Zurich). This program is available on Internet and is consisted of experiments related to daily life chemistry topic. Also experiments can be watched by using real player.

RESULTS

The pre- and post results of Attitude Scale towards Chemistry has been compared using paired samples t-test to determine the effect of Web-Based Project Applications on students' attitudes towards chemistry. The results have been displayed in Table 1.

Table: 1
Paired Samples t-test results for the Pre-and Post Results of Attitude Scale towards Chemistry

	X	n	s	t	p
Pre-test	2,86	42	0,7046	-5,997	0,000
Post-test	3,51				

When students' pre and post test results have been examined, a significant difference²³¹ has been found in favor of post-test ($p < .05$). While students mean scores related to

Attitude Scale towards Chemistry were 2, 86 before the applications, they have increased to 3, 51 after the applications.

Finally, students' attitudes towards chemistry have increased after Web-Based Project Applications.

Regression analyze has been conducted to examine the effect of students' attitudes towards chemistry on student performance and the results have been displayed in Table: 2.

Table: 2
The Explanation of the Student Performance (Dependent Variable)
by Attitude towards Chemistry (Independent Variable)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,467 ^a	,218	,198	6,10608

a Predictors: (Constant): Attitude towards chemistry

In Table: 2, it has been shown that % 21,8 of student performance is explained from attitude towards chemistry [$R^2=, 218$].

Table: 3
The Results Related to Student Performance (Dependent Variable)

ANOVA^b						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	414,918	1	414,918	11,129	,002
	Residual	1491,368	40	37,284		
	Total	1906,286	41			

a Predictors: (Constant): Attitude towards chemistry

b Dependent Variable: Student performance

In Table: 3 has displayed that regression analyze which conducted to determine the relation between student performance and attitude towards chemistry is a significant as a whole ($p<.05$). When the analyze results have been examined, it has been determined that attitude towards chemistry is a significant predictor of student performance ($F=11,129$, sig., 002). Finally, students that have more positive attitudes towards chemistry have greater performance than other students.

DISCUSSION AND CONCLUSIONS

As a result of our study which aims to search the effect of web based project applications on students' attitudes towards chemistry and the relationship between these attitudes and students' performance, it has been determined that the mentioned applications increased students' attitudes towards chemistry positively. At the same time, the results have displayed that students' attitudes towards chemistry were a significant predictor of students' performance.

Web based Learning and large-scale on-line technologies are becoming more visible in schools in general, and in higher education in particular. However, on-line learning is often being provided in loosely structured environments where students usually encounter the problem of being overwhelmed by the vast amount of information and mental influx, and may become unclear about their tasks as learners (Osman 2005).

In the study only chosen experiments related to one topic have been presented to avoid loading students too much information. Daily life chemistry topic has been chosen since it provides students to see usage of their theoretical chemistry knowledge in daily life. It has been thought that being interesting of chosen topic affects students' attitudes toward chemistry positively. The results of the questionnaire have displayed that there was statistically significant increase as a result of the applications. Also it has been thought that the chosen topic in the application had effect on this increase.

As obtained results of our study have displayed, using web technologies in chemistry education has provided limitless repetition opportunity for students and also increased students' interest with their visual characteristics and also increased students' learning. Arasasingham et al. (2005) in their study have expressed that they obtained satisfactory results related to web based applications. Many students which participated in the study have found this type of reasoning difficult and their studies revealed that Web based applications were successful in teaching introductory chemistry students. In the study of Njagi et.al (2003) in which they primarily aimed to assess students' attitude towards web-based learning resources, results have indicated no significant difference in attitude-change between the groups. However, there was a positive significant relationship between computer literacy and attitude towards computer technology.

Among the demographic variables, gender and time students spent on the Internet for class projects have found to predict positive attitude. These findings have agreed with those of Mayes (1995) and Gee (1990) who also found no differences. However the study has disagreed with the findings of (Koohang, 1989; Rothman, 2000) who found differences in attitude change.

In Masiello et al., (2005) study, a Web-based learning management system has employed by a medical university to support undergraduate courses. The objective has been to help the university's staff to understand the readiness and attitudes of students to the use of information technology, their orientation to new learning environments, and the functionality of the system.

The results of the study have revealed that students showed readiness to and positive attitudes towards information technology in education and exposed a possible benefit from its use in the long run. Shih and Gamon (2001) in their study have analyzed the relationships between student achievement and the following variables: attitude, motivation, learning styles, and selected demographics.

The students have enjoyed the convenience and self-controlled learning pace and were motivated by competition and high expectations in web-based learning. Motivation has been the only significant factor that explained more than one-fourth of student achievement measured by class grade.

Pucel and Stertz (2005) in their study have compared the student performance and satisfaction in two WBI-enhanced classes with the performance and satisfaction in²³³ equivalent, traditional classroom versions of the same two classes. Student satisfaction

and student performance in both the WBI version and the traditional classroom version of each course have evaluated using the same criteria.

There have been no statistically significant differences in student evaluations between the WBI versions of the two courses and the traditional versions. The only exception has been that the students in the methods course indicated they learned more from the WBI version. In web based project applications, students have benefited from simulation experiments while determining their own project questions.

These simulation experiments have been both visual resources for them and also they have been able to watch again and again. At the same time, these experiments have provided opportunities for students' improvement in their individual learning process. Pre service teachers have determined their own project questions by transferring learnt knowledge while watching simulation experiments to the new conditions. Students have suggested solutions for their own project question and to reach the solution they have benefited from various resources such as online sources, libraries, field trips and observations etc.

Through web based project applications, the lecturer has not presented the knowledge to the students; on the contrary students have learnt how to reach the knowledge and use this knowledge in the solution process. As Barley (1999) have expressed that over the past decades education has traditionally meant bringing students to sources of knowledge, but the time has come to bring sources of knowledge to the students.

Finally, as Kim and Moore (2005) express, the instructional design of Web-based courses should integrate the components of Brockett and Heimstra's Personal Responsibility Orientation model (1991), which situates the student as the instructor facilitates the regulator of the learning process while the learning.

Web-based learning should not be used instead of traditional methods, but it should be used together with traditional teaching methods.

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