The Factors that Affect Computer Assisted Education Implementations in the Chemistry Education and Comparison of Traditional and Computer Assisted Education Methods in REDOX Subject

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Abstract:

The objective of the research is to learn if learning level of the university students in redox subject of chemistry education change when they use traditional learning method and computer supported method, and to compare these two methods by measuring their success through pre- test and final test. And also some factors that may affect the students and the implementations such as attitudes of the students towards computer their geometrical imagination capabilities, learning methods were searched.

With this aim the students are divided into control and experiment group randomly. After the applications, it is observed that these factors (attitudes towards computer, geometrical imagination capability and learning styles) did not affect the student success so much. Above these, after the computer assisted applications it is observed that in the control group there is a difference about % 48 between pre and post tests. Also, it is observed that the geometrical imagination capabilities of the control group students are better than the experiment group. But in spite of these, it is observed that, in the experiment group, the increase in the success is more than the control group.

Keywords: Redox, Chemistry Achievement Test, Pre and Post-Test Applications, Control-Experiment Groups, Computer Assisted Education, Traditional Education.

Preface

In all science and chemistry lessons in the education processes, it is possible to access instantly to the studies of the education institutions which make researches about the lessons in which internet is used and also it again possible to use the teaching means prepared by these institutions using such implementations for the purpose of education. Usage of the educational tools, diversifying the information given, their repeatability and showing the chemistry experiments in the cyber world which were not performed due to different reasons affect the sucess of students in chemistry education. One of the methods that teachers use most is simple expression method. In simple expression is a method, any teacher or any other one instead of him/her conveys the information about an issue to the active students who sit and listen to him/her. This method was used alone in the schools for many years. It causes the students to sit passively and do not let them ask any questions. Another method is 'Question- answer' method, which was develeped to eliminate the tediousness of simple expression method and to incerase effectiveness of education. Question- answer method means to ask question to get an answer. The teachers who make the neceassary preparations before use this method more successfully. In order to implement this method better, the teachers should let the students to ask questions, and objectives and directions of teaching should depend on the student questions. In the demosntration method, it is the teacher who is active and who makes the experiment, demonstates and explain the issues. The students take the prepared information like listeners. On the other, as this method stimulates more sense organs and attracts the attention of the students, it is accepted as a way that facilitates learning (Bayramlı, 2000). Sample event method makes the student be aware of the real life problems. Implementing the principles and concept which were learnt before, the gaps between theory and practice is filled. Its biggest benefit is that it helps the students to implement in a real situtation what they know and conceived in the lessons. It makes students active in the lessons (Sönmez, 1986). Experiment method is a method in which students fallow the lessons in the labaratories or special classes individually or in small groups through observation and experiment technics. In the labaratories, the students should do the work themselves, the teachers should only help and instruct them. In the demonstraiton method, the teacher explains some issues in the class, laboratory and workshop by using some means and tools. Computer was used in the chemistry education as it is used in other fileds and took its place as computer education in the school schedules. In the Computer Assisted Learning, teachers can use computers in different place and time accoding to the software and hardware opportunity of computers and charecteristics of the students as well as the features of the issues. This usage types can be; repitition, assessment, practice, implementation and subject learning. Programs in CAL can be implemented as practice repitition, mutual learning, problem solving and comparision (Demirel, 1996).

Applications in Chemistry Education

The studies conducted and took place in the literature are listed below. In thier studies in Cortland University mathematic departmant, Romeu and Alemzadeh (1998- 99) examined the effect of labaratory method implemented by using traditional method and technology in the lesson of introduction to computer programming

lesson. In the studies conducted, the lesson was divided into two sectşon, control group was given the lesson by traditional method and the experiment group was given the lesson through labaratory approach. Statistical evaluations were made through final exam notes of students, the grades they took from projects, the grades they took from quizes. In the first test after the evaluations of the results, the performance of the labarator students is lower than the performance of the students who took the lesson with traditional methods; however it was observed that grades of the laboratory students are higher than the other group in the quizzes. Using computer simulations, Rivers and Vockell (1987) examined the increase of the problem solving ability of high school biology students. Simulations were applied to the students in the experiment group without guidance and with guidance. And the control group was not given simulations. In order to search the affect of simulations to problem solving ability, performance pre-tests were measured through tests measuring the scientific thinking ability and critic thinking tests. The results showed that the students using simulations understood the lessons as good as the students in the control group, the students taking the lessons with the simulations being guided became more successful than the others in pre-test, scientific thinking and critic thinking tests. In the study of Lord (1988) on 90 high school students, it was observed that when the students were given the lesson of nitrogen cycle with traditional method, they had difficulty in understanding this lesson and they made mistakes. However, in the analyses and resource researches, the education made through structural approach helped the students to understand the subject. The students were divided into two group; control group and experiment group. In the control group, the lesson was given with traditional method, teacher centered education, modals, slides, projections, however the students' questions were not allowed. In the experiment, the students were divided into groups, class discussion took place, and students asked questions and actively participated in the lesson, critic-thinking questions were used. The rest - one fourth - of the lesson was given as teacher centered. After these implementations, students were given a unit test of multiply choice 50 questions. According to the data obtained form the results of the tests, it was seen that the students in the experiment group answered the questions about analyses and critic thought, this proves that the lessons given with structural method helps the students understand the subjects better.

In the Engineering Faculty of Alabama University, Fortran evaluated the effect of computer supported learning in his lesson (Gerardo, 1986). The study was conducted in the fall and spring semesters of the same year. The main objective of the study conducted in the first semester was to determine whether the students learn the Fortran lesson with computer supported and PLATO based methods or with traditional method. In the first semester, the students were divided into two groups in which traditional methods are used. According to the information obtained from the answers of the students it was learnt, the students believed that they learn the Fortran lesson best when the standard lesson is supported with PLATO. In the second semester, the same students were divided into two Fortran Lesson Group, one of which was experiment group and the other was control group. The control group was given the lesson with PLATO method as well as traditional method. According to the data obtained from this study, it was seen that the control group which took the lesson with PLATO method together with the traditional method increased. In a study on effects of conceptual systems and education methods on general chemistry laboratory success (Jackman, Moellenberg, Brabson, 1990), conceptual systems were divided into four groups. In the first system, the belief of the individuals and their logical thinking capacity are very high and concrete. In the second system, individuals are very negative against authority and institutions and they are self-governing people. In the third system, individuals are more abstract and complex than the ones in the first and second group. They strongly need to preserve the good relations. In the fourth system, individuals are most concrete, broad-minded, and conciliatory and have the analytic of problem solving. Conceptual system side of samples was conducted through using 'This is my belief' test in the general chemistry laboratories. The sample was classified as 1, 2, 3, 4 systems or mixtures. In the laboratory section, three education methods (traditional approach, learning circle, computer simulation) were arbitrarily selected, spectrophotometer principles given in the laboratory education of three hours. Covariance factor analyses showed that there is no meaningful relationship between conceptual system and education method. For conceptual system, main effect is meaningful and in the double comparison of final test grades, the sample of third test is more meaningful than the sample of first test, and the fourth test sample is the best. There is no meaningful difference between the scores of 4. and 3. system's individuals. In another study made by Jackman and Moellenberg (1987), the effects of traditional method, learning circle and computer simulation methods in the laboratory lesson of university first class students about spectrophotometer on the success of students was compared. The study composed of 300 students, % 62,5 of which were boys and % 35,8 of which were girls. 95 of the students took the lesson with traditional method, 98 with the learning circle method, and 95 with computer simulations. First of all, in order to measure the prior information of the students about spectrophotometer, a pretest was 20 questions was given, after method implementations, the students were given final test. In order to see if effective learning occurred after the lessons and to examine if there is any difference between pre-test, final test, t-test was used and meaningful differences were found between the results. The average grades of the group taking the lesson with simulation method were higher than the other groups taking the lesson with other methods. And also no difference was found between the final tests average grades of the groups taking the lesson

with learning circle and traditional methods. In a study to determine the effects of computer usage in the science lessons on the attitude, motivation and learning and to see if computer supported test programs have advantages in education (Jackson, 1988), the students in secondary school were divided into experiment and control groups, after the lesson was given to students by the author, the assessment was applied to control group in written, and to experiment group on computer. In the statistical assessments, it was found that the average grades of the group taking the test with computer-based method are higher than the other groups. In the analyses, it was observed that students can instantly take feedback, can see their errors, and the teacher can easily make the gradation, the motivation, attitude and success of the students increase in the computer supported assessments. In their study, Baker and Beisel (2001) used traditional method, concrete approach and visual approach on computer monitor while teaching 22 students the solution of arithmetic averaging problems. In the assessments made, it was found that visual approach is the best after the pretest and final test results were examined. In another study in which computer supported learning is compared with traditional learning method, students were divided into control group using the traditional methods and into experiment group using computer-supported education in the algebra lesson. After the implementations and assessments, no difference was found between the successes in pretest and final test (Tilidetzke, 1992). In the study of Levine and Donitsa- Schmidt (1996), computer based activities and traditional learning strategies were compared. The students were divided to experiment and control group, implementations and assessments were made. After the results of the assessments, it was seen that experiment group was more successful than the control group. The objective of the study that Demircioglu and Geban made (1996) was to search the effect of computer supported learning with traditional method on science lesson of six class students. Two students group took place in this study. The experiment group was given the lesson with computer-supported method as well as in-class teaching method. And the students of the control group benefited from problem solving implementations as well as the in-class implementation. The units in the research were; static electric, electrical conduciveness, electric circuits and ohm laws. T-test analyze compared both group's success of science lesson and showed that the group using computer supported method was more successful.

In the studies of Green and Mink (1973) in their book 'Assessment of Computer Simulations in Scientific Methodology Teaching', computer supported simulations were compared with traditional methods in the introduction to psychology lesson. After the assessments, it was learnt that the group using computer simulations became more successful an students preferred this metho KAruiki and Pulson (2001) made a similar study in Tennessee with 104 students, students were divided to control group which examined the earthworms with traditional methods, and to experiment group which examined the earthworms with traditional group. In the statistical assessments after the pre-test and final test implementations, no meaningful difference was found between the academic success averages of control group and experiment group. A similar research was made by Ybarrondo (1984) in a high school biology class to determine if computer supported learning (CSL) increases learning or not. The students were divided into control and experiment group. CSL method as well as the traditional method was implemented to experiment group. CSL implementations are the simulations in computers. Changes were observed in the T-test and test scores after the results of the final tests implemented to both group. However, the students showed so much interest to CSL programs. A similar research was conducted by Redish, Saul and Steinderg (2000) through comparison of microcomputer based laboratory lesson with traditional problem solving methods in introduction to calculus lesson. The assessments of both lessons were made by standard multiply choice questions and open- ended exam questions. When the multiply choice questions and open- ended exam questions were evaluated, it was observed that the success of the group taking the lesson with computer is higher the other group. In another study in which Computer Supported implementations were used, the samples consisted of 3 classes. These are experiment group, and the group taking the lesson with personal lesson and traditional teaching method. After the pre-test, students were applied final test and attitude test after implementations of 12 weeks. After the data is analyzed with covariance and multiply regression, no difference was found in the success of the students in different implementations Denton, 1972. In a research made by Durbin (2002) and in which computer was used as a presentation mean, it was observed that students were more successful in the geography lesson in situations where computers and Internet are used as a presentation vehicle. In the study which Ertepınar (1995) examined the contribution of teaching method consisting of logical thinking capability and two different learning method (computer supported education and studying questionnaire) to success of high school students in chemistry lesson was made with 119 students. After the study, it was determined that the implementations consisting of two different teaching method and logical thinking capacity have a meaningful contribution to success in chemistry lesson.

The Purpose of the Study

In this research it is aimed to learn if learning level of the university students in redox subject in chemistry education change when they use traditional learning method and computer supported method, and to compare these two methods by measuring their success through pre- test and final test. And also some factors, such as

attitudes of the students towards computer their geometrical imagination capabilities, learning methods, that may affect the implementations were searched.

Experimental Details

The Subject

The research was conducted with 84 students who continue the Chemistry Education Internet Exam and participate in the Chemistry Education and Chemistry Education Seminar Lessons in Hacettepe University, Faculty of Education, and Department of Chemistry Education.

The Test Instrument

The data assessed in the research are gathered in the fallowing test, scale and implementations.

Purdue Rotation Orientation Test

In this test, geometrical (three dimensional) imagination capability and factors of students are measured (Bodner and Guay, 1997). In 10 minutes, students answered 20 questions in the Rotation Orientation test. The results assessed show the relationship between psychometric structure known as geometrical capacity and chemistry lesson of students. The aim of the test is to determine the capability of students such as imagination of the students when the parts of a picture or shape move, moving the shapes (geometrical imagination) and staying unconfused in the changes in orientations. Therefore, through Rotation- Orientation test, it can be learnt that which students have difficulty in geometrical subjects and which students do not perceive the two dimensional shapes on computer monitor.

Attitude Scale

In order to measure the attitudes of students towards computer supported chemistry education, 'Computer attitude scale' of 21 questions developed by N. Selwyn was applied to 84 students (Selwyn, 1997). While the attitudes of students are measured in this scale, four structures were focused on, these are; the perception of students about computer, their knowledge of computer, their attitudes about computer and whether they have difficulty in using computer. The scale was Likert-type, and assessment of the clauses was made according to the five-gradation system (I certainly agree, I agree, I am confused, I do not agree, I certainly do not agree). The scale also contained 11 positive, 10 negative clauses.

Learning Style Inventory

Learning Style Inventory developed by Kolb in 1985 (LSE) showed that learning style is more suitable for the individuals (Kolb, 1984; Kolb, 1985, Kolb et al. 1985, Askar and Akkoyunlu). Determining this helps individuals to select his/her occupation, problem solving approach and how to determine the objectives. It is a scale that helps the individual, a learner, to understand his/her weak and strong sides. Kolb defined 4 learning style depending on the lifestyle learning theory. LSE consists of 12 clauses, each of which have 4 choices and which wants the individual to list best four learning type the individuals. In the learning model of Kolb, learning style of individuals is like a circle and where the individual takes place in this circle is determined through Learning Style Inventory. There are four learning type in this circle. These are Concrete life, Reflective Observation, Abstract Conception and Active Life. Learning methods symbolizing each learning style is different from each other. There are; for Concrete Life, learning 'by Feeling', for Reflective Observation, 'by Observing', for Abstract Conception, 'by thinking', and for Active Life 'by doing'. However, there is not only one type that determines learning style of individual. Learning style of each individual consist of these four basic components. These learning styles mentioned are the one that 'places', 'assimilates', 'alters' and 'decomposes' (Askar, Akkoyunlu, 1993).

The Computer Program

Computer program used in computer supported implementations are prepared by CCI- Projekt (Creative Chemistry on the web) / ETH (Eidgenossiche Hochschule Zurich). This program can be accessed through Internet. The experiment about redox can be watched in this program via real player program. Explanations also appear on the screen. There are also some sections where students can reach detailed information and explanations and reasch the reactions.

Special permission was taken from CCI- Projeckt / ETH to use this program on Internet.

Chemistry Achievement Test

The test used to measure success of students was prepared by the researchers considering the implementation within the framework of CCI – Projekt (Creative Chemistry on the Web). Chemistry Success Test (CST) containing the concepts about redox and used within the context of the research consisted of open-ended 20 questions. First of all, the expert were individually consulted about which questions should be used

about redox and CST was prepared as 20 open ended questions. Taking the advice of the experts, domestic validity of CST was established. The questions are shown in table 1.

Table 1. *Chemistry Achievement Test About Redox Test*

1. How does the Na/K alloy occurs and gives which reaction with air?
2. Which reaction occurs when metal nitrates are mixed with $KClO_3$ and $C_{12}H_{22}O_{11}$ and concentrated H_2SO_4 is added to the solution?
3. Show the reactions happening when $LiAlH_4$ is added to water?
4. Show the reactions happening when Sn^{+2} salts are added to H_2S, $(NH_3)_4S_x$?
5. Show the reactions happening between PbO_2 with HCl, and H_2O_2?
6. Write the reaction between NO with air Oxygen and water?
7. Show the reactions happening Red Phosphor in NO luft?
8. Explain Marsch Experiment.
9. $As^{3+} + S^{-2} \longrightarrow$
   $Sb^{3+} + S^{-2} \longrightarrow$
   $As^{3+} + Sn+^{2} \longrightarrow$
   $Sb^{3+} + Sn+^{2} \longrightarrow$
10. Explain the redox amphoterlics of H_2O_2.
11. Explain the reaction between H_2S and SO_2.
12. Explain the redox amphoterlics of SO_3^{-2} ion.
13. Can Halogens react with $KMnO_4$?
14. Show the reactions happening between Br_2 and I_2 with the effect of NaOH.
15. Show the reactions happening between chlorat, bromat, and iodat between I_3^-.
16. Complete and describe the reactions.
    $Cr^{+3} + Zn + H^+ \longrightarrow$
    $Cr^{+3} + H_2O_2 + H^+ \longrightarrow$
17. Show the reaction between glucose solution and Au^{+3} salts.
18. Show the reaction between $CuSO_4$ and white phosphor.
19. Show the reaction of sodium potassium tarthrat with H_2O_2 in $CuSO_4$ solution.
20. Show the reaction between $KMnO_4$ and ethanol.

Test Procedure

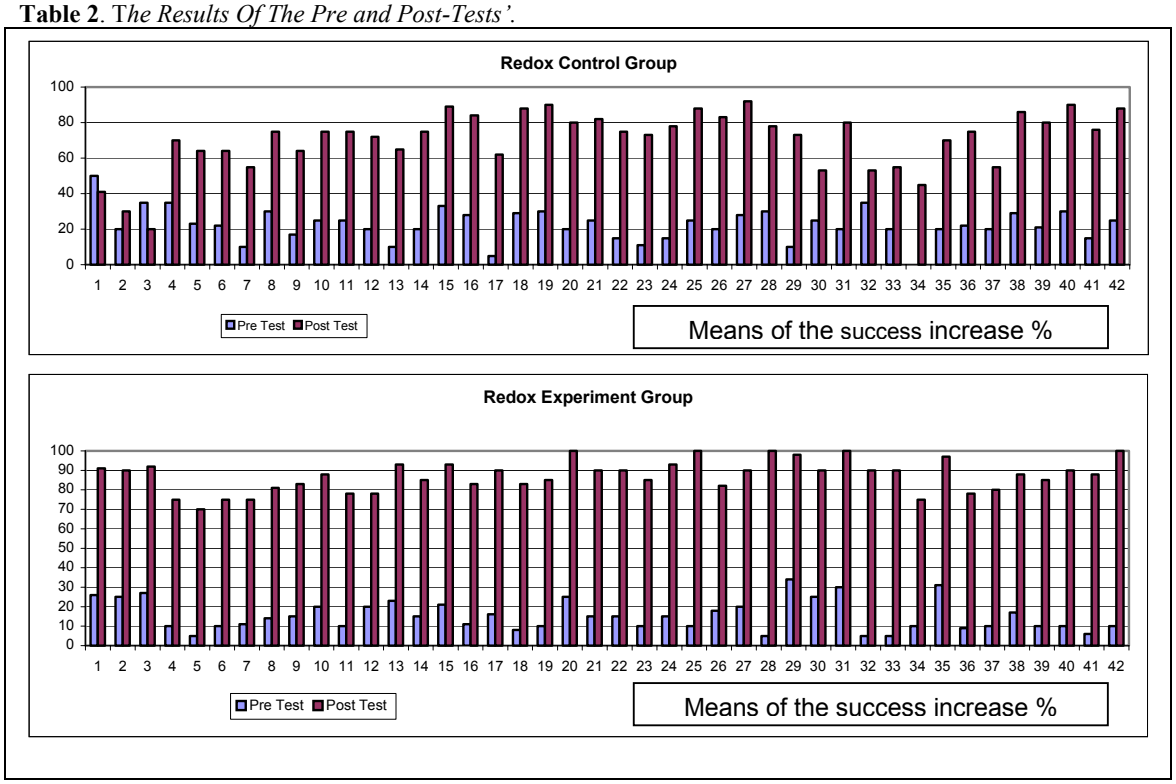
In our study, the first process was to measure the knowledge of students about redox in chemistry education using computer and Internet through Chemistry Success Test which was implemented as pre-test. After that, control and experiment groups were constituted and information about Chemistry Success Test was given to experiment group as computer supported education, and it was control if the success of the students change after Chemistry Success Test, implemented before, was applied again. Some factors that might affect the students learning the lessons in computer supported program; such as attitudes of students towards chemistry learning, their geometrical learning capacity and success of their learning style were examined. The same information was given to the students in control group through traditional methods and Chemistry Success test was given as final test.

In the implementations, 84 students, who were going to Chemistry Education Internet class and who participated in the seminar lessons of Chemistry lesson in Hacettepe University, Faculty of Education, Department of Chemistry, were arbitrarily divided into experiment group and control group. Both groups consisted of 42 students and were given Chemistry Success Test of 20 questions as a pre-test. Both groups were also applied Rotation Orientation Test to measure geometrical imagination capacity and factor of the students in both groups, computer attitude scale to measure their attitudes towards computer supported learning style, learning style inventory to measure in which learning style students became more successful. Information and experiments about acid-base were given to experiment group in computer environment. Redox subject was given to control group via traditional methods. After implementing both education methods, exam date was announced before and chemistry success test was given as final test.

Results

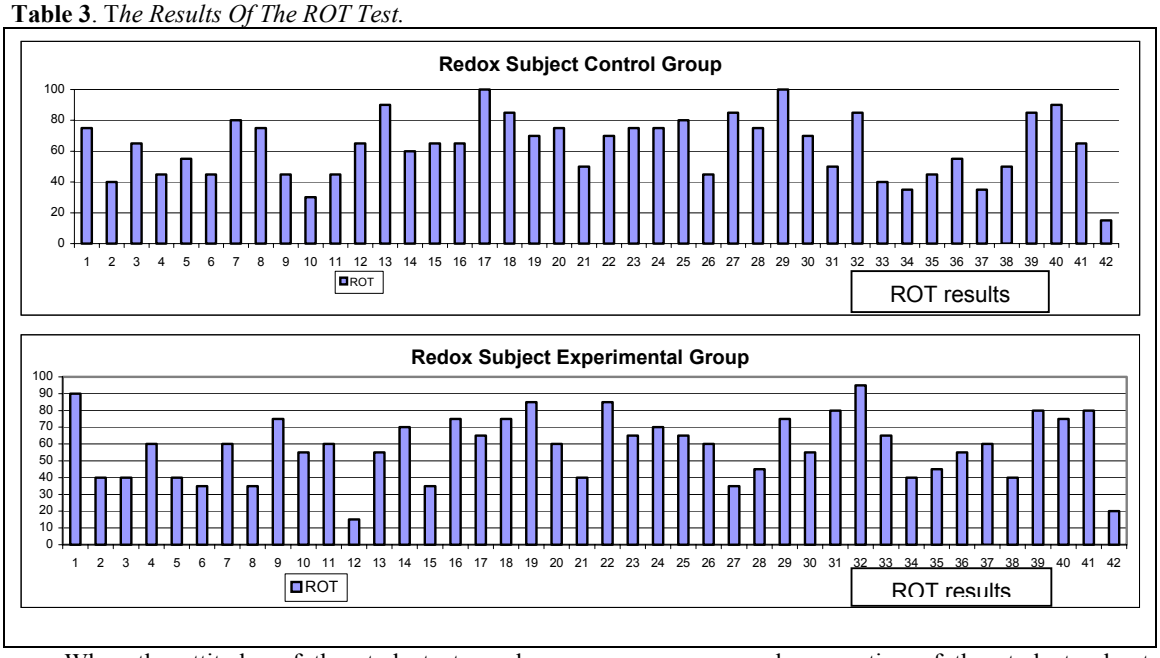
The pre-test, final test results of the students in control group and experiment group which were given the lessons through traditional method and computer supported method are given in table 2- 3.

Table 2. T*he Results Of The Pre and Post-Tests'.*



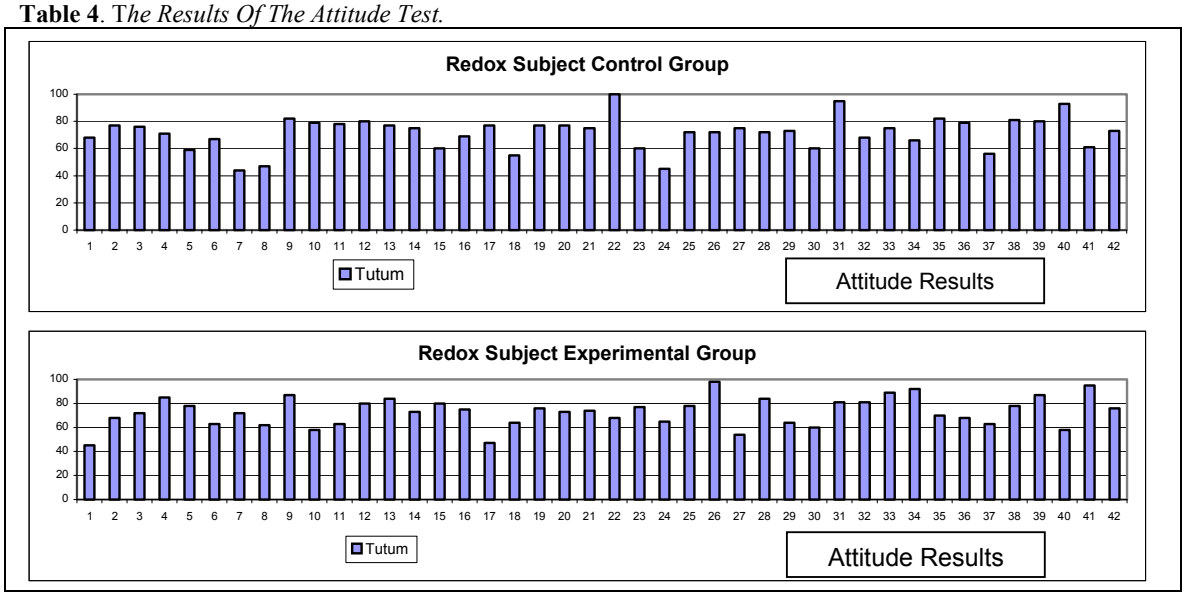
In the Rotation Orientation Test implementation, more than 50 % of the students had the sufficient three dimensional imagination capacity (see table 3).

Table 3. T*he Results Of The ROT Test.*



When the attitudes of the students towards success was measured, perception of the students about computer is more as seen in the Table 4, students can still use the computers. With the other words, they have enough knowledge to use computers. However, the students cannot control the computers so good (lack of technology), however the behaviors of students towards computer is sufficient.

Table 4. T*he Results Of The Attitude Test.*



After Kolb Learning style inventory, it was observed that students show four different learning styles. Respectively, 26 students in control group and 26 students in experiment group were included in the **assimilation** learning group which makes **reflecting** observation and abstract conception by thinking, 10 student in control group and 10 students in experiment group were included in the **decomposing** learning group which makes abstract conception by thinking and constituting active life. 2 students from experiment group and 3 students in control group showed learning style of **altering,** and 4 students from experiment group and control group with 3 students showed learning style of **placing.** Students taking science lesson showed similar results, too. All results of the control and 84 experiment groups consisting of 84 students were evaluated; results of Rotation Orientation test, computer attitude scale and pre test and final test about redox were statically evaluated and independent two samples –Test were applied. The results are shown on table 5.

Table 5. T*he Results Of The Statistical Evaluations.*

Control Group

	N	x	s	t	p
Pre test	42	22,57	18,35	-16,97	0,000
Post test	42	7,62			

Meaningful relation was observed in favor of final test.

	N	x	s	t	p
Post test	42	70,62	24,04	2,03	0,049
Rot test	42	63,10			

Meaningful relation was observed in favor of final test.

	N	x	s	t	p
Post test	42	70,62	18,94	-0,34	0,734
Attitude	42	71,62			

There is no meaningful relationship.

Experiment Group

	N	x	s	t	p
Pre test	42	15,29	8,12	-57,51	0,000
Post test	42	87,31			

Meaningful relation was observed in favor of final test.

	N	x	s	t	p
Post test	42	87,31	19,77	9,46	0,000
Rot test	42	58,45			

Meaningful relation was observed in favor of final test.

	N	x	s	t	p
Post test	42	87,31	14,99	6,20	0,000
Attitude	42	72,98			

Meaningful relation was observed in favor of final test.

Experiment Group and Control Group

	N	x	s	t	p
Pre test experiment	42	15,29	12,03	-3,93	0,000
Pre test Control	42	22,57			

Meaningful relation is observed in favor of control group pre- test.

	N	x	s	t	p
Post test experiment	42	87,31	16,94	6,38	0,000
Post test control	42	70,62			

Meaningful relation is observed in favor of control group post- test.

Discussion

When all the applications made to 84 students that continued to chemistry education internet class are evaluated; the results emerging from the studies about their students' learning styles, their attitudes towards computer and their rotation orientation capacity were compared are shown in the fallowing table (See Table 6-7).

Table 6. Percentages of the Control and Experimental Group Students' Pre-Post Test, Attitute, ROT Test, and Success Results.

Control Group	N	CAT			ROT	Attitude
		Pre Test	Post Test	Achievement		
Assimilator	26	%23,0	%69,9	%46,9	%64,2	70,0
Altering	3	%22,7	%81,0	%58,3	%86,7	73,3
Placing	3	%26,7	%62,0	%35,3	%68,3	74,3
Decomposing	10	%20,2	%72,0	%51,8	%51,5	74,6

Experiment Group	N	CAT			ROT	Attitude
		Pre Test	Post Test	Achievement		
Assimilator	26	%15,6	%85,7	%70,1	%58,1	71,7
Altering	2	%12,5	%80,0	%67,5	%40,0	69,0
Placing	4	%23,5	%94,5	%71,0	%76,3	71,5
Decomposing	10	%11,8	%87,1	%75,3	%56,0	77,6

Table 7. Percentages of the Control and Experimental Group Students' Pre-Post Test, Attitute, ROT Test, and Success Results.

	CAT			ROT	Attitude
	Pre Test	Post Test	Increase in the Achievement		
Control	%22,6	%70,6	%48,1	% 62,0	71,6
Experiment	%15,3	%87,3	%72,0	% 58,5	73,0

As it is seen in table 6 which shows 4 different learning style of all group, increases in the success of the students in experiment group are more than the success of the control group. This situation shows the superiority of computer supported learning on the classic methods. On the other hand, Rotation - Orientation Test and Attitudes test results do not show any differences in control and experiment groups. This situation shows that students do not have any differences in the mentioned issues. However, when the groups are compared without considering their learning style, it is seen that control group has more attitude towards Rotation Orientation Test and the experiment group has more attitude towards computer (See Table 7).

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