REAL-TIME/ONLINE ASSIGNMENT GRADING PROGRAM DEVELOPED IN JAVA SUPPORTED WEB BROWSER FORMAT FOR FUNDAMENTAL ENGINEERING COURSES

Y. O. Devres, G. Bingöl

Istanbul Technical University, Food Engineering Department, 34469 Maslak-Istanbul, Turkey

Abstract

A computer program was developed to organize homework assignments of fundamental engineering courses. With this program, it is possible to deliver and grade the assignments online through Internet. The assignment but with randomly generated data for each student is being given in Thermodynamics and Heat Transfer courses of Istanbul Technical University, Food Engineering Department. Since the problem is same, students can collaborate with each other as they like, but each one of them has to individually calculate with his/her own data in order to find the answer. Each student has maximum five attempts to solve the problem where every wrong answer decreases the grade of the problem by 5%, 25%, 50%, 75% respectively. With this program, more assignments can be given without need of any manpower in grading while the student can get more practice with its self-amendment capability. In this study, uses of web-based technologies in teaching of Thermodynamics and Heat Transfer are described and experiences gained in these activities are presented.

Keywords: web-based learning, assignment grading, thermodynamics, heat transfer

1. INTRODUCTION

In recent years, the use of web-based learning is becoming wide-spread in universities in various parts of the world. According to the definition of the IEEE Learning Technology Standard Committee, a web-based learning system is: ‘‘A learning technology system that uses Web-browsers as the primary means of interaction with learners, and the Internet or an intranet as the primary means of communication among its subsystems and with other systems’’ [1]. For this purpose other than specially prepared web pages and interfaces, some general platforms are developed for organizing e-courses’ structures like discussion boards, chat rooms, course content management etc. The forthcoming platforms are Web Course Tools (WebCT) (http://www.webct.com/) and Blackboard Learning System (http://www.blackboard.com/). They supply a user friendly interface and with these platforms it is possible to present course materials, manage discussions and surveys, handle static exams and quizzes (same questions to all of the participants) without knowledge of web page preparation programs. On the other hand, it is possible to handle dynamic exams in web platform with today’s infrastructure. In these exams, questions and answers can be changed randomly depending on time, subject, group and pre-defined requirements, etc. With this approach, a user can have different questions in every take of exam instead of memorizing questions and learning their answers after some trials. Programming languages should be used to organize dynamic exams with the aid of knowledge of course subject. In this study a platform for organizing homework assignments’ grading in Thermodynamics and Heat Transfer courses is described and its past and present with applications are discussed.

2. PAST OF THE APPLICATION

In educational activities it is experienced that students (or learners) rely on themselves and are motivated to move for further phases of learning if they solve the problems by themselves and find the results with their own efforts or with minor supports. Later on, subject becomes easier to them. Unfortunately, in the absence of satisfactory man-power, like having a few teaching staff for too many numbers of students, it is not easy to organize effective teaching activities in a good manner [2]. The

starting point of the study was pushing the students to solve as much problem as possible with as low man-power as possible for checking them.

The origin of this study goes to 1995 [3, 4]. In first applications, homework assignments were given as texts of problems where the texts of the problems were same but their data were individually created. So the intention was to force each student to solve the problem in person instead of "exchanging" solutions among themselves. Evaluations of results were done by simple EXCEL worksheets where, there is no need to mention, the process was boring and very time consuming. For instance, in homework assignment of 10 questions for a class of 40 students there should be checking of roughly 2000-2500 data as inputs and outputs. In 1997, VisualBasic programs were written for manual evaluating the results. In these programs, steam, refrigerant and air tables were defined and more detailed problems were prepared as homework assignments. In September 1998, www.devres.net was started to use handling of homework assignments as an announcement platform. Since then devres.net has being successfully used as a supporting platform in teaching. In November 2000, solutions were asked to be sent by email messages to thermodynamics@devres.net and heattransfer@devres.net. For manual checking of solutions, Java programs were written. Important Thermodynamics and Heat Transfer tables were also prepared in Java in objects. In spring term of 2001, an on-line interface between users and problems was established using Telnet in Thermodynamics course. In Telnet applications only ASCII character set can be exchanged. For this reason problems prepared in Turkish were given in English characters. During assignment grading procedure, students were connected to known IP address where a server was running through Telnet connection with their username and password. For this purpose a manual of 12 pages was prepared. In their first connection they got their assignment questions with their individual data. When they prepared solutions, they connected again to the server and checked the results. In every wrong attempt in evaluating the results caused 20% decrease in the points of the problems. Students criticized huge decrease in their first attempts and ratios were changed as 5%, 25%, 50% and 75%. In autumn term of 2001-2002, Telnet procedures were applied in homework assignments of Heat Transfer course. In spring term of 2001-2002, students' data were started to keep in MS Access files instead of matrices defined in the programs. In autumn term of 2002-2003, connection to the server and question presentations was handled in web pages prepared in HTML and Java programming language. Since then an effort is being continuously spent to increase the number of problems in homework assignments. Currently there are 28 problems in Thermodynamics course namely on mathematical calculations (2), basic concepts of thermodynamics (3), properties of pure substance (5), first law of thermodynamics and gas-vapor mixtures (4), second law of thermodynamics (4), evaluation of Rankine vapor power cycle (5) and evaluation of ideal vapor-compression refrigeration cycle (5). Objects are prepared to calculate physical properties of substances like water, ammonia, R134a. In these objects properties of substances can be calculated in saturation, compressed liquid and super-heated regions as the way that they can be found from the tables by students. An object was written to calculate thermodynamic properties of humid air (dry-bulb, wet-bulb and dew-point temperatures, relative humidity, pressure, humidity ratio and enthalpy) respect to any known three properties [4-6]. There are also 24 problems in homework assignments of Heat Transfer course namely on conduction (7), forced and free convection (13) and radiation (4). For this purpose, objects were written to calculate properties of water and air that are being used in the solution of problems

3. MATERIALS AND METHODS

The student assignment system is composed of web pages which are coded using Java Server Pages™ (JSP) technology that is a mixture of HTML (HyperText Mark-up Language) and Java Programming Language. Java Server Pages are edited by using Macromedia Dreamweaver MX 6.0. JSP can not run standalone and needs a server to run on. Thus, Java Web Server 2.0 is installed on a Windows XP system to run JSP. JSP can be viewed using a standard browser such as Internet Explorer or Netscape Navigator. HTML has the capability to use images, animation and etc. which plays a key role in interactive education.

Students are registered to assignment by teaching assistant of the course with their student ID's as their usernames and surnames as passwords. However, after first login they are eligible to change their passwords as they want.

Students are welcomed to respective assignment with a page asking their passwords and usernames which enables/disables them to proceed further. Upon successful login, three previous connections and their login number are shown. After further proceedings, they can take questions of the same assignment. Each text of the question is same but the values within the questions vary in a reasonable and predefined range for each student.

It is not possible for a student to calculate taken values within a short period of time during their connection to the server. For this reason, the values belong to a student which has taken/been given should be recorded. For this purpose, JDBC : ODBC, namely Java Database Connectivity : Open Database Connectivity respectively, were used to connect MS Access™. With this utility, tables were designed to record students' data such as values, grades; personal information and connection times etc in MS Access which is not suitable for large number of users but maybe a perfect fit for a classroom and has the advantage of visual design and management.

After answering a question, the question is promptly graded either as being true or false. If true, students get the full point for that question. In latter case, students are eligible to re-answer the question but, in return for a decrease in point. In the calculation of the grade, predetermined percentage of the system's answer is checked and if student's answer is in a range, it is accepted as a true reply and graded accordingly. At any time, students and educator can also view the grades.

A messaging utility page has been designed where notifications about the assignment can be announced. Students also can send messages to each other regarding with the assignment. Language of the courses is Turkish but for this study sample pages were prepared in English and presented in Figures 1 and 2.

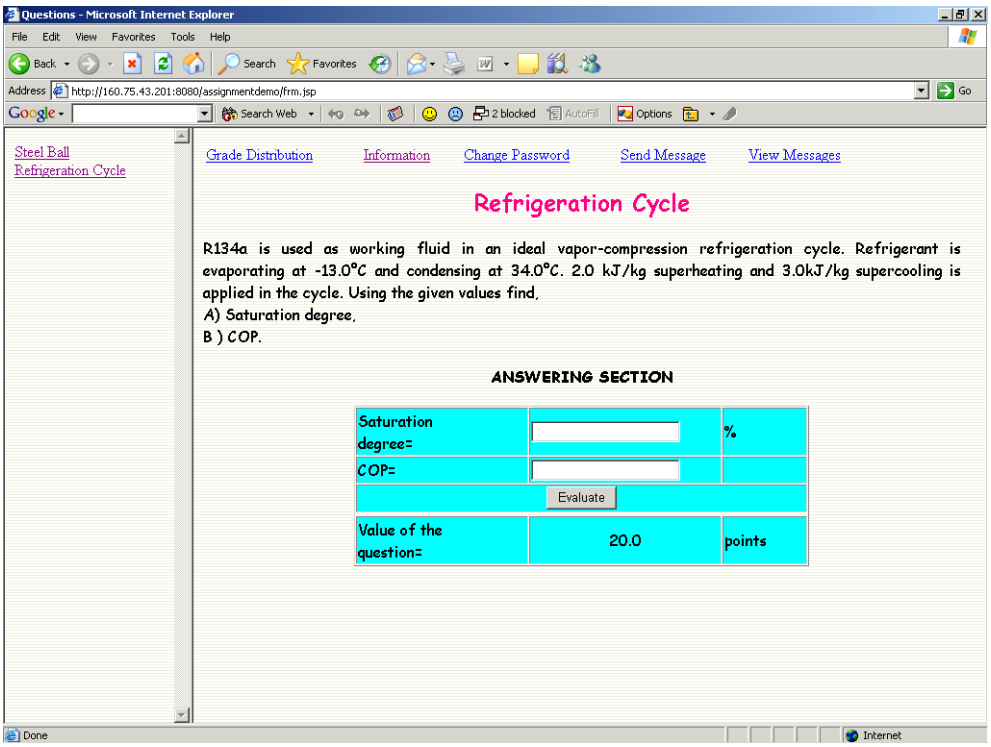

Figure 1. Sample Thermodynamics homework assignment page

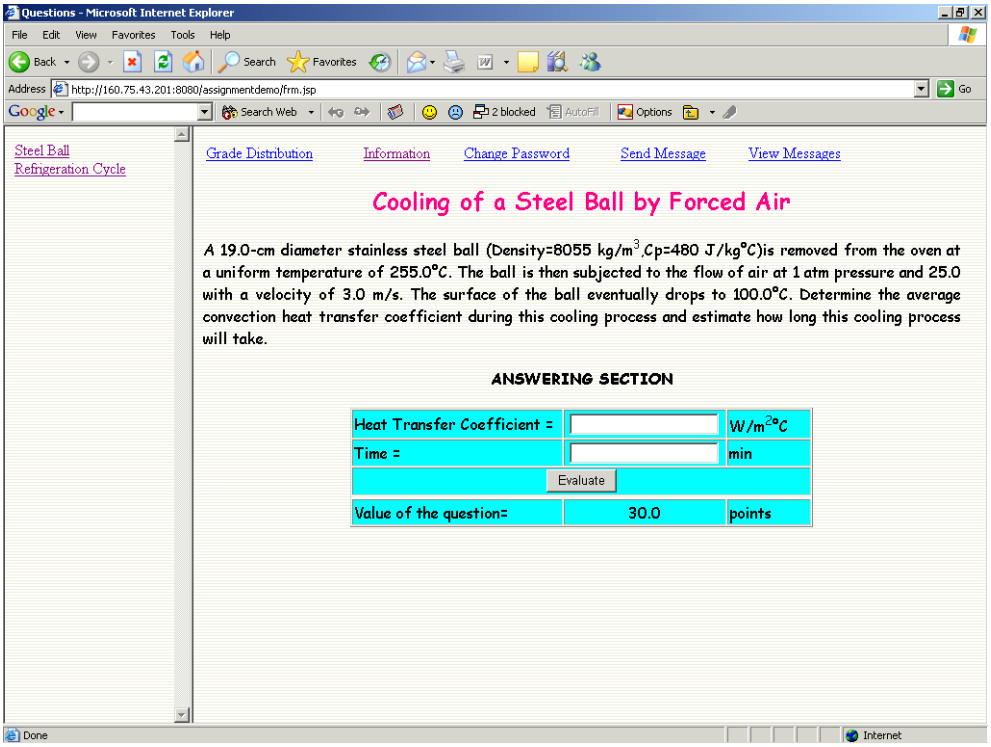

Figure 2. Sample Heat Transfer homework assignment page

4. RESULTS AND DISCUSSION

In the past five years, on-line assessment grading system has been successfully used. In spring term of 2004-2005, system was applied to Thermodynamics and Heat Transfer courses in ITU. Evaluations are presented below:

a) Thermodynamics Course

Course was given to Food Engineering students in their 4th term. Enrollment to this compulsory course was 43 and 3 of them could not fulfill minimum attending requirements. They got VF and they are going to repeat the course again in next year. Scores of examinations and homework assignments were used to determine the grades. There were three midterm exams (10%, 16% and 22% in share) and a final exam (40%). The rest 12% of the grade was the share of homework assignments. In six homework assignments there were four main problem sets as HA1a, HA1b, HA2, HA3, HA4a, and HA4b where each problem set has a 3% effect in grading. The text book of the course was Cengel and Boles' Thermodynamics [7, 8]. The assignments were chosen on subjects of previous weeks that are presented as is in the text book. The first two problems of HA1a were calculation of surface area of cylinder and sphere. The aim of the questions is to show the logic of the platform by using only fundamental knowledge and by this make the platform familiar to students. There were in total 1204 possible answers to be checked where 53.1% of the trials found the right answers in their first attempt. The sums of multiple trials were 24.4%. Together with the students not properly attending the courses, 22.5% of the possible attempts in solving the assignments was not even tried (Table I).

The distribution of scores and grades are shown in Figure 3. In the figure, sum of homework assignments are given as "Homework" which was representing 12% up-most; sum of four exam scores are shown as "Exams". Sum of "Homework" and "Exams" are given as "Total". Sometime there is a close relationship between the scores of homework and final exam. Therefore scores of final exam is also shown as "Final". The mean of total scores is 54.2 out of 100 and over 35.0 got the passing grades. The mean of homework assignments' scores is 9.0 out of 12 and its standard deviation is 2.8. In AA-CC grading range it is increased to 10.0 and its standard deviation is 1.4. These results

show us students' support to the platform and their good intention to learn independently in the system by their 932 trials as shown in Table I.

TABLE I. Trials of Thermodynamics Homework Assignments

HA	1a		1b		2		3		4a		4b		Σ	
#Q	5	%	5	%	4	%	4	%	5	%	5	%	28	%
#T1	142	66.0	121	56.3	61	35.5	122	70.9	114	53.0	79	36.7	639	53.1
#T2	35	16.3	35	16.3	33	19.2	20	11.6	42	19.5	37	17.2	202	16.8
#T3	5	2.3	8	3.7	24	14.0	5	2.9	10	4.7	14	6.5	66	5.5
#T4	3	1.4	2	0.9	4	2.3	1	0.6	1	0.5	6	2.8	17	1.4
#T5	3	1.4	1	0.5	3	1.7	0	0.0	0	0.0	1	0.5	8	0.7
#T0	12	5.6	33	15.3	32	18.6	9	5.2	33	15.3	63	29.3	182	15.1
#T0*	15	7.0	15	7.0	15	8.7	15	8.7	15	7.0	15	7.0	90	7.5
Σ#A	215		215		172		172		215		215		1204	

* 3 students did not fully attend the course and their limited answers were accepted as nil

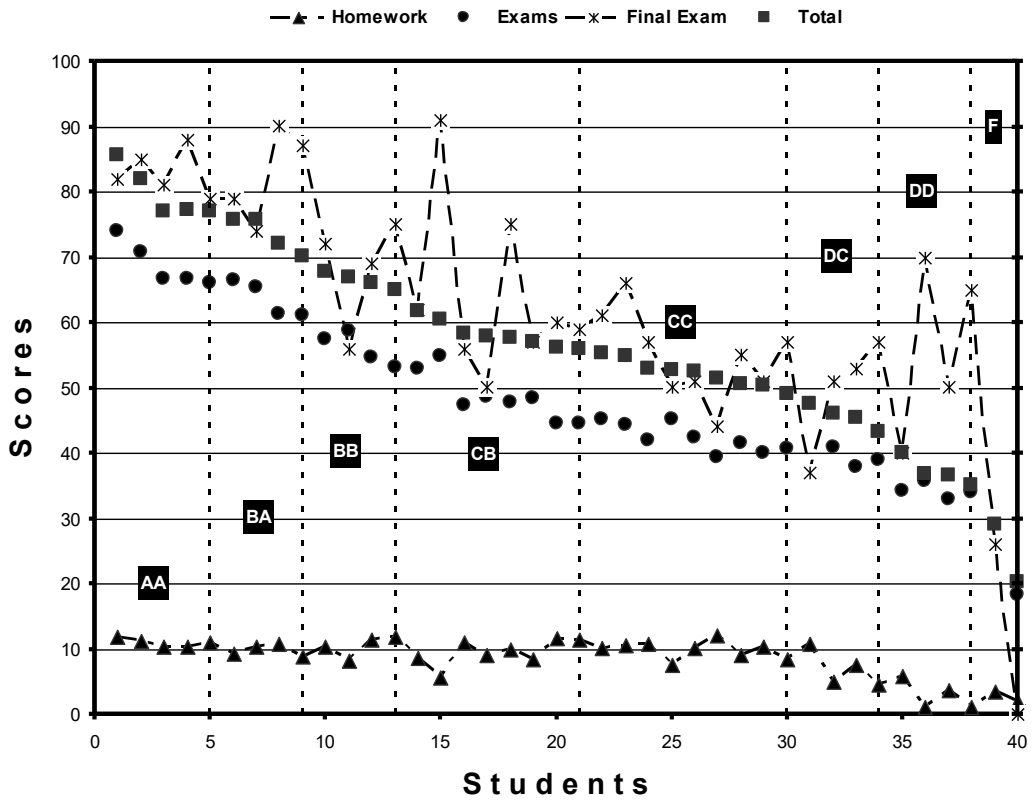

Figure 3. Scores of Thermodynamics course (2004-2005 spring term)

b) Heat Transfer Course

Course was given to Management Engineering students in their 4th term. Enrollment to this elective course was 45 and 2 of them could not fulfill minimum attending requirements and they got VF. Scores of examinations and homework assignments were used to determine the grades. There were two midterm exams (20% each), four quizzes (2% each) and a final exam (40%). The rest 12% of the grade was the share of homework assignments. In six homework assignments there were four main problem sets as HA1a, HA1b, HA2a, HA2b, HA3, and HA4 where each problem set has a 3% effect in grading. The text book of the course was Holman's Heat Transfer [9]. The assignments were chosen on subjects of previous weeks that are presented in the text book. There were in total 1080 possible answers to be checked where 34.8% of the trials found the right answers in their first attempt which was less than Thermodynamics course's value. The sums of multiple trials were only 15.3%. Together with the students who do not properly attend the courses 49.9% of possible attempts of solving the assignments were not even tried (Table II). It is very clear that in this course students would not prefer to employ benefits of the platform. The course was the first time introduced in their

curriculum and they had some hesitations about the aim of the subject and relationship with their degree. It was tried to explain the usage of heat transfer in the industry but their prejudice, unfortunately, could not be changed.

TABLE II. Trials of Heat Transfer Homework Assignments

HA	1a		1b		2a		2b		3		4		Σ	
#Q	5	%	2	%	4	%	5	%	5	%	3	%	24	%
#T1	127	56.4	24	26.7	51	28.3	72	32.0	65	28.9	37	27.4	376	34.8
#T2	23	10.2	19	21.1	23	12.8	24	10.7	20	8.9	5	3.7	114	10.6
#T3	7	3.1	8	8.9	3	1.7	5	2.2	6	2.7	3	2.2	32	3.0
#T4	5	2.2	0	0.0	3	1.7	2	0.9	0	0.0	0	0.0	10	0.9
#T5	1	0.4	2	2.2	2	1.1	1	0.4	0	0.0	3	2.2	9	0.8
#T0	52	23.1	33	36.7	90	50.0	111	49.3	124	55.1	81	60.0	491	45.5
#T0*	10	4.4	4	4.4	8	4.4	10	4.4	10	4.4	6	4.4	48	4.4
Σ#A	225		90		180		225		225		135		1080	

* 2 students did not fully attend the course and their limited answers were accepted as nil

The distribution of scores and grades are shown in Figure 4. The mean of total scores is 53.3 and over 36.0 got the passing grades. The mean of homework assignments' scores is only 4.3 out of 12 and standard deviation is 3.4. In AA-CC grading range, the score and standard deviation are increased to 5.4 and 3.4, respectively. From figures, it can be seen that the most of the students did not try the system in order to support their learning activities. On the other hand they got high scores in their final exams and these scores increased their total scores. The results of their final exams show us their real capacity if they wish to do something.

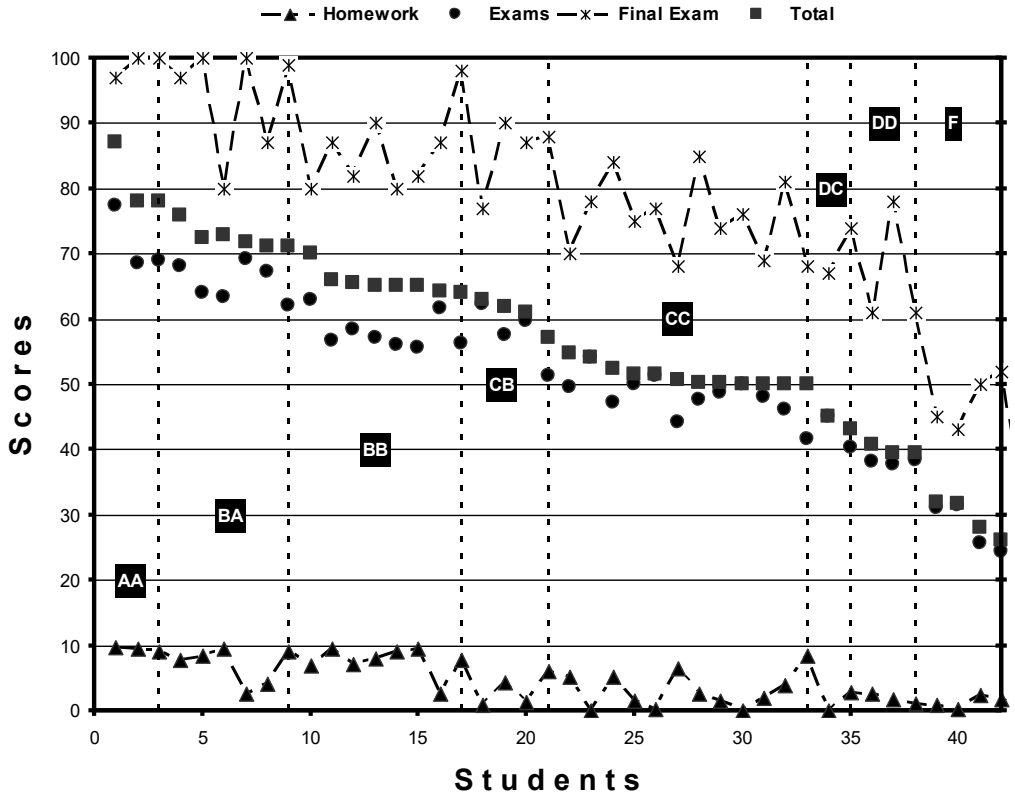

Figure 4. Scores of Heat Transfer course (2004-2005 spring term)

From the forgoing tables and figures, it can be seen that responds of the students to the system were not same in these two different departments. Departmental students got better results. Eager students in learning always get top grades whether homework assignments are checked by computer or not. In the aspects of teaching, however, with this technique, you can help the students who would like to solve more problems. On the other hand, from the teacher's point of view, time required for checking

28 problems in Thermodynamics course and 24 problems in Heat Transfer course is very little when the time for developing the system is not considered.

5. CONCLUSION

In the scope of applications handled in the past decade, experiences to be shared can be given as follows:

1) E-education system is not a magical tool or a ultimate solution. If students would not like to learn, any educational system could not change their minds. If they are eager to learn something, they employ every possibility offered in educational systems. In such cases, web-based technologies help educators for handling these activities in 24-hours-a-day and 7 days-a-week.
2) In choosing between e-education or b-education (blackboard education) systems as a teaching media, b-education will always have more supporters since it is more traditional. On the other hand, it should be kept in mind that in the near future it will be more transitional then today.
3) In near future, E-education will be gained more importance then before. A long term preparation period in all platforms should be supplied before to utile it. The industrial revolution did not occur over night nor can we expect that the computer revolution in education to realize in one semester [10, 11].
4) All kind of data related to courses should be kept in electronic media. This will decrease the further processing time in e-education.
5) The creation of an effective courseware using web-based technologies is a great deal of work. Regardless of the tools used, an educator who creates this tool and makes it an integral part of his/her course soon discovers that designing and producing the initial product are only small part of the entire task. Maintaining it throughout entire teaching years -keeping its content current and its links up-to-date, together with necessary modifications and improvements- is a much more time consuming activity, by far [2].
6) Evidence for the benefits of students' active role in learning in web-based systems can be easily chased and it can be used for future developments of the e-education systems [12].
7) Students' active engagement in the learning process in web-based systems is fostering their curiosity and motivation, and enables the development of life-long learning skills [12-14].
8) We are, also, role models for our students whom are being educated in new instructional technologies and are going to develop better educational implementations using this knowledge. Therefore we have common responsibilities and mutual benefits to move in the direction of new technologies to fill the void and meet the challenge of electronic education [4].
9) Long term patience in all levels should be conserved in e-education applications.
10) Human and financial resources should be supplied and developing teams should be formed. It should be remembered that educators are not computer geniuses and computer programmers are not educators. Everyone should be responsible in his/her own area of interest.
11) E-education applicators should be supported.

ABBREVATIONS

HA Homework assignment
#Q Number of questions that are given
#Tn nth of trials
#T0 Number of none tried
#A Number of answers

REFERENCES

[1] IEEE Learning Technology Standards Committee IEEE LTSC Glossary. http://ltsc.ieee.org

[2] Y. O. Devres and G. Bingöl, ”IN-COR-E: the use of Java supported web browser format for interactive education in vapor-compression refrigeration cycle with real-time/online assignment grading module”, ICR2003 - 21st International Congress of Refrigeration, 17-22 August, Washington DC, USA, ICR0313, 8p, 2003.
[3] Y.O. Devres and T. Duran, “I-HEAT-ED: the use of Java supported web browser format for interactive education in heat transfer”, CHISA 2000 - 14th International Congress of Chemical and Processing Engineering, in Chemical Engineering Education in 21st Century, 27-31 August, Praha, Czech Republic, 9p, 2000.
[4] Y. O. Devres and G. Bingöl, “Psychrometric properties of humid air : calculation procedures and interactive education in java supported web browser format”, CHISA 2000 - 14th International Congress of Chemical and Process Engineering, 27-31 August, Praha, Czech Republic, 12p, 2000.
[5] Y. O. Devres and G. Bingöl, “Psychrometric properties of humid air : calculation procedures and interactive education in Java supported web browser format with real-time/online assignment grading module”, ICR2003 - 21st International Congress of Refrigeration, 17-22 August, Washington DC, USA, ICR0315, 8p, 2003.
[6] Y.O. Devres, “Psychrometry”, in Dehydration of Products on Biological Origin, A.S. Mujumdar (Editor), Science Publishers, Inc., Enfield, NH, USA, Chapter 3, pp. 43-92, 2004.
[7] Y. A. Cengel and M. A. Boles, Thermodynamics: An Engineering Approach, translated to Turkish by Taner Derbentli, 2nd ed., McGraw-Hill, New York, 867p, 1996.
[8] Y. A. Cengel and M. A. Boles, Thermodynamics: An Engineering Approach”, 4th ed., McGraw-Hill, New York, 930p, 2002.
[9] J.P. Holman, Heat Transfer, 8th Edition, McGraw-Hill International Editions, 696p.
[10] K. L. Norman, Teaching in the Switched On Classroom: An Introduction to Electronic Education and HyperCourseware, Department of Psychology and the Human/Computer Interaction Laboratory, University of Maryland, USA, http://www.lap.umd.edu/SOC/sochome.html., 1997.
[11] Y. O Devres, G. Bingöl and T. Duran, “E-education? Let's start tomorrow!”, Academic Informatics Conferences, Çukurova University, February 3-5, Adana, 11p, 2003.
[12] M. Veermans and D. Cesareni, “The nature of the discourse in web-based collaborative learning environments: case studies from four different countries”, to be published in Computers & Education, 21p, 2005.
[13] S. R. Goldman, C. MayWeld-Stewart, H. V. Bateman and J. W. Pellegrino, “The cognition and technology group at Vanderbilt”. Environments that support meaningful learning. In L. Hoffman, A. Krapp, & K. A. Renniger (Eds.), Interest and learning: proceedings of the Seeon conference on interest and gender, pp. 181–196, Kiel, Germany, 1998.
[14] S. Järvelä, K. Hakkarainen, E. Lehtinen and L. Lipponen, “Creating computer-supported collaborative learning (CSCL) culture in Finnish schools: research perspectives on sociocognitive effects”, International Journal of Continuing Engineering Education and Life-Long Learning, vol. 11, pp. 365–374, 2001.