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Full Length Article

A web aided education model that can be used in power electronics course

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ABSTRACT

In this study, the effect of web based power electronics courses on the success of electrical engineering candidates was examined. The participants are consisted of daytime education (30) and evening education (42) students who attended the "Power Electronics" course. First, groups were randomly assigned as experimental and control groups and experimental group and control group were examined according to the students' GPAs, university entrance exam results, academic grades depending on 8 different lectures related with power electronics.

According to the results obtained from validity and reliability of Power Electronics Course Achievement Test, the total correlation values and the standard deviation values of Power Electronics Course Achievement Test were between .301–, .598 and between .304–, .506, respectively. In addition, KR20 coefficient was found as 0.844. Before application of the "Power Electronics Course Achievement Test", there was not a significant difference in total scores of both daytime and evening education students. Although students received Web-Based Education and Web Aided Education were selected as experimental group, the students received "Traditional Education" were selected as control group. After the application, significant differences between the total grade points of both experimental and control groups of daytime education and evening education students were detected.

1. Introduction

The rapid development in technology enriches the academic environment and offers different alternatives. The academic achievement of these alternatives turns the direction of traditional education to web aided education. Transferring theoretical knowledge into web aided educational model and the enrichment of web aided education are now possible applications. The academic benefits of web aided models took academic attention academicians from different fields of science so model studies for implementation have been increased. Very successful applications in science fields such as engineering, science and technical education are available today [1–4].

It is hardly difficult to fulfill practice courses on Technical Education and on Engineering through distance learning technology. Therefore it is a field that has to be examined very carefully. Despite its difficulties when the advantages are taken into account web aided models have potential to increase students success in technical education [3,5–8]. So web aided application of a course in technical education field and the effect of the model on academic success are examined. Today enriching the educational programs provided by using distance learning technology makes it easier to give practice courses appropriately through distance learning technology. Providing practical courses appropriate with distance learning technology has great advantages for researchers, academicians, students and educational institutions.

Advantages of web based education versus traditional educational are as follows [3,5,9–20].

Students have the opportunity to repeat the courses they choose any time they wish.

There will not be any difference among the students from different branches or groups regarding the source of education (teacher) and this will lead to learning equality in general. For example, in case of lectures from different teaching assistants from different branches, some students may complain about the teaching style of the assistant and may state that they are less lucky than other students.

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Control of the learning is completely in students' hands. Students try to learn according to their own detection pace and intelligence level and acquire the responsibility for self-learning.

Students can access the needed lecture notes and other sources of the field immediately.

Evaluation and observation of student learning will be done in computer environment more easily and centrally in a short time.

There is no space and time problem. Where there is access to computer and internet the education can take place anytime and anywhere.

Web based education is more convenient in terms of cost when compared to traditional learning. It can be seem at high cost at first. However, it is highly economical in terms of using the same material many times with same quality.

The content of the education can be revised parallel to the technological development and can easily be updated.

Considering the advantages above, in this research increasing traditional education quality by using different educational models was examined and two models were designed. In the study, model used for traditional education (TE 1) and two different education models (WBE 1 and WAE 1) on web based platforms were used and "power electronics" course for junior students in Faculty of Technical Education, Teacher Training in Electrical Works Department was selected. At the end of the application the effects of these two different models on students' academic achievement was examined.

The experiment group of the study received the web based and web aided education programs. There were 48 students in the experiment group. The control group of the study continued taking the traditional education model. Control group consisted of 24 students.

The research is an experimental study and used two group pretest posttest research model. For this purpose the following hypothesis were tested in the study.

No significant difference was found between pretest scores of experimental and control groups.

There is no significant difference between the pretest and posttest scores of experiment group.

There is a significant difference between posttest scores of experimental and control group in favor of experimental group.

It is possible to see many distance learning models in the field of education in Turkey in recent years [4,21–34]. Most of these studies have a technological structure rather than being education oriented. Effectiveness and efficiency of the programs are discussed in general with these researches. Therefore a lot of research needs to be done in the field. Among these studies, stating steps and rules that must be fulfilled to prepare educational programs through a scientific method, laying out the missing, incorrect and correct sides of the design after evaluations done with ideal and scientific criteria and showing the effect on academic achievement can be the significance of this study.

2. Method

2.1. Research design

The research is designed as an experimental study. There were multiple groups (experimental and control) and random assignment was used to form these groups. So a pretest–posttest control group model was chosen (Karasar, 2012). "Effectiveness of Interactive Aided Education Program of Web Based Designed Power Electronics Course" is given to the experimental group and "Power Electronics" course in undergraduate program was given to control group.

2.2. Study group

Study group of the research consisted of male junior students studying at Faculty of Technical Education, Teacher Training in Electrical Works Department. %41.7 of the study group was day time education students and %58.3 was evening education students. The distribution of the students regarding their high schools were Industrial Vocational High School was %38.9, Technical Vocational High School was %33.3, Anatolian Vocational High School was %22.2, regular high school was %1.4 and others were %4.2.

As seen in the Table 1, there were totally 72 students; 48 were in the experimental group and 24 were in the control group. Experimental 1 group received the program prepared through web based training platform. Experimental 2 was supported with program prepared through web based training program as well as the traditional education. Control group received only traditional education. Basic knowledge of the experimental and control group was tested before the study (pretest) and it was found out that they were at the same level.

2.3. Data collection tools

2.3.1. Demographic form

Demographic form used in this study was developed by the researcher and consisted of eight questions determining the gender, type of education, type of secondary education, for how long s/he uses computer, where he learned using internet and computer, daily average internet usage, group type in the study and review of the courses.

2.3.2. Power electronics course achievement test

"Power Electronics Course Achievement Test", which was designed by the researcher, was used to support Power Electronics Course Education Program and identify the effectiveness of the program. The test consisted of 60 items. Result of the analysis for validity and reliability study of "Power Electronics Course Achievement Test" total correlation values were between .301 and .598, standard deviation values were between .304 and .506 and K20 coefficient was found 0.844.

2.3.3. Web based education platform

It is a platform designed by the researcher to carry out and support the education program given to the web based and web aided education groups in the experimental group. The platform provided the opportunities of not only synchronous training providing online classroom environment but also repeating the whole lesson with asynchronous training. At the same time more comprehension of the course content issues with the help of interactive audiobooks including theoretical knowledge was supported.

Table 1
Group types.

Type of Education	Group Type	Groups	N
Daytime Education	Experimental 1	Web Based Education (WBE I)	10
	Experimental 2	Web Aided Education (WAE I)	10
	Control	Traditional Education (TE I)	10
Type of Education	Group Type	Groups	N
Evening Education	Experimental 1	Web Based Education (WBE I)	14
	Experimental 2	Web Aided Education (WAE I)	14
	Control	Traditional Education (TE I)	14

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3. Findings

Findings of the study designated within the framework of the hypothesis determined in accordance with the research question are listed below.

3.1. Findings for pretest results of experimental and control groups' total scores on "power electronics course achievement test"

When the Kruskal Wallis H Test results of "Power Electronics Course Achievement Test" pretest scores of both daytime and evening education students who are in web based education, web aided education and traditional education groups are examined, it was found out that there was not a meaningful difference between the students' "Power Electronics Course Achievement Test" total scores in experimental and control group before the application (Daytime Education; X2 = 2926, p > .05 and Evening Education; X2 = 1244, p > .05). Because the basic information of this course is similar, it has been started to test the web based and web aided program developed in the study.

3.2. Findings for posttest results of experimental and control groups' total scores on "power electronics course achievement test"

When Table 2 was examined, it was seen that as a result of Kruskal Wallis H Test, day time education students' "Power Electronics Course Achievement Test" total scores showed a significant difference after the application (X2 = 7720, p < .05).

As shown in Table 3, it was found out that there is a significant difference between "Power Electronics Course Achievement Test" total score of the students who received Web Based Education in experimental group and the students who received traditional Education in the control group (U = 19,000, p < .05). When examining mean squares it was seen that the resulting difference was in favor of the group who received web based education.

As shown in Table 4, it was found out that there is a significant difference between "Power Electronics Course Achievement Test" total score of the students who received Web Aided Education in experimental group and the students who received traditional Education in the control group (U = 18,000, p < .05). When examining mean squares it was seen that the resulting difference was in favor of the group who received web aided education.

When Table 5 was examined, it was seen that as a result of Kruskal Wallis H Test, evening education students' "Power Electronics Course Achievement Test" total scores showed a significant difference after the application (X2 = 10,640, p < .05).

As shown in Table 6, it was found out that there was a significant difference between "Power Electronics Course Achievement Test" total score of evening education students who received Web Based Education in experimental group and the students who received traditional Education in the control group (U = 36,000, p < .05). When examining mean squares it was seen that

Table 2
Kruskal Wallis H test results of "power electronics course achievement test" posttest scores of daytime education students who are in web based education, web aided education and traditional education groups after the application.

Group Type	Groups	N	SO	X2	Sd	P
Experiment 1	Web Based Education I	10	18.50	7720	2	.021*
Experiment 2	Web Aided Education I	10	18.80			
Control	Traditional Education I	10	9.20			
	Total	30				

* p < .05.

Table 3
Mann Whitney-U test posttest results of "power electronics course achievement test" total scores according to experimental (WBE I) and control group variable.

Group	N	KO	KT	U	Z	P
WBE I	10	13.60	136.00	19,000	−2346	,019*
TE I	10	7.40	74.00			
Total	20					

* p < .05.

Table 4
Mann Whitney-U test posttest results of "power electronics course achievement test" total scores according to experimental (WAE I) and control group variable.

Group	N	KO	KT	U	Z	P
WAE I	10	13.70	137.00	18,000	−2426	.015*
TE I	10	7.30	73.00			
Total	20					

* p < .05

Table 5
Kruskal Wallis H test results of "power electronics course achievement test" posttest scores of evening education students who are in web based education, web aided education and traditional education groups after the application.

Group Type	Groups	N	SO	X2	Sd	P
Experimental 1	Web Based Education II	14	26.57	10,640	2	.005**
Experimental 2	Web Aided Education II	14	25.07			
Control	Traditional Education II	14	12.86			
	Total	42				

** p < .01.

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Table 6
Mann Whitney-U test posttest results of "power electronics course achievement test" total scores according to experimental (WBE II) and control group variable.

Group	N	KO	KT	U	Z	P
WBE II	14	18.93	265.00	36,000	−2861	.004**
TE II	14	10.07	141.00			
Total	28					

** p < .01.

the resulting difference was in favor of the group who received web based education.

As shown in Table 7, it was found out that there was a significant difference between "Power Electronics Course Achievement Test" total score of evening education students who received Web Aided Education in experimental group and the students who received traditional Education in the control group (U = 39,000, p < .05). When examining mean squares it was seen that the resulting difference was in favor of the group who received web aided education.

3.3. Findings for pretest and posttest results of experimental and control groups' total scores on "power electronics course achievement test"

According to Table 8, there was a significant difference between pretest (X = 15.60; ss = 7.02) and posttest (X = 80.60; ss = 8.39) "Power Electronics Course Achievement Test" scores of the daytime students who received web based education during power electronics course (z = 2807, p < .05). When average rank/sequence and total of the points of difference are taken into account the observed difference was in favor of positive ranks in other words the posttest score. There was a meaningful difference between pretest (X = 19.50; ss = 8.80) and posttest (X = 86.78; ss = 4.40) "Power Electronics Course Achievement Test" scores of the evening education students who received web based education during power electronics course (z = 3297, p < .05). When average rank/sequence and total of the points of difference are taken into account the observed difference was in favor of positive ranks in other words the posttest score.

According to Table 9, there was a significant difference between pretest (X = 10.30; Ss = 7.28) and posttest (X = 80.90; Ss = 9.37) "Power Electronics Course Achievement Test" scores of the daytime education students who received web aided education during power electronics course (z = 2807, p < .05). When average rank/sequence and total of the points of difference are taken into account the observed difference was in favor of positive ranks in other words the posttest score. There was a significant difference between pretest (X = 18.85; Ss = 9.67) and posttest (X = 86.35; Ss = 4.37) "Power Electronics Course Achievement Test" scores of the evening education students who received web aided education during power electronics course (z = 3299, p < .05). When average

Table 7
Mann Whitney-U test posttest results of "power electronics course achievement test" total scores according to experimental (WAE II) and control group variable.

Group	N	KO	KT	U	Z	P
WAE II	14	18.71	262.00	39,000	−2722	.006**
TE II	14	10.29	144.00			
Total	28					

** p < .01.

Table 8
Wilcoxon signed-rank test results of "power electronics course achievement test" scores of the daytime and evening education students who received web based education before and after the application.

Education Type	Pretest-Posttest	N	SO	ST	Z	P
Daytime Education	Negative Rank	0	.00	.00	2807	.005**
	Positive Rank	10	5.50	55.00		
	Equal	0				
Evening Education	Negative Rank	0	.00	.00	3297	.001**
	Positive Rank	14	7.50	105.00		
	Equal	0				

** p < .01.

Table 9
Wilcoxon signed-rank test results of "power electronics course achievement test" scores of the daytime and evening education students who received web aided education before and after the application.

Education Type	Pretest-Posttest	*N*	*SO*	*ST*	*Z*	*P*
Daytime Education	Negative Rank	0	.00	.00	2807	.005**
	Positive Rank	10	5.50	55.00		
	Equal	0				
Evening Education	Negative Rank	0	.00	.00	3299	.001**
	Positive Rank	14	7.50	105.00		
	Equal	0				

** p < .01.

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Table 10
Wilcoxon signed-rank test results of "power electronics course achievement test" scores before and after the application for the daytime and evening education students who received traditional education.

Education Type	Pretest-Posttest	N	SO	ST	Z	p
Daytime Education	Negative Rank	0	.00	.00	2805	.005**
	Positive Rank	10	5.50	55.00		
	Equal	0				
Evening Education	Negative Rank	0	.00	.00	3297	.001**
	Positive Rank	14	7.50	105.00		
	Equal	0				

** $p < .01$.

rank/sequence and total of the points of difference are taken into account the observed difference was in favor of positive ranks in other words the posttest score.

According to Table 10, there was a significant difference between pretest (X = 15.60; ss = 8.54) and posttest (X = 66.80; ss = 15.12) "Power Electronics Course Achievement Test" scores of the daytime education students who received traditional education during power electronics course ($z = 2805$, $p < .05$). When average rank/sequence and total of the points of difference are taken into account the observed difference was in favor of positive ranks in other words the posttest score. There was a significant difference between pretest (X = 23.07; Ss = 8.24) and posttest (X = 75.78; Ss = 11.19) "Power Electronics Course Achievement Test" scores of the evening education students who received traditional education during power electronics course ($z = 3297$, $p < .05$). When average rank/sequence and total of the points of difference are taken into account the observed difference was in favor of positive ranks in other words the posttest score.

When the findings on the program applied to experimental group by using Power Electronics Course web based education, it can be said that the program applied to experimental group had an effect on increasing academic achievement of students.

4. Discussion

It was seen that the findings of the research were parallel to the related literature. Web-based software applications had been found to be useful in many other works, as in this study. [4,7,21–43]. It can be stated that there is a need for environments arranged with the help of web based and web aided education approaches whose productivity is proved by many researches like this one. Anderson, in his research which he used single sample pretest posttest experimental model in 2000, showed that web based education programs are effective on student success. Arıkan [22], thought his lessons with web based effective learning applications to students in Computer Networks and Communication course and at the end of the research, results obtained by the analysis of data on achievement test showed that web based effective learning applications were more effective on student success when compared to traditional classroom teaching.

In another research, Arslan [23] examined the usage of web based learning platform MOODLE in "German as a Foreign Language" teaching with prep students and the contribution to students' learning process, especially to writing abilities. According to research results, with the web aided learning platform MOODLE it was found out that especially activities for developing the skills of written expression, there was a positive effect on success in examinations testing learning outcomes. Similarly, Biber [24] in his research provided special education support by using web environment to students receiving inclusive education in regular education classrooms. It provided to students carrying learning packages independently from time and space and fulfilling the learning units from known to unknown, from concrete to abstract, from simple to complicated according to their own pace and level. Looking at the research results, it was concluded that giving special education support with web aided teaching methods on students with special needs increased students' academic achievement and performance. In another study conducted by Cavanaugh and friends [7], in Educational Technology Course the sample was divided into three different homogenous groups; face to face, online and semi online. At the end of the education it was observed that educational technology skills of the mixed group was significantly higher than other groups. Similarly Çakır [25], examined the effect of web aided education and computer aided education on students success in Trafic Education course prepared for elementary education students. In light of the obtained results, students in web aided education group learned better in Trafic Education Course than the students in computer aided education group.

For another study, Çetin [26], conducted a research for Basics of Information Technology and examined the effect of web aided education system and traditional education system on student success and he stated that there was a significant difference between experimental group who received web aided education system and control group who received traditional education system. It was found out that posttest achievement score average of experimental group was meaningfully higher than the control group. Likewise, Ekinci [27], used traditional education model supported by web aided educational model in his thesis research for students, who study in vocational and technical secondary education institutions, to acquire professional career skills and examined the effect of student success. As a result of statistical comparisons based on data obtained with achievement test, it was found out that traditional education system supported with web aided education showed more significant difference than completely traditional education model.

Filiz [28], found out that the softwares prepared for the study " The Effect of Using Geogebra and Cabri Geometry II Dynamic Geometry Softwares on Students Success in Web Aided Environments", achieved more effective learning in students who worked with web aided materials than students who received traditional education. Similarly, Kenanoğlu in his research conducted in 2008, examined the effect of web based distance education systems on students success in Information and Communication Technologies Course. After the statistical comparisons based on data obtained with achievement test, access points of the group that applied web aided education methods were significantly higher than the group applied traditional education methods. In another study in 2002, Khalifa and Lam examined the relative effectiveness of two different types of web based learning environments; distributed interactive learning environments and distributed passive learning environments. According to the results of the experimental study, distributed interactive learning was superior to distributed passive learning in terms of learning process and learning outcomes.

Likewise, Kucuksuleyman [30], studied usage of Virtual Polarized Microscope Applications in his research and interviews for

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the evaluation of the web aided learning environments were made with students chosen with sampling method. It was concluded that the web aided education environment which was developed according to the responses received, was appropriate for the students' level, motivating, instructive and had an effect of increasing academic success. In another study conducted, in the content of web based education developed by Lesh and his friends [37], a platform including e-mail discussion board and learning via phone was developed. When the research findings were examined it was seen that web based education effected student success positively. In their research conducted in 2005, Pucel and Stertz compared web based and traditional education courses given to technical education teachers for in-service and career purposes. When the findings are examined it was reported that almost half of the students spent more time in web based courses than traditional courses. The difference between two groups was statistically significant.

In another study conducted in 1997, Schutle lectured the social statistics course to student sample with traditional and web based distance learning. As a result of the application it was detected that students who received web based distance learning were more successful than students who received traditional education. In Scachar and his friends' [41] *meta*-analysis which scanned the researches between 1990 and 2002, academic success of traditional education courses and distance learning courses were compared. As a result of 86 experimental and quasi experimental researches conducted on distance learning and *meta*-analysis done with 15,000 participant students it was stated that distance learning was effective in providing information. Participation criteria, *meta*-analysis and effect sizes clearly revealed that; two-thirds of distance education students were more successful than their peers in traditional learning environments.

Tekmen [31], in secondary education physics course, examined the effect of web aided education system on student's access, attitudes towards the course and permanence. As a result of an experimental study, with a physics course held with web aided education a significant difference in favor of the experimental group was found when comparing the average scores of comprehension, application level access, total access, level of information and total average permanence of the experimental group and application level access of the control group who received traditional education.

Thirunarayanan and his friends [42] compared student success in teaching English to speakers of other languages in traditional education system and other suggested web based training system. Students receiving web based education got a lower pretest score when compared to students receiving traditional education. However, according to the posttest, with the *t*-test analysis showed that there was a significant increase among students in two groups in terms of achievement. According to this result it can be said that students with web based education were more successful than students with traditional education. Similarly, Tosun, in his research in 2011, examined whether web based environment that provides students repeating and practicing according to their own pace, created a significant change in student success in Information Technology in Education I course. According to the research results it was found out that while improving students' academic achievement in the training given to both groups, web-aided education given to the experimental group increased students' success significantly when compared to the traditional education in the control group.

Tucker [43] compared web aided and campus based education in business communication course in his research. Pretest before the course and posttest and a final examination after the course was applied and there was not a significant difference between pretest and graduation rate averages. However, in the final examinations there was a significant difference in favor of web based education students. However, these results showed that the older students tend to be more successful. Similarly, Uzunboylu [34], studied the relationship between attitudes towards computer and learning levels of students taking computer lessons in schools in Turkish Republic of Northern Cyprus. When the data obtained from the research was analyzed, it was seen that students' web aided learning levels was not at the desired levels but was found to be at low levels. Also, according to certain variables a significant difference was found in students' computer learning levels. In his another research Uzunboylu [33] examined English grammar practices and stated that English grammar achievement of experimental group who applied web aided education was higher than the control group who applied traditional education.

5. Results

It was seen that there was not a significant difference between the "Power Electronics Course Achievement Test" total scores of daytime education students in both experimental and control group before the application and an experimental study was initiated. In addition, similarly there was not a significant difference between the "Power Electronics Course Achievement Test" total scores of evening education students in both experimental and control group before the application.

It was found out that there was not a significant difference between "Power Electronics Course Achievement Test" total scores of daytime education students in experimental group who received web based and web aided education and evening education students in experimental group who received web based and web aided education. In line with the results obtained in the study it is possible to express that both daytime education and evening education students in experimental group equally benefitted the web based and web aided education applications prepared for Power Electronics Course.

It was determined that there was a significant difference in "Power Electronics Course Achievement Test" total scores between daytime education students in experimental group who received web based and web aided education and daytime education students in control group who received traditional education. It was seen that the resulting difference was in favor of the groups who received web based education and web aided education. Parallel to these results, it was found out that there was a significant difference in "Power Electronics Course Achievement Test" total scores between evening education students in experimental group who received web based and web aided education and evening education students in control group who received traditional education. The difference was in favor of the groups who received web based and web aided education.

It was seen that there was a significant difference between pretest and posttest scores of daytime education students who received traditional education during Power Electronics Course and this observed difference was in favor of posttest scores. Also again in the process of giving Power Electronics Course it was found out that there was a significant difference between pretest and posttest scores of evening education students who received traditional education and this difference was in favor of posttest scores. According to these results, applied traditional education practices had an effect on increasing groups' success in Power Electronics education Course.

It can be stated that educational environments arranged with technology integrated education approaches like web based and web aided education as well as traditional education approach effect student success positively. In the conducted study finding results on student success in favor of students who received web

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based and web aided education strength our claim of prepared program is effective. Also one of the reasons for not finding significant difference between the effect of traditional education and programs prepared with web based and web aided support can be explained with differences in study group, implementation period of the program, software differences in preparation of the program and differences between the researchers.

6. Suggestions

Research findings showed that web-based instruction is effective on the academic achievement of the students so web-based and web-aided program applications as well as traditional education approaches can be included into educational institutions. As a result of this study it was found out that two applied models over the web tested, was more effective than traditional education in course achievement. Web based and web aided prepared "Power Electronics Course" can be applied in different universities for different courses and the obtained results can be compared.

It can be suggested that educationists who can use technology effectively can arrange their disciplines in which they are expert according to web based and web aided methods.

Results of the study show that program applied in the research can be used effectively by distance education professionals.

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