Heuristic Evaluation and Usability Testing: Case Study

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Abstract. The goal of this user centered design (UCD) study was to to identify usability issues on the Boğaziçi University Industrial Engineering (BUIE) department website user interface (UI) and also to provide a re-design guideline for the website. In this context, the website was evalauted via using heuristic evaluation, remote usability testing, and post-test questionnaire methods. Every single screen of the BUIE website was evaluated, and design problems along with associated severity rankings were determined. Based on the heuristic evaluation findings, various task scenarios were created for the remote usability testing study. Four diffferent user groups were identified for the study: high school students, BUIE undergraduate students, BUIE Graduate students/academic staff, and other university students. The users were asked to perform tasks relavant to the group characteristics and expectations related to the website. Their performance were evaluated in terms of task completion success rate, number of clicks, and time spent till either accomplishment, failure, or quittance by a remote usability testing tool, Loop11. A post user testing questionnaire was also administered online where the user subjective rating data were collected for each task in terms of ease of use. The results indicated numerous UI design issues, as confirmed by both heuristic and usability testing methods. Further redesign study is required to implement the results of this sudy in order to enhance the ease of use of the BUIE department website.

Keywords: Heuristic Evaluation, Usability Test, User-Centered Design, Web Design.

1 Introduction

In the information era, a college web site is one of the most important tools for different user groups, including current college students, academic staff, prospective students and other college students. And, most often the users do not visit the website frequently unless it is a registration time, college application time or student transfer time of the year. Thus there is no learning factor of using a college department web site. Designing a web site for different user groups with different user needs and background is a challenge for the web site designers [1][2][6]. And, designing for different user groups is one of the most important factors that needs to be considered in order to ensure an ease of use of a website. In addition, the frequency of a website

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usage is another important factor and needs to be considered for ease of use [1][2][6] because the learning factor cannot be counted into account if a website is not used frequently. Those two important facts need to be considered for a successful web site design.

This project started with the fact that there has been a known negative user experience of BUIE department website. Recently, the website was degraded negatively in terms of ease of use by the undergraduate students in a student survey. The student group stated that the website needs to be redesigned. Then, a UCD project was initiated by the human factors professor at BUIE department, and it was assigned to three undergraduate students as a senior graduation project. The project plan including the deliverables, schedule and resources was prepared by the professor and it was implemented by the students in fall 2010 semester.

In this paper, it was illustrated what UCD methodologies were used, how they were used, what type of data were collected, how data was analyzed, and how the analyses results can be utilized to redesign the BUIE department website to enhance user experience.

2 Objectives

The objectives of this user-centered design (UCD) study were:

- Identifying high-level UI design issues about the web site by conducting a heuristic evaluation
- Conducting a usability study to identify the details about the high-level issues found by the heuristic evaluation for different user groups
- Providing solutions for the identified usability issues discovered by the usability tests sessions

3 Methodology

This UCD study was assigned to a group of senior undergraduate students of industrial engineering as a graduation project. The students chose their department's web site; because of the fact that this website is the most commonly used one amongst both undergraduate and graduate students, faculty members and prospective students from other universities and high schools. The usability of this web site is very important in order to meet the needs of these different user groups.

First, a heuristic evaluation was conducted in order to identify high level usability issues via using both "Research-Based Web Design and Usability Guidelines" of U.S. Department of Health and Human Services [2] and Nielsen´s [3] heuristic evaluation principles. However, [2] was used as the primary resource. The BUIE website was evaluated using 129 of 209 of these usability guidelines. Every single window of of the BUIE website was evaluated, and design problems along with associated severity rankings were determined. Heuristic evaluation was performed by three senior undergraduate students who were familiar with the website and somewhat knowledgeable about usability principles. Based on the results of this evaluation, the usability test scenarios were created. The following heuristics were the major ones

considered while creating usability test scenarios:

- Ensure that necessary information is displayed
- Group related elements
- Match link names with their destination pages
- Avoid misleading cues to click
- Design for working memory limitations
- Place important items at top center
- Structure each content page to facilitate scanning
- Use scrolling pages for reading comprehension

The test scenarios were implemented by using Loop11, www.loop11.com, a remote usability testing tool. The users were not moderated during the usability test sessions. The user data were collected and analyzed by the Loop11 tool automatically.

3.1 Participants

Four groups of users were selected for the study: 1) high school students who are potential candidate students for the BUIE department, 2) BUIE undergraduate students, 3) BUIE graduate students/academic staff, and 4) other university students. A total of 115 users participated in the study. User testings were performed remotely using loop11. The users in each of the four groups were asked to perform tasks relavant to the group characteristics and expectations related to the website.

Table 1. User Groups and number of participants

User Group	Number of Users
High School Students	15
Other University Students	47
BUIE Undergraduate Students	24
BUIE Graduate Students & Academic Staff	29
Total	115

The demographic breakdown of the participants was as follows:

Table 2. Gender distribution accros user groups

	Undergrad	Graduate	Other University	High School	Total
Male	13	15	21	5	54
Female	11	14	26	10	61

Table 3. Frequency of internet usage

	Undergrad	Graduate	Other University	High School	Total
More than 8 hr a day	3	8	13	-	24
More than 4 hr a day	12	13	17	7	49
More than 1 hr a day	7	5	15	5	32
Daily	2	3	2	2	9
Weekly	-	-	-	1	1

3.2 User Testing

After design and approval of the pre-task, task and post-task evaluation questions, pilot studies conducted with two users who are counted as expert users for each category. In this manner, we observed real-time reflections of the users towards the tasks. We traced performances of pilot users while they complete each stage of the evaluation process and noted problems faced. We faced some minor errors in the tasks that could lead the users to ambiguity or misunderstanding. After correction of wording or other miscellaneous problems faced during pilot studies, we agreed on appropriateness of tasks uploaded to the Loop11 test environment and sent links to the participants by email.

Before the usability test questions, the participants were asked several pre-task questions about demographics, frequency of internet usage and their website usage purposes.

During the test, the high school students performed the following five tasks:

1. Please find information about the definition of Industrial Engineering and its fields. *Guideline 16.3: Ensure that necessary information is displayed [2].*
2. Please find the communication information (phone number and e-mail) of the department. *Guideline 16.3: Ensure that necessary information is displayed [2].*
3. You are a successful high school student and want to get more information about the Department. Please find the Department Leaflet. *Guideline 16.4: Group related elements [2]. Guideline 10.3: Match link names with their destination pages [2].*
4. Please find the descriptions of the courses given in Industrial Engineering. *Guideline 16.3: Ensure that necessary information is displayed [2].*
5. Please find the internships that Industrial Engineering students are supposed to fulfill? *Guideline 10.4: Avoid misleading cues to click [2].*

During the test, the students from other universities performed the following five tasks in Turkish language:

1. You are a student at a university in Turkey and want to get graduate education in Boğaziçi University, Industrial Engineering. Please find the minimum grade point average to apply. *Guideline 10.4: Avoid misleading cues to click [2].*
2. You want to transfer to Boğaziçi University, Industrial Engineering. Please find the transfer requirements. *Guideline 10.4: Avoid misleading cues to click [2].*
3. Please find the descriptions of the courses given in graduate program in Industrial Engineering. *Guideline 10.3: Match link names with their destination pages [2].*
4. Please find the communication information (phone number and e-mail) of the Department. *Guideline 16.3: Ensure that necessary information is displayed [2].*
5. You want to get graduate education in Boğaziçi University, Industrial Engineering. Please find the general application conditions of Boğaziçi University in the Departmental website. *Guideline 16.3: Ensure that necessary information is displayed [2].*

During the test, the BUIE undergraduate students performed the following ten tasks:

1. You are interested in Flexible Automation. Please go to the website of the related laboratory. *Guideline 10.4: Avoid misleading cues to click [2].*
2. You want to call the chairman of IE department. Find his/her phone number. *Guideline 2.5: Design for working memory limitations [2.]*

3. Find the link to Office of International Relations website to get information about Erasmus or Exchange. *Guideline 10.4: Avoid misleading cues to click [2].*
4. You are interested in searching academic staff and want to know which courses are given by an IE Professor, namely Prof. Dr. Barbarosoğlu. Find the courses given by her. *Guideline 10.4: Avoid misleading cues to click [2].*
5. You heard that Boğaziçi University Industrial Engineering Dept. has a research group called "Quantitative Finance Research Group". Please go to the webpage of the Group. *Guideline 10.4: Avoid misleading cues to click [2].*
6. Please go to related information page to see if you can get PSY 101 as an HSS elective. *Guideline 16.2: Structure each content page to facilitate scanning [2].*
7. You finally graduated from BU-IE. Find the Alumni list of the IE Department to stay in touch with peers. *Guideline 10.4: Avoid misleading cues to click [2].*
8. You want to call Instructor Dr. Yasemin Aksoy to get detailed information about an elective course. Find her phone number. *Guideline 16.4: Group related elements. Guideline 2.5: Design for working memory limitations [2].*
9. You have heard that Dr. Suat Genç is a very successful instructor. Find out if he has any undergrad courses available as an elective course. *Guideline 16.4: Group related elements [2].*
10. Find the list and descriptions of IE-Elective courses you may take during your undergraduate education. *Guideline 16.2: Structure each content page to facilitate scanning [2].*

During the test, the BUIE graduate students and academic staff performed the following eight tasks:

1. You are interested in Flexible Automation. Please go to the website of the related laboratory. *Guideline 10.4: Avoid misleading cues to click [2].*
2. You want to call the chairman of IE department. Find his/her phone number. *Guideline 2.5: Design for working memory limitations [2.]*
3. Find the link to Office of International Relations website to get information about Erasmus or Exchange. *Guideline 10.4: Avoid misleading cues to click [2].*
4. You are interested in searching academic staff and want to know which courses are given by an IE Professor, namely Prof. Dr. Barbarosoğlu. Find the courses given by her. *Guideline 10.4: Avoid misleading cues to click [2].*
5. You heard that Boğaziçi University Industrial Engineering Dept. has a research group called "Quantitative Finance Research Group". Please go to the webpage of the Group. *Guideline 10.4: Avoid misleading cues to click [2].*
6. Find the academic program of Masters Degree education in IE. *Guideline 16.2: Structure each content page to facilitate scanning [2].*
7. Find the syllabus of the course IE 544. *Guideline 10.3: Match link names with their destination pages [2]. Guideline 10.4: Avoid misleading cues to click [2].*
8. You are interested in Master or Doctorate theses reports by IE students. Find the list of these theses reports. *Guideline 8.3: Use scrolling pages for reading comprehension [2].*

After each task performed, the participants rated the ease of use of each task using a Likert scale (-3 -2-1 0 1 2 3; where -3 corresponds to "very difficult", 3 corresponds to "very easy" and 0 corresponds to "neutral").

In addition, the participants answered 13 subjective evaluation questions to rate the usability of the website on a Likert scale (-3 -2 -1 0 1 2 3; where -3 corresponds to "strongly disagree", 3 corresponds to "strongly agree" and 0 corresponds to "neutral") and were asked open-ended questions about their experience with the web interfaces.

Loop11 is used to obtain the descriptive statistics of the collected task data and Google Docs is used to obtain the collected usability rating data of the website from the four participant groups.

3.3 Collected Data and Analyses

Task completion time, task completion success rate and number of clicks were recorded for each task and participant. Effects of three factors (user group, gender and internet usage) on two response variables (success rate and task completion time) were investigated with Analysis of Variance (ANOVA) and Tukey's multiple comparison tests using Minitab statistical package. For all comparisons, $p \leq 0.05$ were accepted as statistically significant, and $0.05 < p \leq 0.1$ were accepted as marginal.

High school students' data were not included in the analysis, since there are so few data on this group.

4 Results

Mean task completion rates for each user group are shown in Fig. 1. BUIE graduate students and academic staff completed the tasks with a success rate of 86% and all other groups completed the tasks at the success rate of less than 58%. Table 4 and Table 5 depict the success rate and task completion times separated by gender, respectively. As it can be seen BUIE undergraduate and graduate/staff groups took less time to complete the tasks compared to the group of students from other universities. Table 6 and Table 7 show the success rate and task completion time with respect to groups separated by internet usage factor, respectively.

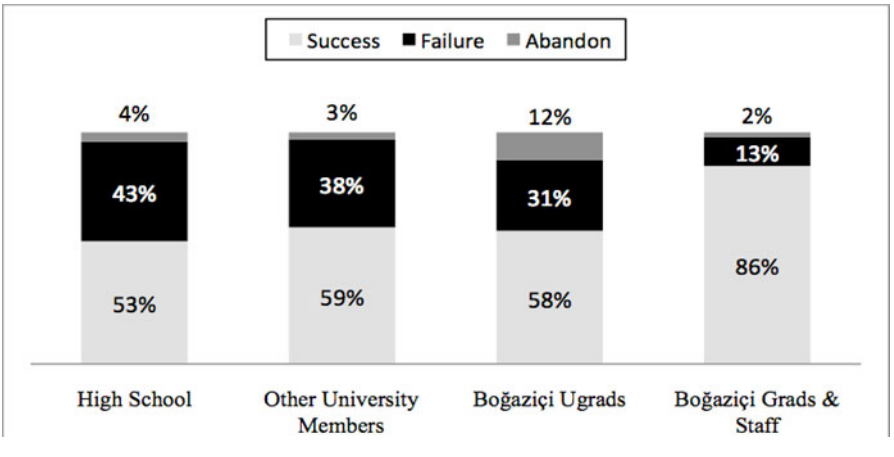

Fig. 1. Task completion rate for each user group

Table 4. Mean success rate % for each user group seperated by gender

	Male	Female
Undergraduate	55 (N=13)	56 (N=11)
Graduate and staff	88 (N=15)	83 (N=14)
Other universities	49 (N=20)	60 (N=23)

Table 5. Mean task completion time (sec) for each user group seperated by gender

	Male	Female
Undergraduate	37.09 (N=13)	37.63 (N=11)
Graduate and staff	28.67 (N=15)	32.16 (N=14)
Other universities	50.36 (N=20)	73.99 (N=23)

Table 6. Mean success rate % with respect to internet usage for each user group

	8+ hr	4+hr	1+hr	Daily
Undergraduate	36 (N=3)	60 (N=12)	52 (N=7)	65 (N=2)
Graduate and staff	78 (N=8)	85 (N=13)	95 (N=5)	91 (N=3)
Other universities	56 (N=12)	63 (N=17)	43 (N=12)	40 (N=2)

Table 7. Mean task completion time (sec) with respect to internet usage for each user group

	8+ hr	4+hr	1+hr	Daily
Undergraduate	40.33 (N=3)	33.35 (N=12)	44.35 (N=7)	32.20 (N=2)
Graduate and staff	28.29 (N=8)	28.87 (N=13)	35.45 (N=5)	33.83 (N=3)
Other universities	99.02 (N=12)	51.98 (N=17)	37.92 (N=12)	91.1 (N=2)

ANOVA results indicated significant ´user group´ effect on ´success rate´ ($p<0.001$) and marginal effect on ´task completion time´ ($p<0.055$). Following the ANOVA, Tukey´s multiple comparison tests indicated that the success rate of the group of graduate students/staff was higher than the other two groups (undergraduate students and students from other universities) ($p<0.001$). Similarly, Tukey´s tests indicated that the group of graduate students/staff, on average, completed the tasks marginally shorter time than the group of other university students ($p<0.051$). On the other hand, ´gender´ and ´internet usage´ did not have any significant effect on the two response variables.

Table 8 shows the mean ease of use ratings for each user group by using a Likert scale (-3 -2-1 0 1 2 3; where -3 corresponds to “very difficult”, 3 corresponds to “very easy” and 0 corresponds to “neutral”). Although the undergraduate students were expected to be the most experienced user group, the results show that their user experience with the web site is quite negative based on the collected task completion success rate, task completion time and subjective rating data.

Table 8. Mean ease of use rating based on Likert (-3 to 3)

User Group	Ease of use rating
Undergraduate	0.883
Graduate and staff	1.24
Other universities	1.42
High School	2

Based on the results, all the tasks except Task 4 need a major redesign for undergraduate students. The graduate students and staff completed almost all the tasks successfully. The task 7 is the one recorded with the lowest completion rate and needs to be studied in details before redesigning. For other university students success rate is a mix among five tasks. Task 3 and Task 5 are the most problematic tasks for this. Both of them need major redesign effort. Overall, the high school students’ average task completion success rate is low except Task 2. On the other hand, surprisingly they found the tasks easier than the other groups.

5 Conclusions

This study showed the website has major UI design problems. The completion of tasks related to finding information on the web site was low, task completion time was high and ease of use rating was low. Because of this fact, this web pre-test question findings suggested that the most users need this web site to locate the interested courses, instructors, rules and regulations. The information architecture of the web site should consider all these user needs and structure the web site around the information needed by the users.

Both gender and internet usage factors do not affect the task completion time and task completion success rate according to our analyses. Because of this fact we can conclude that the web usage experience or learning factors do not affect the users’ performance on the website interaction. This should be taken into account that the new design should not relay on the learning factor.

The individual screens need to be redesigned based on the collected data available for each screen. And, there is a need to repeat this study on the redesigned website and compare the pre and post design data in order to prove the impact of this study on the ease of use of the website.

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