User Evaluation of Internet Kiosks in University Setting

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Abstract. METU kiosks are established at common points of METU campus to meet the immediate internet needs of students however they are not used at expected level. In this study, usability of METU kiosks is evaluated to identify design problems that may discourage users from using kiosks. For the evaluation, series of user trials were conducted based on some common tasks. Evaluation results show that there are critical usability problems with the design of input devices mounted on kiosk. Users generally had problems while typing with keyboard, while moving pointer using trackball mouse and while clicking using touch screen. In addition, no significant difference is observed between inexperienced and experienced users in terms of their overall success during trials. Specific examples for these usability problems and related recommendations are provided in this paper.

Keywords: Usability, user evaluation, kiosks, human computer interaction.

1 Introduction

Kiosks are generally described as centers which enables public access to information and communications technology to address needs of the community (e.g. educational, economic, or entertainment needs) [1]. Kiosk is not a new technology and its design has taken many forms for years depending on target user, its services and new technology trends. Back to its initial forms, according to Frances and Jennifer [2], kiosks that are designed in 1990s were like uninteresting boxes with simple interfaces produced for specific purposes. However, the role and nature of the kiosks has changed significantly throughout the years and today there is variety of kiosk types designed for numerous purposes. For example, there are internet kiosks for public internet access; there are photo kiosks to take photo or to print pictures; there are telekiosk used for communication. The other kiosk types can be listed as audio kiosks, credit card kiosks, customer service kiosks, educational kiosks, hotel kiosks, medical kiosks and museum kiosks. In the following table, 21st century kiosks are compared with the early kiosks in terms of dialog design, philosophy and connectivity.

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Table 1. Comparison of early and recent kiosks [2]

	Early Kiosks	Recent Kiosks
Dialog Design	- Menu based access to a limited number of screens. - Touch screen.	- Web/Windows-like interfaces, with data entry dialog boxes, dropdown lists, scroll bars, pointers and hyperlinks. Touch screen supplemented by keyboard.
Philosophy	- Task based.	- Customer service based.
Connectivity	- Stand alone or connected to one proprietary database.	- Internet enabled for real time information provision and communication.

An important observation from this comparison is the change in the philosophy: there is a shift from task focus to customer focus in kiosk design. Furthermore, the interface design of kiosks has changed significantly. Whereas initial form of kiosks interfaces has offered limited number of screens consisting of limited number of navigational elements, today's kiosks supports web/windows-like complex interfaces containing dropdown lists, scroll bars, pointers and hyperlinks. The transition to more complex interfaces has been driven by mainly internet technology and web pages containing detailed information [2].

Today, the number of terminals, or kiosks, placed in public locations to deliver information and services to the general public is increasing day-by-day [3]. In parallel to this, as a public access system, usability has become an important aspect for kiosks. According to Rowley and Slack (1999), there are four major components to be considered while designing public access systems: user characteristics, environment, task and technology, and kiosk design should support the task, the user profile and the environment in which the task is to be performed. Therefore, kiosks should be designed in a way that user should complete a specific task (e.g. sending e-mail) in a desired duration using the available technology provided by the kiosk in the environment.

Recently, kiosk technology has been established in Middle East Technical University (METU) at common locations such as Student Affairs, Computer Center, Medical Center and Cafeteria to meet the immediate internet needs of students. However, usage rate is below what was expected and many of the students are even not aware of that technology. The aim of this study is to evaluate usability of these kiosks by testing whether specific internet tasks could be completed by target users using the available technology on the kiosk. For this purpose, series of user trials have been conducted for set of frequent tasks and the results have been analyzed and discussed to emphasize design problems that impair the usability.

The reminder of the paper is organized as follows: first, related literature is briefly described to identify trends in evaluation methods of kiosk usability; then methodology employed in empirical study is discussed; then the results will be presented with data analysis and findings are explained; then findings are discussed, and finally paper ends with the conclusion section.

2 Literature Review

There are various case studies in the literature related to measurement of kiosks' usability. In this section, these studies are briefly explained by focusing on especially their methodology sections to identify how they evaluate the usability of kiosk.

One of these studies is "User evaluation of the MASK kiosk" conducted by Lamel et al [5] In this study, Multimodal Multimedia Service Kiosk has been evaluated on different tasks. Task details for each user trial are recorded in terms of number of inputs, transaction time and success rate for quantitative analysis. In addition, after user trials, a questionnaire consisting of general questions about the subject and overall satisfaction has been applied. Therefore, quantitative results are supported by the qualitative data.

The other important usability study related to kiosks is the case study conducted by Kules et al [6] in 2004 to evaluate the usability of community photo library. In this study, "usage logs, a survey and three days of extensive informal observations were employed to evaluate the use of the system by an estimated 1000 users" [6]. Based on the results of the study, some design guidelines are developed, under four categories: immediate attraction, immediate learning, immediate engagement, and immediate disengagement.

Ashford et al have conducted a study, called "Electronic Public Service Delivery through Online Kiosks: The User's Perspective" [4]. In this study, mainly user's views towards using kiosks and users' awareness of kiosks have been identified with the help of questionnaire surveys with 1068 respondents. There is no user trial conducted to get quantitative data. However, usage statistics are used to obtain comparative statistics on usage levels and length of usage times.

There is another study conducted by Yi-Shun Wang and Ying-Wei Shih [7], which applies Unified Theory of Acceptance and Use of Technology by conducting survey over 244 respondents to investigate the determinants of usage behavior of information kiosks. In addition, "moderating effects of age and gender differences on the relationships between the determinants and behavioral intention/use behavior" are identified [7].

3 Methodology

In order to evaluate the usability of kiosk some user trials have been performed onsite in the Student Affairs of Middle East Technical University (METU) with the target user group, which are students of METU. Students around were invited to attend trials as potential respondents and ones those are willing to participate were directly selected as experimental without any restriction on gender, age or prior experience with METU kiosks provided that they are computer literate. Gender and experience range of subjects are shown in Table 2.

Prior to user trials, a pilot study has been conducted to identify possible problems or limitations with the initial design of the tasks for user testing. According to observations during pilot study, these tasks for user testing were reviewed and final version (See Table 3) was decided. There are seven tasks in total designed to address different usability aspects of kiosk, which are basically usability of keyboard, mouse and touch screen.

Table 2. Comparison of early and recent kiosks

Gender		**Kiosk Experience**	
Male	Female	Experienced	Inexperienced
9	6	6	9

Table 3. Details of tasks for user testing

	Task Description
Task 1	Login to system.
Task 2	Check your MetuMail.
Task 3	Send a short mail to yourself.
Task 4	Search for a book in library system.
Task 5	Learn the transcript fee for student copy.
Task 6	Repeat Task 2 with touch screen to read the mail you have just sent.
Task 7	Logout from the system.

Sub-steps for each task are defined with all details to constrain each user to follow the same procedure to accomplish the specific task. For example, user can access MetuMail, in task 2, by either typing direct URL or by clicking on MetuMail link on METU home page. For such cases, in order to prevent uncontrolled diversity of actions within tasks, users are forced to apply the specified procedure to accomplish tasks. This restriction is must to obtain consistent results in user testing.

Before testing, subjects were given a brief introduction to the purpose of the study briefly and to the tasks to be performed. Then, a small questionnaire (See Appendix A) was applied to learn demographic information as well as prior knowledge of users. During user trials, the durations for completing tasks and the number of errors made have been measured and recorded for each user and for each task separately. After trials were completed, a short interview has been conducted with users to identify their attitudes towards the use of METU kiosks and its design. These interviews provided opportunity to learn users' suggestions for alternative design for the kiosks.

4 Results

User trials were performed with 15 subjects. The main results obtained in user trials are provided in Table 4 in terms of duration and errors. In the duration column, firstly average duration times are calculated considering the timings of all subjects for each task separately. Also, percentages of average durations are calculated to identify the tasks taking longer time or shorter time in general. The errors column comprises total number of errors, percentage of errors and average number of errors per user. These values help to identify tasks with higher or lower percentage of errors and to detect tasks that challenged users most or least.

Table 4. Results of user trials for each task testing

TASK #	Duration (s)		Errors	
	Avg. Dur.	*%*	*Total # of errors*	*Avg. per user*
1	16.2	9.62	10 (7.8 %)	0.67
2	24.2	14.38	11 (8.6 %)	0.73
3	44.8	26.65	28 (22 %)	1.87
4	25.0	14.89	11 (8.6 %)	0.73
5	19.7	11.72	2 (1.5 %)	0.13
6	29.2	17.39	60 (47 %)	4.00
7	9	5.35	5 (3.9 %)	0.33

Based on the observations during user testing, a prediction is made regarding the time periods that users spent on using different input devices on the kiosk. For that purpose, a score over ten is assigned for representing the length of time spent using keyboard, trackball mouse or touch screen separately for each task. These scores are provided in the Table 5.

Table 5. Scorings of input devices for each task based on duration of usage

Tasks	Keyboard	Trackball Mouse	Touch Screen
Task 1	9	1	0
Task 2	5	5	0
Task 3	8	2	0
Task 4	7	3	0
Task 5	0	10	0
Task 6	3	0	7
Task 7	0	10	0
Total	**32**	**31**	**7**

According to scores presented in Table 5, keyboard and trackball mouse are used equally in terms of durations. On the other hand, the least used input device is the touch screen because subjects were allowed to use touch screen device only in task 6. In addition, whereas task 1, 3 and 4 are completed mainly using keyboard, task 5 and task 7 are completed solely using trackball mouse.

According to Table 4, the task that is completed in longest period of time is the task 3 with the average value of 44.87 seconds, during which users tried to send a short mail themselves. In addition, task 3 is one of the tasks that users made lots of errors to complete; 22 percentage of errors in overall occurred during the completion of task 3. This indicates that the length of the completion duration for task 3 is not related only with the nature of task but also related with the difficulty that users has with using input devices, and consequently, with the high number of errors made.

Another important observation about results is the high rate of errors in task 6. Almost half of the total errors (i.e. 47.2 %) occurred during the completion of task 6. It is surprising that although it has the highest number of errors with 60, its duration is not the highest. For instance, although its average error number per user is higher than the twice of errors occurred during task 3 (i.e. 4.00 vs. 1.87), its average completion

duration is much less than the completion duration of task 3. This is actually because different input devices were used in task 3 and task 6: during task 3, users used mainly keyboard or trackball mouse whereas they used only touch screen during task 6. Since users were able to recover from their mistakes more easily by using touch screen, they could complete task 6 in shorter time despite of higher number of errors.

Furthermore, the tasks with minimum completion time are task 7, task 1 and task 5 with the values of 9 seconds, 16.2 seconds and 19.72 seconds, respectively. These tasks also were completed with the minimum error rate, 3.9 %, 7.8 % and 1.5 % respectively. Interestingly, two of these tasks (i.e. task 5 and task 7) were completed only by using trackball mouse. This means that users made less number of errors when they used trackball mouse to complete tasks. On the other hand, task 6 and task 3, which does not require mouse use, are the tasks that users made high number of errors. Task 6 is completed using mainly touch screen and task 3 is completed using mainly keyboard. Therefore, users faced some problems while using these input devices.

Table 6. User-specific results of trials

Users	Duration		Errors		Experience
	Total dur. (s)	*Task with max. dur.*	*# of errors*	*Task with max. error rate*	
1	138	3	12	6	No
2	214	3	12	3	No
3	248	2, 6	17	2	No
4	167	1	6	1, 6	No
5	160	6	11	6	Yes
6	145	3	4	6	Yes
7	131	3	7	6	Yes
8	136	3	11	3	Yes
9	159	4	5	4, 6	No
10	154	2	4	6	No
11	188	3	12	3	No
12	189	6	6	6	Yes
13	168	3	8	6	No
14	152	3	6	6	No
15	176	3	6	6	Yes

In Table 6, overall duration and error values are summarized for each user. In the duration column, total duration of all tasks for each user and the task that took longest time are shown. In the error column, total number of errors made by each user during all experiment is provided and also the task which is completed with the highest error rate is indicated. Beside duration and error column, experience column is included to differentiate users based on their experience with METU kiosks. “Yes” means that the user has an initial experience with METU kiosks, whereas “No” means that experiment is the first time that user used the kiosk.

According to Table 6, nine users has completed task 3 with the longest duration during which users have used intensely keyboard. An interesting behavior of users while completing task 3, which is not provided in result tables, is that eleven users preferred to use “Tab” key on the keyboard to place cursor on the text area to type

e-mail although general tendency in desktop or laptop computers is using mouse click to place cursor on specific text field. This is an indication of that users generally got easily tired while they were using trackball mouse and preferred to use keyboard as alternative when possible.

Moreover, considering error rates, task 6 is the common task during which users made errors most: eleven users made errors mostly in task 6 whether they are experienced or in experienced. Task 5 and task 7 during which users used only trackball mouse is not available in the column of "task with maximum error". This is actually another representation of the same observation in Table 3: total number of errors in task 5 and task 7 (i.e. 7) is less than the number of errors made in any other single task. Thus, users could be able to use trackball mouse free of error in general.

For further analysis, the data dispersed in Table 6 are represented in bar chart format in following figure. In the first chart (a), users are sorted ascending according to durations that they completed the experiment. In the second cart (2) users are arranged based on the number of errors they made in total in ascending order. In these figures, users with prior experience are indicated with blue color and users without experience are marked in dark green color.

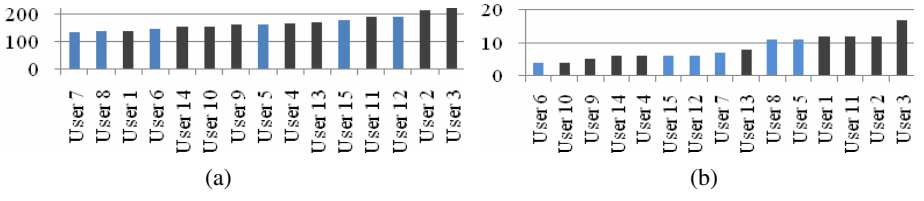

Fig. 1. (a) Experiment duration for each user; (b) Total number of errors of each user

One of the significant observations from the figure is that users with prior experience could not succeed much better than the users without prior experience. Figure 1 shows that, although user 7 and user 8 completed the experiment in the shortest duration, many inexperienced users could complete the experiment in shorter duration than other experienced users. In addition, a similar case is observed in the figure 2. That is, error rates change independent from the experience level of users. For example many inexperienced users (e.g. user 10, user 9 or user 14) have made less number of errors than experienced users (e.g. user 15, user 12 or user 7) in general. Thus, there is no consistency within experienced or inexperienced users regarding duration of experiment and error rate.

Average of duration and error rate for experienced and inexperienced users, on the other hand, shows significant difference and it helps to differentiate these two user groups. These average values are presented in table 7.

Table 7. Average results for experienced and inexperienced users

User Groups	Avg. Dur. (s)	Avg. Error Rate
Exper. Users	156.17	7.50
Inexper. Users	176.44	9.11

Table 7 shows that experienced users could complete experiment in shorter time with lower error rate in overall. To be more specific, there are 20 seconds difference considering duration and almost 2 errors difference considering average error rate.

5 Discussion

In this study, user-based evaluation of kiosks is conducted based on user trials in natural setting. The purpose of the study is to test usability of input devices on the kiosk, which are keyboard, trackball mouse and touch screen. Results obtained in user trials provided enough evidences to identify problematic usability issues with the kiosk design. In addition, interviews with users have provided some clues to identify usability problems and propose related recommendations for alternative designs.

5.1 Usability Issues Related with Keyboard Design

Task 1 involved mainly use of keyboard to enter username and password information to be able to login the system and also little use of mouse to click on login button. The unusual keypad design of kiosk has challenged user in identifying intended key. Especially, almost half of the users could not enter password correctly at first time because it contains generally special characters. As an exceptional case, one of the users could not continue experiment after first task because he could not enter the password correctly. His password, which is provided by Computer Center of Metu, contains '#' character which is not available in keyboard of kiosk, which was installed by Computer Center of Metu. This means that Computer Center prohibits some of Metu students to use kiosks unintentionally.

Furthermore, keyboard design has lead to similar problems in Task 3 and Task 4, which are completed in longer duration than tasks completed on PC. In task 3, keyboard was used to login the mail account, which is a similar activity with task 1. On the other hand, task 4, which is about sending a short mail, required more extensive use of keyboard. Users made a common error while typing the receiver e-mail address: they could not find the '@' key for seconds because it is positioned in different part of kiosk keyboard, which is much different than the standard location of '@' key. Furthermore, users made many mistakes while typing the mail content and they could not easily corrected their typing mistakes.

In interview sessions, many of the users complained about the position of the keyboard: it is much lower than the level of the screen which makes eye transition between keyboard and screen difficult, and it is positioned in deep side of the kiosk which makes it harder to type. Besides its unfamiliar keypad design, these issues also have increased the time it takes to complete tasks requiring extensive use of keyboard and lead to significant time difference for the same tasks between kiosk and PC.

5.2 Usability Issues Related with Trackball Mouse Design

Trackball mouse was used mainly in task 5 and task 7 to click on buttons or links to navigate to related pages or menu items. Although results (See Table 3) show that users made less number of errors during these tasks, Table 7 indicates that these tasks took longer time than others if compared with the duration of corresponding tasks

completed using PC. This is actually because users had to make many mouse movements to position pointer at intended location.

The common mistake related with mouse use is that many users could not find out where the left click button of mouse is at first. If they could not find it after initial attempts, they were informed about the place of the left click button of mouse.

Interview results show that users generally felt inconvenient with the use of trackball mouse, and they tried to use keyboard instead of mouse if possible. An observation during user trials supporting this tendency is that users generally preferred to use tab key instead of mouse to access the intended textbox field to type e-mail.

5.3 Usability Issues Related with Touch Screen

Users were not introduced to touch screen capability of kiosk until task 6 to observe whether they notice that capability without any external notification. None of the users could predict the touch screen functionality, which means that kiosk design could not enhance the visibility of the touch screen capability.

As stated before, touch screen was used only in task 6 which has the highest error rate in overall. There are two reasons for high error rate: (1) adjustment of the touch screen is not well done, which causes users not to be able to click intended part of the screen, (2) the standard view of web pages seems to be small and therefore inappropriate for touch screen use.

Efficiency of touch screen can be evaluated better if completion duration of task 6 and task 2, which comprised very similar activities, are compared. As a reminder, task 2 involved use of mouse and keyboard. Task 6 took longer time in general than task 2 although the reverse was expected because of touch screen use. This comparison again pointed to inefficiency of touch screen design.

According to interview results, although users liked the touch screen functionality they think that it could be more effective to use it. In addition, some users suggested that the monitor should not be vertically positioned; there should be some horizontality, which will enhance the usability of touch screen. To enhance functionality of touch screen, some special software can be used in kiosks instead of operating systems used in PCs. This software can provide a user interface with appropriate size navigational elements that users are able to click with higher efficiency. In addition, this software can have some intelligence so that users do not have to login to mail account after the first login to system

6 Conclusion

In this study, usability of METU kiosks was tested with the serious of user trials which comprises pre-determined tasks. The data tracked during user trials have been analyzed to elicit evidences to evaluate usability of different input devices mounted on the kiosk. Evaluation results have revealed that the design of the kiosk comprising all input devices has some usability problems and that there is no significant difference in success of experienced and inexperienced users.

There are some limitations of that study. Firstly, the number of participants for user testing is a bit low. Conducting a user testing with higher number of users such

as 100 users can produce more valuable and substantial results for evaluation, which can be considered as future work. Furthermore, in that study, timing of use of each input device is estimated for each task only based on observations during user trials. However, exact time for each input device could be tracked to identify exact duration of each device use. As a final limitation, completion duration of tasks in PC are measured based on 5 computer literate users, which are different than subjects of the experiment. However, subject could perform tasks in kiosk and then in PC for better evaluation.

In summary, this study provided useful conclusions on the design problems of kiosk. These conclusions and recommendations can be considered as a usability guideline for the future design of kiosks at METU.

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