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Usability Evaluation of Web Based Educational Multimedia by Eye-Tracking Technique

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Abstract

In cases that education processes are supported by the internet and web technologies, usability is one of the factors that can affect success of students and technology usage status of teachers. In this study, usability factors for effective design and usage of web based multimedia packages created for educational purposes are surveyed. During the research, experiments and analysis are done in the Human – Computer Interaction Laboratory with nine prospective teachers. According to literature review, it is generally possible to find 75% of the usability problems by testing only 5 participants. Experiment data are collected by using screen and voice records, which contain eye and mouse motions. For analysis of data, fixation count, sequence and dwell time values in gridded area of interest, heat map values in whole are considered. The present study demonstrates that large number of fixations and the disperse nature of fixation locations make it hard for users to find the task. It was also found based on eye-movement data that size of some objects and words were too small to notice. There should be options that enable users to decide on the size of objects according to their preference. Finally, this study makes recommendations aimed at making the multimedia more effective, efficient and of higher quality to ensure user satisfaction. It can be said that results obtained from this study can also be used for design and validation of computer aided materials such as learning objects, web based applications and serious games.

Keywords: *Usability Test, Eye-tracking, Web-based Educational Multimedia, Effective Design*

1. Introduction

Usability can be defined as a measurement of how easy it is to complete certain operations according to given roles within the scope of a product or system (Shackel, 1991; Chapanis, 1991; Lindgaard, 1994; Acartürk and Çağıltay, 2006). Usability comprises the aspects effectiveness, efficiency and satisfaction of a system or goods (ISO, 1997). According to Nielsen (1993), usability is a quality attribute that assesses how easy user interfaces are to use and it is defined by five quality components: learnability, efficiency, memorability, errors, satisfaction. Brinck, Gergle, and Wood (2002) argue that "highly usable products are intuitive" and "transparent" to the user. This type of user-centered design makes it easy and efficient for people to achieve their goals without having to deal with an excessively complicated system (p. 2). Likewise, Schneiderman (2002) emphasizes ''universal usability, in which everyone can be a successful computer user" (p. 67). Today, there are many different usability evaluation methods aimed at development of user-centered and efficient designs.

Usability testing is one of the usability evaluation methods that can be used for evaluation of usability of a system or product. Usability testing process involves gathering satisfaction, efficiency and effectiveness data from target audiences for certain tasks in certain interfaces. They try to identify quality of a system with respect to ease of use, ease of learning and user satisfaction (Rosson& Carroll, 2002). Therefore, usability testing has an important role in evaluation of software for certain goals (Tarasewich et al., 2005; METU HCI Research and Application Laboratory, 2008).

When studies on interface usability are reviewed, it can be seen that there are a number of usability testing methods. Only voice and screen records, or interviews conducted with users while using the system were included in previous studies carried out on usability. On the other hand, in some of these studies, users were asked to fill in questionnaires or to state what they learned from the system. Today, it has been observed that eye-tracking applications have an important role in explanation of visual attention and cognitive processes (Duchowski, 2007; Van Gog & Scheiter, 2009; Byerly, 2007). Furthermore, as eye-tracking systems have become both more sophisticated and more affordable, there has been an increasing interest in the use of eye-tracking within the software usability testing domain (Byrne et al., 1999; Kotval & Goldberg, 1998; Hornof & Halverson, 2003; Russell, 2005). Through this technique, concrete statistical data are obtained about both interface designs and tendencies of users while they use the interface. By using the eye-trackers, data is gathered as to where, how long and how many times users look, on which points the concurrent and retrospective attention of users focus, as well as on the cognitive aspects of users.

Özçelik et al. (2009) carried out an eye-tracking study to investigate how color-coding affects multimedia learning. Eye movement data (number of focuses, average focus time and total focus time) were gathered to investigate the cognitive processes. Using these data, the study suggested that color-coding aids participants to find corresponding information in text and illustrations and to pay attention to critical information for meaningful learning. Miller et al. (2011) suggested that the usability rating was a strong predictor of learning after controlling for computer gaming experience. In other words, students who reported that Crime Scene Investigation game play did not present difficulties for them were likely to learn more from it. The results confirmed previous findings that a serious game’s impacts are, at least partly, influenced by its usability (Markopoulos & Bekker, 2003; Mayes & Fowler, 1999).

In cases where educational processes are supported by Internet and web technologies, usability is an important factor. Poorly designed instructional applications are unlikely to be instructionally effective; therefore, those designing computer-mediated instructions have a moral, ethical and pedagogical obligation to create usable applications (Crowther et al., 2004; Virvou & Katsionis, 2008; Gülbahar et al., 2008). Usable websites allow students to learn more effectively and attractively (İşman & İşbulan, 2010). It is also important for educational multimedia not to be abandoned by users, to be motivating them to learn, and to be clear and useful (Nielsen, 1993; Karagöz, 2006). It is important whether educational web sites expected to be used by teachers and students are suitable for the target audience, and whether the content presented attains the target. Presentation of information is important to affect users on websites with educational content. The user, who comes to the web site to get information which s/he is searching for, sees the word looking for not looking at. In this respect, for similar users, in addition to beautifully designed static and dynamic visual objects, they should allow easy browsing, and be consistent in terms of the contents. Websites designed in this way can succeed in meeting the needs of users, pleasing them and keeping them on the website (Eraslan, 2008).

This study was conducted to evaluate usability of the teacher interface of a web-based educational multimedia package using the eye-tracking method. A review of the previous studies showed that there is no usability studies conducted on systems used only by teachers. However, it is considered important that teachers, who are the main drivers that motivate and guide students in systems expected to be used by teachers and students jointly, use such systems effectively and efficiently. Therefore, it is considered that this study would contribute to the literature. The ‘Vitamin Primary Education Multimedia Software’ package is a web-based education product that supports school education and offers many animations and visual applications. The Turkish Ministry of National Education supports and recommends this package for use at schools. Although Vitamin Primary Education Multimedia Software is an award-winning successful education software package, it is considered that there are certain deficiencies about its usability. Usability of the system can be developed for easy access and effective use of the contents.

This study makes recommendations aimed at making the system more effective, efficient and of higher quality to ensure user satisfaction. Effectiveness refers to the degree of how successful the participants are in performing the task by using the application, and thus it can be measured in terms of capability percentage of doing the task. The measurement of the effectiveness is not sufficient on its own. Other resources (time, cost, etc.) that are used to complete a task are evaluated by measuring the efficiency. The ratio between the expected labour before starting the task and the actual labour at the end of the task can provide us with important findings about efficiency. Satisfaction refers to measurement of participants' ideas (likes, dislikes, etc.) that develop during use of the application. This study sought answers to the following research problems (Table 1):

Table 1: Research problems by type

Category	Problems
Effectiveness (Degree of success)	1. What are the rates of accomplished tasks, and the success rates of subjects? 2. What are the numbers of fixation counts and fixation areas in tasks with low success levels?
Efficiency (Other success factors like time, number of steps etc.)	3. How much time did it take to complete the tasks (reaction time)? 4. How many steps did it take to complete the tasks? 5. What is the number of steps completed within the unit of time for each task (time/step)? 6. How is the heat map of the page and how long is the dwell time in tasks requiring low number of steps within the unit of time? 7. What are the reference sources and number of sources used for help?
Satisfaction (Likes, dislikes etc.)	8. What are the graded rates of users' satisfaction?

2. Method

The research model of this study is based on case study. Data collected in this study are only related to teacher interface of the web-based educational software that is the subject matter of the study, and do not claim generalization. The "User Participation" evaluation method from among the usability evaluation methods was employed. The "Eye tracking" method was used as the physiological technique from among those with user participants.

Study Group and Environment

The study group consisted of nine prospective teachers (7 female and 2 male), who were senior students at the Department of Science Education at Marmara University. Nielsen (1993) stated that it is generally possible to find 75% of the usability problems by testing only 5 participants. Selection of the participants was based on willingness principle. Ages of the participants varied between 20 and 24. A questionnaire was administered to identify levels of perception of computers and information technologies. All participants had received computer training at the university for minimum one year. Two participants rated their computer skills as "expert", seven as "intermediate". Five participants stated they used the Internet for an average of 1 or 2 days a week, and four participants for an average of two hours on a daily basis. The study was carried out at the Human-Computer Interaction Laboratory of Marmara University. Please visit http://www.hci-usabilitylab.com/ for more information and photographs of the environment.

Material

Within the framework of the study, the teacher interface of the web-based educational multimedia software (Vitamin Primary Education Multimedia Software - hereinafter referred to as "Vitamin"), which is supported by the Turkish Ministry of National Education, was analyzed. Vitamin won the Best Content Service Award in the World Communication Awards 2009 (WCA). Vitamin consists of a huge library of educational content and an online platform tailored to the needs of primary and secondary school students. Adaptive Curriculum, the US version of Vitamin, won many international awards in the world. Adaptive Curriculum won the 2012 Codie Award for the Best Virtual School Solution for Students at the SIIA CODIE Awards. Furthermore, Chinese version of Vitamin, Tian-yi, won international awards. The package can be accessed at www.mebvitamin.com (only for members).

Figure 1: Login page of the Vitamin

Selection of Tasks

Teachers working at schools of the Turkish Ministry of National Education were interviewed, and their needs and functions they may frequently use were identified. Furthermore, it was also ensured that varieties of tasks reflect different uses on the website, including using the menu, searching, watching animations, browsing the pages using the links, returning to the home page, etc. Attention was paid to ensure that instructions are clearly worded similar to daily usage. Tasks were designed as processes that could be completed within ten to fifteen minutes in total, although it may vary from person to person. A pilot application was carried out to test to see whether they are meaningful or can be understood easily. The wording of task descriptions was revised and one task was removed to ensure that the process does not exceed the estimated time. A list of the tasks, which prospective teachers were expected to perform, is provided: (1) Login as a teacher, (2) Find description of the subject, (3) Watch an animation, (4) Find a prepared test, (5) Find the dictionary menu,(6) Find classroom list, (7) Revise classroom list, (8) Give homework, (9) Create a moderately difficult exam on a specific topic, (10) Find the help menu, (11) Securely logout.

Collection and Analysis of Data

For data collection, participants were asked to login the website and complete the task assigned to them. Eye-tracking recordings, voice recordings and screen recordings were utilized during this process. SMI Experiment Center 2.4 and IView X 2.4 applications were used to record eye movements. Furthermore, Noldus Observer 9.0 was used to record voices and mouse movements. Achievement rates of the participants on the task assigned, number of sources and references referred to, time spent to complete tasks, as well as the number of steps followed were all measured by analyzing the screen recordings. Satisfaction levels of the participants were measured by analyzing the satisfaction questionnaire. The questionnaire was designed in the light of the literature and other similar questionnaires (WAMMI, SUMI, etc.) by Kılıç and Güngör (2006). Cronbach's alpha reliability test was applied and $\alpha = 0,873$ value indicates a high level of reliability (Kılıç & Güngör, 2006). In order to determine the patterns involved in the process, eye-tracking recordings were analyzed using the SMI Be Gaze 2.4 software, and screen, voice and mouse recordings were analyzed using Noldus Observer 9.0 software. Number of fixations, gaze sequences, dwell times in the gridded area of interest, as well as the values obtained from heat maps were analyzed during this process.

3. Results

Results were obtained through analysis of data on patterns of effectiveness, efficiency, satisfaction and eye tracking processes. Results were presented based on the research problems.

Effectiveness

Research Problem 1: What are the rates of accomplished tasks, and the success rates of subjects?

Success levels of each subject for all tasks were analyzed. They are considered successful on the basis that they completed a specific task on their own, without asking help from the observer; and they are considered unsuccessful on the basis that they were not able to complete the task, left the tasks incomplete or completed the tasks with the help of the observer. Figure 2 shows number of tasks completed by nine subjects in a column chart. According to the chart, "the subject 8" is the most successful one, as he completed all 11 tasks given; and "the subject 2" is the least successful one, as he completed only 5 out of 11 tasks given.

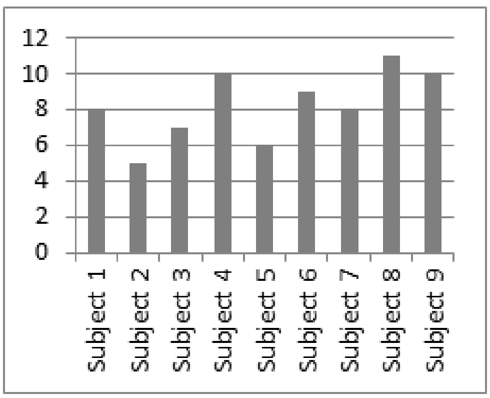

Figure 2: Number of tasks successfully completed by subjects

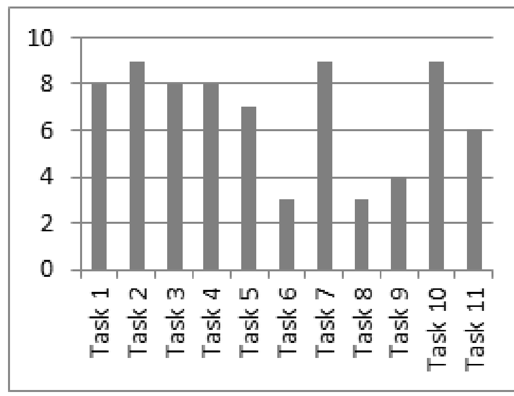

Figure 3: Success rates by tasks

Figure 3 shows the success rates by tasks in a column chart. According to the chart, subjects are successful in "find description of the subject (task 2)", "revise classroom list (task 7)" and "find the help menu (task 10)". According to the same chart, the most difficult task for the subjects was "find the classroom list (task 6)" and "give homework (task 8)".

Research Problem 2: What are the numbers of fixation counts and fixation areas in tasks with low success levels?

"Find the classroom list (task 6)" and "give homework (task 8)" are the tasks with the lowest success rates. This low rate of success decreases the effectiveness of the software. The reasons of low success rates of tasks were analyzed using the eye-tracking data. Gridded areas of interest are formed by dividing the screen into areas of interests using grid lines. During the task, varying numbers of grid lines were used for each task based on the area of the object or menu required to be found on the screen. A 14-column x 14-line area of interest was formed for task 6, and a 10-column x 10-line area of interest for the task 10. During calculation of the fixation counts, the moment in which the task was explained to the subject was considered the starting time and the moment the task was completed was considered the ending time. Fixation counts between these two points in time were calculated. Areas with higher fixation counts are indicated in red, and those with lower fixation counts are indicated in blue.

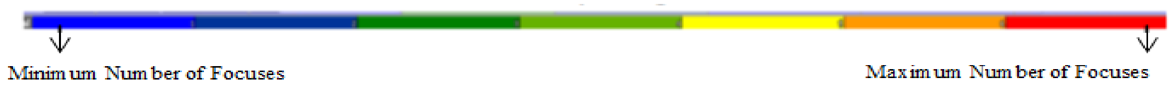

Figure 4: Color scale for number of focuses

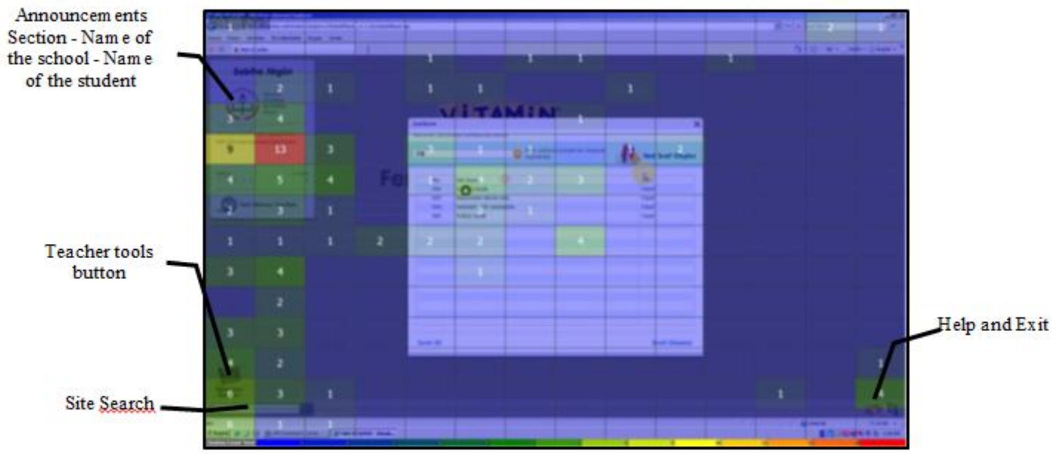

Figure 5: Fixation counts in the gridded areas of interest for task 6

To complete the task "find the classroom list (task 6)" successfully, subjects were required to click the "teacher tools menu" button located in the lower left corner of the screen. Classroom lists are located under the teacher tools menu. However, only 3 subjects were able to complete this task without asking help. In Figure 5, fixation count for the area of teacher tools button in the lower left corner of the screen is low. Fixation counts are the densest in the area of "Announcements" on the upper left hand side of the screen. The second densest area is in the location of the "Site Search" button. Scattered fixation areas indicate that subjects had difficulties in this task.

In the task "give homework (task 8)", fixation counts are denser on homework window section of the screen (Figure 6). The reason is that, screen areas out of the window were darkened. It is seen that this method is quite effective in directing attention of users only to required areas. Within the first ten seconds, all subjects were able to open the homework window under the teacher tools. This is an indication of the fact that they learnt the location of the teacher tools during the previous task. However, none of the subjects, except one, focused on the "give new homework" button within the homework window. Eye movements concentrated on the area where previous homework was listed. As for the sequence of fixations, eyes were first directed to the area where the previous homework were listed, and then noticed the "give new homework" button on the upper left corner.

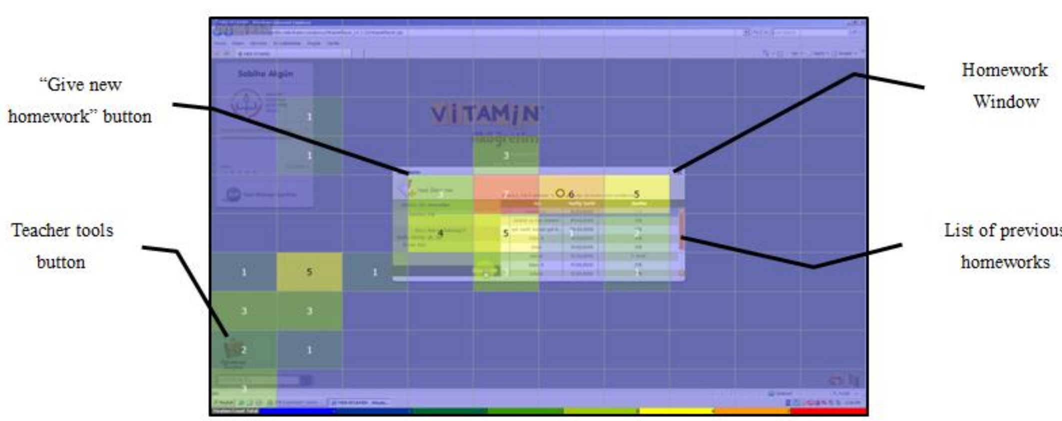

Figure 6: Fixation counts in the gridded areas of interest for Task 8

The subjects did not notice the “teacher tools” menu used for many tasks and they noticed the “give new homework” button too late; in terms of effectiveness, these situations indicate the weak sides of the software. On the other hand, darkening the areas beyond the homework window enables subjects to concentrate only on the required areas.

Efficiency

Research Problem 3: How much time did it take to complete the tasks (reaction time)?

The time spent to complete the tasks provides important data regarding effectiveness. The data gathered by observing 9 subjects’ screen recordings taken while completing 11 tasks were calculated. The time spent was measured from the moment the task was given to the subject to the moment he/she said, “I found!”, or he/she completed the task on his/her own or with help.

For each task, the time spent was computed based on screen recordings. While securely logout (task 11), find the help menu (task 10), and find description of the subject (task 2) were the tasks completed in the shortest time (within 9 seconds, 10 seconds, 13 seconds respectively); prepare exam (task 9) and give homework (task 8) were the tasks completed in the longest time (197 seconds and 115 seconds respectively). As to the relationship between subjects’ successes and completion time of tasks, the subject 8 completed all 11 tasks successfully within 8 minutes, and became one of the subjects who were able to complete the tasks in the shortest time. Completing only five of eleven tasks in 14 minutes, the subject 2 was the one who completed the tasks in the longest time.

Research Problem 4: How many steps did it take to complete the tasks?

Efficiency is defined as other sources used to complete a specific task. These sources may be illustrated as time, cost and labour. The proportion between the expected labour and the labour used gives important findings about efficiency. In this study, the work required to be performed while completing the tasks involved using the mouse and keyboard. After the tasks were given, each mouse clicking and keyboard use action of subjects were considered a step and recorded as average number of steps. Furthermore, “ideal number of steps” was calculated by computing the number of steps required for the shortest path possible for each task. For example, in order to complete the task “find description of the subject for 7th grade”, the subjects were expected to click on “Science and Technology 7th Grade” and then on “the title of the subject”. As Task 2 could be completed with only two clicks, the ideal number of steps was considered two. A comparison between the ideal number of steps and the number of subjects’ steps is given in Table 2.

Table 2: Average number of steps of each subject and ideal number of steps by task

Tasks	*S1*	*S 2*	*S3*	*S4*	*S5*	*S6*	*S7*	*S8*	*S 9*	*Mean*	*Ideal Number of Steps*
Task 1	9	16	9	9	9	9	9	9	9	9,8	9
Task 2	2	2	4	2	2	2	2	2	2	2,2	2
Task 3	3	6	6	4	6	3	3	3	4	4,2	3
Task 4	6	9	3	4	4	3	6	5	3	4,8	3
Task 5	9	11	12	26	17	9	6	16	5	12,3	4
Task 6	10	10	10	9	11	14	9	28	6	11,9	6
Task 7	10	4	13	12	5	5	4	4	6	7,0	4
Task 8	20	23	52	27	29	22	29	19	36	28,6	17
Task 9	29	45	37	32	27	42	33	47	29	35,7	20
Task 10	2	2	4	2	5	2	2	2	2	2,6	2
Task 11	2	2	2	2	2	2	2	2	2	2,0	2
Total	102	130	152	129	117	113	105	137	104	121,0	72

According to Table 2, the task “Find the dictionary menu (Task 5)” was expected to be completed in 4 steps ideally; however, it was completed in an average of 12 steps by the subjects. The tasks that were completed with the number of steps closest to the ideal number of steps were the tasks “Securely Logout (Task 11)” and “Login as a teacher (Task 1)”. Furthermore, as to total number of steps, subject 1 (102) and subject 9 (104) were the ones who completed their tasks with the least and closest steps to the ideal number of steps. Subject 3 (152) completed the tasks with the most and the farthest number of steps compared to the ideal number of steps.

Research Problem 5: What is the number of steps completed within the unit of time for each task (time/step)?

As tasks did not have equal difficulty levels, the rate between how many steps are required to complete a task and the time spent to complete a task are important in terms of efficiency. Thus, the time that subjects spent to follow the instructions in the shortest possible way presents important findings with respect to efficiency. Table 3 shows the findings obtained by dividing the time spent for each task by the minimum required number of steps.

According to the data presented in Table 3, the tasks for which the subjects spent the most time are “find the dictionary menu (Task 5)” and “find classroom list (Task 6).” In fact, “find the dictionary menu” requires four (4) steps and “find classroom list” requires six (6) steps and they are short tasks; however, it was seen that much more time was spent to complete these tasks compared to others. It is considered that this situation is an important finding with respect to effectiveness.

Table 3: The ratio of time to step numbers
(Time spent to complete tasks (sec)/ Minimum number of steps required to complete the tasks)

Tasks	*S 1*	*S 2*	*S 3*	*S4*	*S5*	*S 6*	*S 7*	*S8*	*S 9*	*Mean*
Task 1	5	8	5	5	5	4	5	5	5	*5*
Task 2	6	11	12	6	7	4	7	2	5	*7*
Task 3	6	10	5	5	11	2	5	3	5	*6*
Task 4	7	18	11	7	8	5	10	4	7	*9*
Task 5	14	28	13	42	16	12	7	15	9	***17***
Task 6	9	20	11	8	13	16	18	11	9	***13***
Task 7	9	6	7	12	7	7	4	6	14	*8*
Task 8	4	9	11	6	7	4	7	3	8	*6*
Task 9	6	11	11	10	11	7	8	8	8	*9*
Task 10	3	4	11	3	12	4	2	3	6	*5*
Task 11	2	6	5	5	1	1	4	2	2	*3*

Research Problem 6: How is the heat map of the page and how long is the dwell time in tasks requiring low number of steps within the unit of time?

The tasks that required less work were “find the dictionary menu (Task 5)” and “find classroom list (Task 6)”. Although they were short tasks, much time was spent than required; this is a problem of efficiency. A ‘heat map’ and a ‘dwell time in gridded areas of interest’ analyses were applied to the eye tracking data.

In heat map analysis, the screen was graduated in colors based on the number and the sequence of the looks. The most concentrated area related to the task about the interface can be found within the ten seconds following the assignment of the task. While taking the screen capture of the heat map, the start time of the task was the period of ten seconds following the assignment of the task to the user. Therefore, it was possible to identify the points where the participants first focused their attention in order to carry out the task. The points on which the participants concentrated the most are marked in red color, while less concentrated points were marked with blue or green.

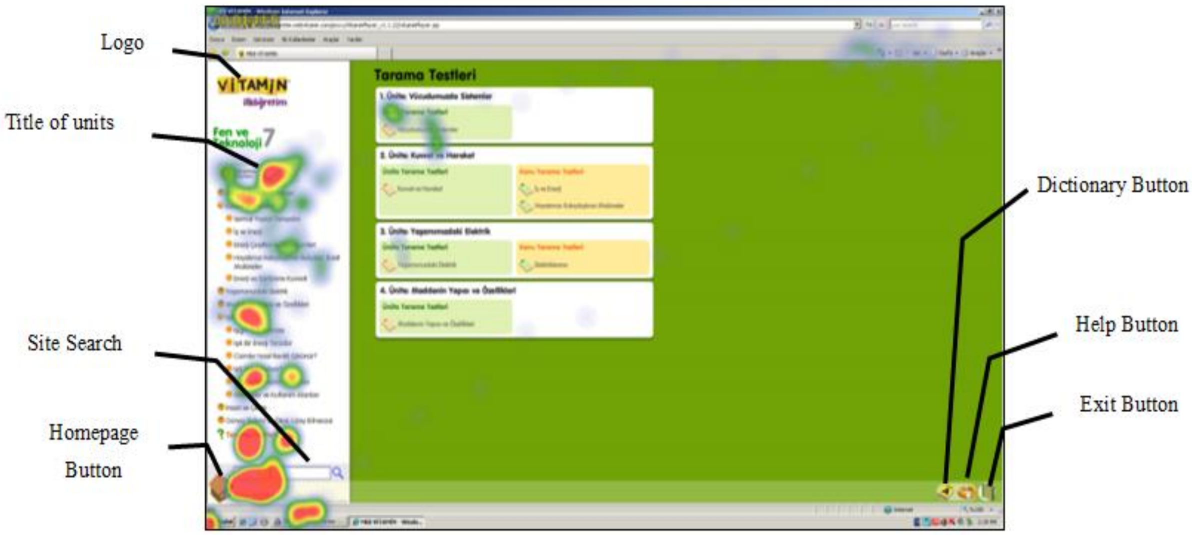

Figure 7: Heat map of the screen for Task 5

The screen on which that the task was given is shown below (Figure 7). This screen consists of three sections, which are content headings, navigation and contents. Content headings section is located on the left hand side; navigation part is located at the bottom, and the contents section is at the center of the screen. To perform the task in this screen, the participants were expected to open the dictionary window in the first place. The dictionary window could be opened by clicking on the book-shaped dictionary button on the lower right corner of the screen in the navigation section. However, when the heatmaps recorded in the first ten seconds were investigated, it was seen that only one participant focused on the dictionary button, which was on the lower right corner of the screen. Other participants were not able to notice the dictionary button in the first ten seconds as shown in Figure 7. The button could only be noticed after a while or the dictionary window could be reached through the site search application.

Another task that involved low number of steps to perform was "find classroom list (Task 6)". The findings obtained by analyzing the eye-tracking data and the dwell time in the gridded areas of interest are presented below (Figure 8). The dwell time in the gridded areas of interest was measured in millisecond units, and the start time is considered the moment when the task was told to the user, while the end time is considered the moment when the task was completed. Based on the dwell time in the gridded areas of interest on the screen, the points with long dwelling duration were marked in red and yellow, while points with less dwell time were marked in blue and green. Classroom lists are located in teacher tools menu on the left bottom section of the homepage. Subjects were required to turn to the homepage from subject explanation page (Figure 8). However, while looking for classroom lists, users mostly looked at the areas of unit titles, content area and site search. Dwell time for the area of homepage button is low compared to other areas. Thus, users spent much more time than they had been supposed to in the task 'find the classroom list'.

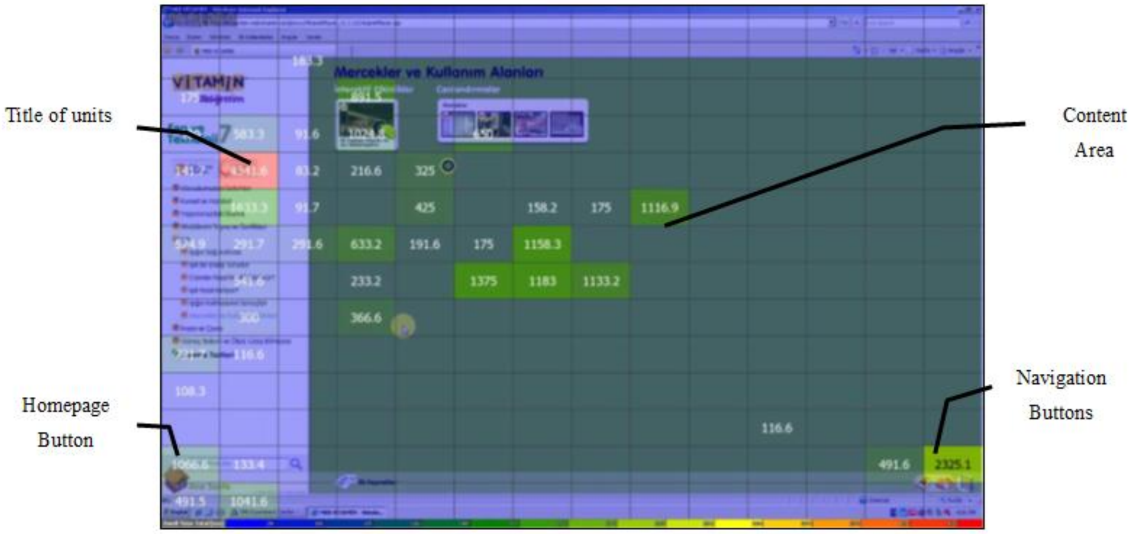

Figure 8: Dwell time of the page in the gridded areas of interest for Task 6

Research Problem 7: What are the reference sources and number of sources used for help?

The help provided to the subjects to complete their tasks was the sources used. The help they demanded while performing the tasks presents important findings about efficiency. The tasks they demanded help the most, and how they received the help they needed were identified by analyzing the screen and voice recordings. The ways they followed while completing their tasks were also analyzed. It was seen that they followed three different ways when they were unable to do the things they were supposed to do. These are:"Ask help from the observer", "Use the help menu", "Search within the site". It was analyzed how many times they needed help when they were unable to do the things they were supposed to do. Among help sources, they preferred the "help menu" the least (3 times) and site search (9 times), whereas they preferred asking help from observer the most (42 times). They needed help the most in the task "find the dictionary menu". The number of help sources and the duration of help process differ from subject to subject. It was seen that some users demanded help many times for short durations; whereas some demanded fewer help for long durations. To identify these situations, the duration of helps is given.

Table 4: Help Durations According to Subjects (seconds)

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 7	Subject 8	Subject 9	Total
Observer	32	140	125	8	158	35	57	2	15	572
Site Search	27	43	17	36	57	22	0	60	0	262
Help Menu	0	23	0	0	0	4	60	0	0	87
Total	59	206	142	44	215	61	117	62	15	921

According to Table 4, the subject 5 (215s) and the subject 2 (206s) are the ones whose help durations are the longest. The subject 9 (15s) and the subject 1 (59s) are the ones whose help durations are the shortest. Also observer's help is the most preferred way of help with 572 seconds and using help menu is the least preferred way of help with 87 seconds.

Satisfaction

Research Problem 8: What are the graded rates of users' satisfaction?

According to findings of satisfaction survey, users ranked the item "Learning how to use the site is easy" highest (4,6); also the ratings of the "Knowledge can be reached readily" (4,2), "Knowledge organization of the site is not complicated" (4,2), "I am pleased with the use of the site" (4,2) items are quite high. The item "Help messages are sufficient" has the lowest average with 2,8.

Table 5: Satisfaction levels of participants by main parts

Main Parts	Mean (0-5)
Controllability	3,8
Learnability	4,6
Availability of Help	3,2
Appearance	3,7
Efficiency	4
Satisfaction	4,2

In Table 5, when we look at the averages of the sections formed by grouping the satisfaction items, it can be seen that the users ranked "Learnability" (4,6) the highest. Users gave the least points to "Availability of help" (3,2) of the site. As mentioned above, using the help menu was the least preferred help source compared to other sources.

4. Discussion and Conclusion

When the eye movements are analyzed, it was seen that users first looked at the center of the screen and then to the left column. While links and buttons located on the top section of the screen and in the center were easily noticed, it took much longer to notice those located in the lower sections of the screen. In this study, subjects didn't notice the dictionary button on the right bottom corner of the page. They started searching from the upper left corner of the page towards the areas at the bottom of the page. It can be said that users visiting a web site initially look at the central column, then the left column, and finally the right column, and that the attention of users get distracted, unless there is anything interesting towards the lower parts of the page (Schroeder, 1998; Yaprakdal, 2006). Zambarbieri et al (2008) performed eye-tracking analysis while people were reading an online newspaper. Parallel to this study, they found that people focused the most on the left and central column and the least on the right column. Byerly (2007) established the "Golden Triangle Rules". According to this rule, if a screen as divided diagonally from right top to lower left, the area above the line would be the Golden Triangle. This is the prime viewing area where website users initiate and concentrate their focus. Goldberg et al (2002) studied users' behaviors while they were scanning web pages, and found that users tended to look at the upper or left side of the screen at the first look. Furthermore, Russell (2005) explained that the upper-most sections on the left navigation menu received the most fixations. According to Gilutz and Nielsen's usability findings regarding children, they rarely scrolled pages and mainly interacted with the information that was visible above the fold (as cited in Yahaya & Salam, 2010). Based on this finding, it is considered that anything that is desired to be definitely seen by users should be located in the center or on the left side of the page.

The present study demonstrates that large number of fixations and the disperse nature of fixation locations make it hard for users to find the task. In this study, scattered fixation areas indicate that subjects had difficulties in the "find the classroom list (Task 6)". Gagneux et al (2001) also found in their study that there is a relation between the fixation range and the time spent on the page, the quality of the page and the structure of the page.

The habits and experiences of users are very important while they are surfing on a web site. It has been observed that they usually expect to meet situations they are familiar with while they are surfing on a web site. They want to find objects in locations where they are used to see and with familiar icons. In this study, it has been seen that users prefer to use “site search” application in order to reach objects they cannot find on the site and in order to achieve the goal. Users employ site search application as a source of help in cases where they have difficulties. Similarly, Josephson and Holmes (2002) recorded users’ eye-movements for three different types of web pages in their study. Eye movements were recorded three times weekly. Researchers found that, although the study was an exploratory one in natural environment, users followed a way opposite the page habitually. In this study as well, users preferred “search site” function and it is considered that they did it habitually.

One of the situations related to habits is the links on web pages. It was seen that users wanted to reach the task they wanted to complete using a link on the screen or with one-step without needing to return to the homepage. In this study, subjects did not notice the “teacher tools” menu used for many tasks. Even though the buttons were noticed, they had trouble with the links on the screen when they were unable to realize that they needed to return to the homepage. Therefore, locations of the links on the screen should be designed in such a way that users can go to another page with only one click.

In this study, it was seen that there were objects in sizes that made it difficult for users to notice on the screen. It was also found based on eye-movement data that size of some objects and words were too small to notice. There should be options that enable users to decide on the size of objects according to their preference. Similarly, in an eye-tracking study conducted on 650 students, Byerly (2007) stated that the size of objects should be designed based on age groups. According to this study, one of the most important factors in terms of usability and children is age. Byerly said, “One size doesn’t fit all”. Furthermore, Mackey and Ho (2008) explained that presentation of a Web page is affected by screen resolution, which is variable among different computer monitors. This is a web usability factor that can be defined by developers in values of pixels or percentages. Niederst (2001) argues that ‘‘the page should be accessible (and display properly) to the greatest possible number of people”. As a result, screen designs should present options for adults to use the screen with the size they like, and screen should be designed in such a way that, when screen resolution changes, the size of objects and words also change automatically.

It was found that pop-up windows within the site (animation window, homework window, classroom list window, help window etc.) were the areas users focused the most. It is considered that the reason is the shadowing of the areas out of the window. The things attracting attention in the areas out of the open windows were shadowed and thus users focused only on the open window. Using this feature on the windows containing explanations of course subjects is especially important to ensure continuity of users’ attention.

When perceptions towards the help menu are analyzed, it was observed that participants had a little confidence in the help menu. It is not regarded as a reference source for difficult situations. Furthermore, subjects gave the least points to “availability of help” in the satisfaction survey. The reason lying behind the loss of confidence of users in the help menu can be that they cannot reach a solution for their problems even though they apply to the help menu. Therefore, in webpage designs, help menus should offer reliable solutions for problems that are likely to emerge.

As a result of this study, it was seen that education media disregarding users’ expectations and usability criteria cannot attain their goals. Even in Vitamin educational software package, which is supported by The Republic of Turkey Ministry of National Education and received many international awards, some problems were identified with respect to usability. Therefore, it is considered that, particularly in educational software, studies on usability are not adequate, and more importance should be attached to this matter. Furthermore, it can be said that eye-tracking techniques can be used effectively in usability studies. Eye-tracking devices can be utilized for identifying the problems that emerge with respect to the design and for determining changes required to be made on the design. In order to create new user-friendly designs, eye-tracking devices can be employed both in the design and the evaluation phases in an effective way.

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