THE USE OF USER CENTERED AND MODEL BASED APPROACHES IN THE SOLUTION OF USABILITY PROBLEMS OF WEB INTERFACE

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Abstract – As the computers are included in our daily lives more and more, the importance of comfortable and easy usage of interfaces in computer media has been increasing day by day. There are different approaches which are used to evaluate the usability of these interfaces. The aim of this study is to investigate the effect of the data obtained by applying the user centered and model based approaches on usability in terms of the solution of usability problems that the web interface has. Within this context, with the help of 12 academicians who work at Gaziosmanpaşa University Faculty of Medicine, the user centered approach was conducted on "Faculty of Medicine Assessment and Evaluation" system. The data obtained from CogTool was used for Model Based approach. As a result of this study, it was concluded that both approaches increased the usability, but when they were used separately, they were incompetent to diagnose some of the usability problems. In the light of these results, it can be said that the use of both models together can contribute increasing usability much more.

Keywords – *Usability, user centered approach, model based approach, CogTool.*

1. Introduction

The knowledge produced by humanity makes it possible for societies to have a better place and makes the lives of people easier through technology. It can be said that these developments in technology can make the lives of people easier only by their appropriate use[1]. These rapid changes in information technologies provide opportunities such as immediate communication; obtaining, storing and processing huge amount of data, and presentation of these huge data with other media tools [2]. All of these changes in Information technologies enabled the studies related to the interaction between humans and computers to be conducted from 1960s till today [3].

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The human-computer interaction can be summarized as an interdisciplinary field which investigates not only the users and the processes that these users want to conduct, but also the interaction and usability of computer interfaces [4, 5]. It is not a coincidence that the common point in different definitions by different people is "usability". Usability is defined as a measure about how easy the users complete the specific tasks and the achievement of specific tasks at a targeted level easily in appropriate environment conditions by practitioners who were trained and supported technically [6-8].The things that a user want to do and the responds of the system is called as Gulf approach [9]. This approach can be summarized as the decrease of the effort needed to use the system [10]. The Gulf approach is composed of two parts called as "Gulf of Execution" and "Gulf of Evaluation". The gulf of evaluation refers to the understanding level of messages by the user, and the Gulf of execution refers to the situation where the user understands the messages but has no idea what to do [11, 12].

There are different methods which aim the measurement of the usability of systems. Some of these methods are design guide, heuristic, experimental approach and model based approach. The methods are varied in terms of the style of practice. For example, the usability study can be conducted through eye tracking or think-aloud both on PC and on paper [12]. Among the methods mentioned, it can be said that the model based approach differs from the rest. The cognitive and physical behaviors of the users are tried to be modeled, and it is investigated how to use these models faster in model based approach [12]. It can be said that the limited area where the model based approaches can be used is the handicap of this model.

The number of participants is another issue that should be considered during usability studies based on user centered approach. It is stated that such studies should have at least five participants, but this number is not sufficient for 100% achievement[12, 13].The user centered approach generally reveals the most important problem, making it possible for smaller problems to be ignored or missed out, and this approach doesn't offer a solution for the problems detected. These points are seen as the handicaps of user centered approach [12]. Therefore, using it with model based approach, which helps obtaining the data most about usability problems, can be a guide way in detecting usability problems and providing a solution.

Problem

Considering the current literature, this study seeks an answer to the question "what is the effect of improvement made by the data obtained through user centered and model based approaches in terms of the solution of usability problems of a web interface on the usability?

Research Questions

Within the scope of the research, two questions below are tried to be answered.

1. What kind of usability problems of the relevant web interface are revealed by user centered and model based approaches?

2. What are the effects of user centered and model based approach usage on the gulf of execution and gulf of evaluation?

2. Method

2.1. Research Design

Considering the volunteered participants, the research design was determined as one-sample pretest-posttest model. With one-sample pretest-posttest model, the higher scores on posttest (P_2) are assumed to source from the changes made in the system [14]. The research design is summarized in Table 1.

Table 1. Research Design, One-Sample Pretest-Posttest Model

Sample	Pretest	Practice	Posttest
G_1	P_1	X (Change of Design)	P_2

As the pretest score, the time spent on completion of present tasks was tried to be determined. As for the posttest score, the time spent on completion of the tasks on which the changes were made was tried to be determined.

The practice steps, the approaches used during this process and information about the participants are presented in Table 2. The data obtained from CogTool and users were used in order to determine the usability problems of "*Faculty of Medicine Assessment and Evaluation*" interface, which is in use at Gaziosmanpaşa University and to evaluate the newly developed interface within the scope of model based approach.

Table 2. The approaches used in the study and information about the participants

	Stage	Practice	The approach used	Participants	Goal
1	**Pretest P_1**	Determination of Needs	User Centered / Model Based	12Academicians / Researchers/Expert	The determination of usability problems
2	**Practice X**	Designing new interface	Design	Researchers	Interface design in accordance with the data
3	**Posttest P_2**	Testing the new interface	User centered / Model based	12Academicians / Researchers/Expert	The determination of usability problems Evaluation

The study was conducted in three steps as can be seen in Table 2. The scores related to the present situation were obtained and the needs were determined in Step 2 through pretest. The new interface was designed in the light of data obtained in Step 2. The data related to the new interface were obtained in Step 4 through posttest. A model based practice was conducted in Step 1 and 3 using Cog

Tool in order to gather data about cognitive processes. Along with this, a user centered experimental study was conducted as it is the strongest method in revealing the usability problems [12, 15].

2.2. Sample

Considering the volunteers, the convenience sampling method, which is one of the non-random sampling methods, was preferred as a part of the selection of participants [16]. The sample was composed of 12 academicians who used "Gaziosmanpaşa University Faculty of Medicine Assessment and Evaluation web interface" and taught courses in *Semester 1*. The researchers were also served as field expert in the conduction of model based approach. The demographic information about the participants can be viewed in Table 3.

Table 3. Demographics of Participants.

Participants	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
Female / Male	M	F	M	M	M	M	M	M	F	F	M	F
Age	41	34	36	35	43	42	45	35	35	37	35	32

2.3. Practice

Both user centered one sample experimental practice and model based approach were used separately during the process of practice. The steps of each practice are explained. The practice process is presented in Figure 1.

2.3.1. The Practice Process of User Centered Approach

The user centered approach was conducted as a pre-experiment model with a pretest and posttest. In this step, all of the academicians completed the specific tasks twice; before (pretest) and after the design (posttest). The tasks were presented clearly and in the same operation sequence. The tasks and the steps to be taken during the tasks are presented in Table 4. There was a three-week period between the first and second practice. In order to determine what the participants thought during the practices, they were asked to think aloud. The process of task completion was recorded both in audio and video formats using computer tools.

2.3.2. Web Based System Evaluation Questionnaire

In order to determine the usability of the system and the user satisfaction, a questionnaire was used. The questionnaire model is five point likert and it has 17 question. The

participants were asked to complete the questionnaire twice during pretest and posttest. The items of the questionnaire were created benefiting from the items from Çağıltay's (2011) System Usability Scale.
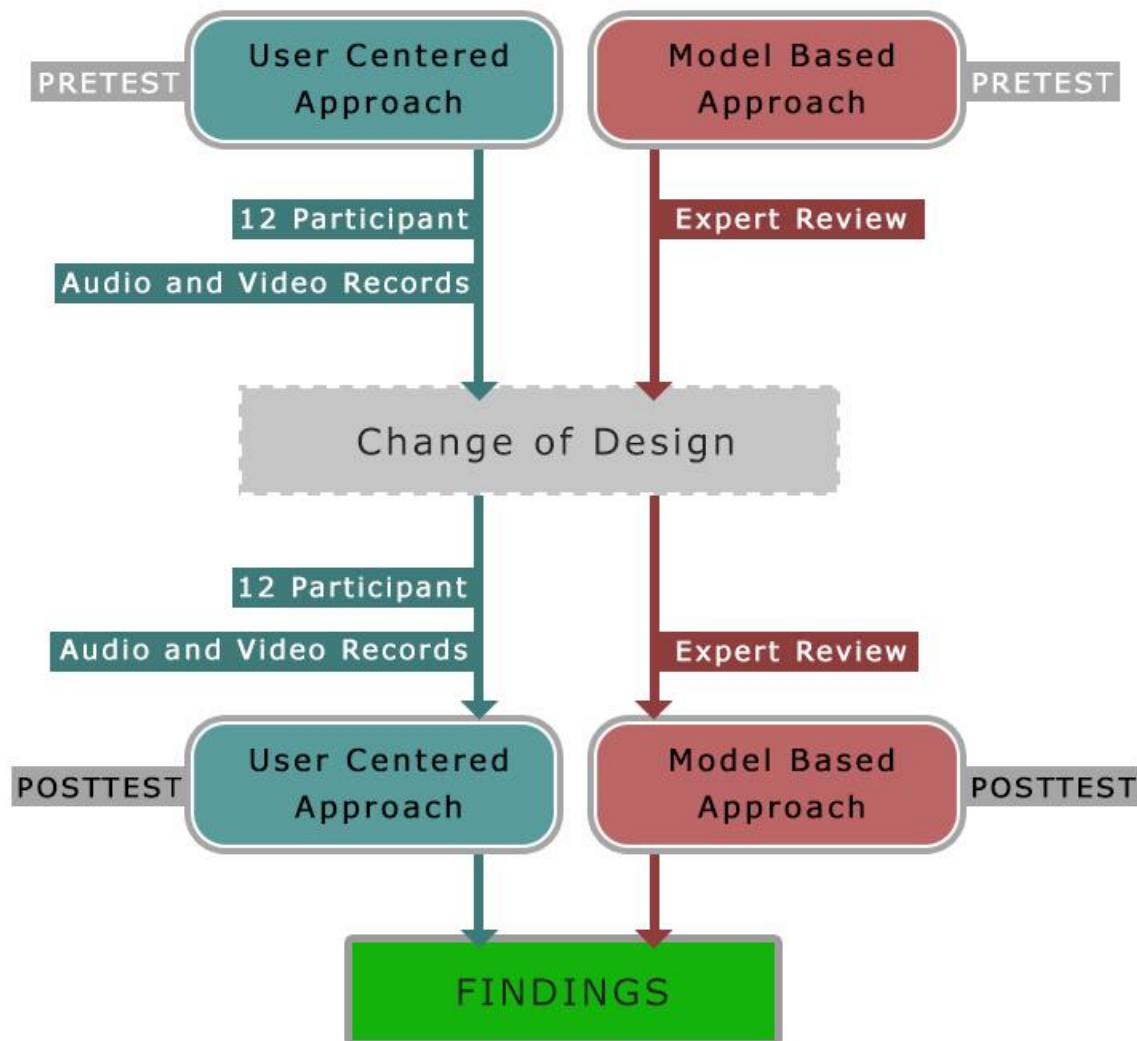

Figure 1. The Practice Process

2.3.3. The Practice Process of Model Based Approach

It is indicated that the studies with model based approach should be conducted by individuals who are experienced both on human-computer interaction/usability and the related system [17]. For that purpose, this model based study was conducted by the researcher who both has studies on human-computer interaction and is the administer of Faculty of Medicine Assessment and Evaluation System. The practices were performed twice before (pretest) and after (posttest) the design.

2.3.4. Data Collection

The data were collected from three different sources. These are the data from user centered approach, model based approach and usability questionnaire. By the user centered

approach, the data about the duration of practice were obtained in terms of seconds. By the model based approach, the estimated duration of completing the practice steps were obtained in terms of seconds. By the Usability questionnaire, the satisfaction of individuals using the system was determined. The responses to the adverse items were reversed so that the questionnaire could produce one way values.

Table 4. The Tasks and the Steps of Tasks

Task 1	Uploading Questions
Steps in Task 1	Clicking on Question Link Clicking on Normal Question Link Pasting Question Text Pasting Alternatives Marking the Correct Alternative Uploading Question Information Clicking on Save Button
Task 2	**Saving Council Questions**
Steps in Task 2	Shifting to Council Question Records Selecting the Council on Which the operation will take place Selecting the Department on Which the operation will take place Finding the Related Question (Which question is this?) Clicking on the Use Button
Task 3	**Exploring the Question Statistics**
Steps in Task 3	Question Statistics Entering the Statistics Menu Clicking on the Question Statistics Option Uploading Council Information

3. Findings

In this part, the data were presented in parallel with the two research questions.

3.1. What kind of usability problems of the relevant web interface are revealed by user centered and model based approaches?

While answering this question, the think aloud technique in user centered approach and web based system evaluation questionnaire was conducted. The findings about the model based approach were obtained through the CogTool. The findings are as follows.

3.2. The Findings about User Centered Approach

The data were collected in two different ways in user centered approach. The first one is think aloud technique and the second one is the system usability questionnaire.

3.2.1. The Findings Obtained Through the Think Aloud Technique

What the participants aimed at doing on the steps of the practice was tried to be determined using the think aloud technique. Within this scope, the recordings of the participants were examined repeatedly and their opinions of the system were tried to be determined. The opinions determined are presented in Table 5.

Table 5. The Findings obtained through participant observations.

Participant	Observation Data
P1	Doesn't know how to return to the Council question records after saving the question.
P1	Doesn't know the function of category based question search.
P1	Doesn't know which option to select during category based question search.
P1	Can't find the return to Question statistics menu after the Council question records.
P1	After saving the question to the Council, can't get a feedback even though clicking on the "Use" button. This situation makes the participant assume that "it's probably used".
P1	Can't find where the question statistics menu.
P3	Doesn't know which option to select about the question entering type.
P3	Doesn't know how to access the council question records menu.
P5	Can't find where the question statistics menu.
P6	Indicates that the question difficulty level is unnecessary to enter.
P1	After saving a question to the council and clicking on the "Use" button, thinks that another operation should be run. Expresses this situation as "I think I should find somewhere to confirm this".
P7	While entering the question, indicates that the right button of the mouse is useless for pasting the question from Word. Instead of this, uses the paste button in the Editor.
P7	The notice informing that the question was uploaded pops up on the top of the page but that feedback isn't enough since the user can't see it. It raises doubts about whether the question was uploaded.
P8	Can't find where the question statistics menu.
P9	Can't find where the question statistics menu. Tells that he/she looked for it earlier but couldn't find, so he/she gives up.
P10	Tried to paste by clicking on the right mouse button. When couldn't, complained about the complexity of the editor.
P12	Told that he/she knew where the question statistics menu since he/she had problems about the question statistics menu earlier.

3.2.2. The Findings Obtained through the User Centered Experimental Method

By examining the video recordings of each participant, the completion duration of steps of the tasks was tried to be determined. The completion duration of steps of the tasks by each academician is presented in Table 6 in terms of seconds.

The findings of the study were dealt with separately on the basis of practices. Obtained through the e-user centered experimental method, the findings about the "question uploading, council question records and question statistics" tasks are as follows.

Task 1: Wilcoxon test results, which was conducted in order to determine whether there was a significant difference between total amount of time spent on completion of "uploading questions" task are presented in Table 7.

Table 6. The completion duration of the tasks by participants (in terms of seconds)

Category	Tasks	P1 P_{11}	P1 P_{12}	P2 P_{11}	P2 P_{12}	P3 P_{11}	P3 P_{12}	P4 P_{11}	P4 P_{12}	P5 P_{11}	P5 P_{12}	P6 P_{11}	P6 P_{12}	P7 P_{11}	P7 P_{12}	P8 P_{11}	P8 P_{12}	P9 P_{11}	P9 P_{12}	P10 P_{11}	P10 P_{12}	P11 P_{11}	P11 P_{12}	P12 P_{11}	P12 P_{12}
Question Uploading Window	Clicking on the question link	3	3	2	3	2	3	5	3	8	3	3	2	3	3	5	3	3	3	4	3	3	2	4	3
	Clicking on the normal question link	2	2	2	2	2	2	2	3	2	2	2	2	10	4	5	2	7	2	2	3	2	2	2	2
	Pasting the question text	37	19	31	21	16	6	52	5	11	11	14	7	52	16	29	10	13	9	48	14	76	10	15	5
	Pasting the alternatives	84	39	44	38	48	27	50	41	43	34	15	36	59	46	70	23	47	39	61	30	38	31	34	25
	Marking the right alternative	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Uploading Question Information	7	19	4	11	5	6	14	9	12	7	17	14	24	13	15	8	20	13	17	18	16	8	15	5
	Clicking on Save Button	1	2	1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
Council Question Records	Shifting to Council Question Records	12	6	2	2	9	2	9	2	11	2	9	3	X	2	4	2	19	4	11	2	15	4	13	2
	Selecting the Council on Which the operation will take place	3	3	5	4	2	2	2	4	3	4	2	3	7	3	2	5	12	2	2	3	2	2	2	2
	Selecting the Department on Which the operation will take place	2	3	2	3	2	2	2	3	2	3	2	3	2	2	1	5	4	2	2	3	2	2	2	2
	Finding the Related Question (Which question is this?)	21	11	7	8	16	6	21	9	24	8	10	5	12	10	2	12	17	11	21	13	19	6	19	14
	Clicking on the Use Button	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2
Question Statistics	Question Statistics	39	3	103	3	16	4	12	3	61	3	5	4	X	2	115	3	14	2	80	3	32	2	5	3
	Entering the Statistics Menu	21	X	X	X	3	X	2	X	X	X	2	X	X	X	5	X	6	X	X	X	5	X	2	X
	Clicking on the Question Statistics Option	9	3	X	3	9	3	6	2	X	3	4	2	X	3	9	2	18	3	X	2	24	1	14	1
	Uploading Council Information	4	6	X	7	6	4	16	8	X	5	X	7	X	11	X	5	X	13	X	5	X	7	X	2

X: Couldn't be observed.
P: Participant
P11: Pretest measurement
P12: Posttest measurement

As can be seen in Table 7, the p<0,01level of pretest and posttest about the "uploading questions" task is significant (Z=-4,637 p<.00). This finding shows that the 31,99 secs pretest completion time has improved to 14,68 secs after the changes were made.

Table 7. Wilcoxon test results about the "uploading questions" task.

Group	N	Average Duration (seconds)	Total Duration (seconds)	Z	p
Pretest	12	31,99 secs	1279.5 secs	-4,637	.00
Posttest		14,68 secs	205.5 secs		

Task 2: Wilcoxon test results, which was conducted in order to determine whether there was a significant difference between total amount of time spent on the completion of "council question records" task are presented in Table 8.

Table 8. Wilcoxon test results about the "council question records" task.

Group	N	Average Duration (seconds)	Total Duration (seconds)	Z	p
Pretest		26,13 secs	627 secs		
	12			-3,32	.01
Posttest		10,20 secs	153 secs		

As can be seen in Table 8, the completion time of pretest and posttest about the "council question records" task is significant at p<0,05level (Z=-3,32 p<.01). This finding shows that the 26,13secs pretest completion time has improved to 10,20 secs after the changes were made.

Task 3: Wilcoxon test results, which was conducted in order to determine whether there was a significant difference between total amount of time spent on the completion of "question statistics" task are presented in Table 9.

Table 9. Wilcoxon test results about the "question statistics" task.

Group	N	Average Duration (seconds)	Total Duration (seconds)	Z	p
Pretest		11,88 secs	249 secs		
	12			-3,996	.00
Posttest		3,5 secs	3,5 secs		

As can be seen in Table 9, the completion time of pretest and posttest about the "question statistics" task is significant at p<0,01level (Z=-3,996 p<.00). This finding shows that the 11,88secs pretest completion time has improved to 3,5 secs after the changes were made.

3.2.3. The Findings Obtained through the Web Based System Evaluation Questionnaire

After the user centered approach, the scores obtained from the questionnaire which was presented to the participants twice as pretest and posttest were calculated. The mean scores of 12 participants on each item are presented in Table 10.

When the pretest-posttest responses of the participants were examined, it was observed that the user satisfaction changed positively except for only one item.

Table 10. The Pretest-Posttest Average Scores of System Usability Questionnaire

ITEMS	Mean Score of Pretest (secs)	Mean Score of Posttest (secs)
The use of system was clear and understandable.	3,62	4
I was able to use the system comfortably.	3,77	4,38
Learning how to use the system was easy.	3,54	4,38
I am satisfied about the use of the system.	3,69	3,69
I think that I will use the system frequently.	3,85	4,38
I think that the system is unnecessarily complicated.	3,31	4,08
I think that the use of system was easy.	3,23	4,46
I think that I can use the system without needing foreknowledge.	2,69	2,15
I think that the system has too many inconsistencies.	3,31	3,85
I think that the use of the system is too slow.	3,77	4,08
I had to learn much before using the system.	3,23	3,69
I think that using the system will be beneficial.	4	4,46
I regard the system as a waste of time.	4,38	4,46
I think that the evaluations made by using the system will make the lessons more quality.	3,69	3,69
I think about sharing the system with my colleagues.	3,77	4,23
I think that I can guide my colleagues about using the system.	3,46	4,15
I have the intention to use the system in my courses in the future.	3,46	4,31
Mean	**3,58**	**4,03**

3.3.   The Findings Obtained through the Model Based Approach

The findings about the "question uploading, council question records and question statistics" tasks obtained through the CogTool using model based approach are as follows.

Task 1: The before and after design process steps of the "Uploading Questions" task were simulated by CogTool. The time spent on before and after design process steps are presented in Table 11 as a result of evaluation conducted using CogTool. Moreover, CogTool Screenshot of the practice can be seen in Figure 2.

When the Table 11 is examined, how much time the windows opening one after another and the links clicked on took cognitively and physically can be viewed. When the data of pretest and posttest is examined, it can be observed that instead of opening on new windows, presenting the related functions with a menu by a link below made it possible for the operations to take less time.

When the Figure 2 is examined, it can be observed that the 15,9 secs duration of participants' accessing to the question uploading screen improved to 11 secs thanks to the changes on the system. The function of pop-up menu was added to the system in the light of the data obtained from the pretest, which was conducted through expert review and user centered approach.

Table 11. The Time spent on process steps of "Question Uploading" practice.

Procedure	Pretest	Posttest
Thinking on the operation to be made.	Mr=1.2 secs	Mr=1.2 secs
+ Accessing memory	Mo=0.05 secs	Mo=0.05 secs
Thinking about moving the cursor	Mr=0.05 secs	Mr=0.05 secs
Moving the cursor	K=0.43 secs	K=0.43 secs
Thinking on Clicking on the mouse	Mr=0,05 secs	Mr=0,05 secs
Clicking on the **Upload** button	Mo=0.15 secs	Mo=0.15 secs
Thinking on the operation to be made	Mr=1.2 secs	-
Perceiving the opening window (wait)	K=3.8 secs	K=4.1 secs
+ Accessing memory	Mr=0,1 secs	Mr=0,1 secs
Thinking about moving the cursor	Mr=0.05 secs	Mr=0.05 secs
Moving the cursor	K=0.28 secs	K=0.42 secs
Thinking on Clicking on the mouse	Mr=0,05 secs	Mr=0,05 secs
Clicking on the **Question** button	Mo=0.15 secs	Mo=0.15 secs
Thinking on the operation to be made	Mr=1.2 secs	-
Perceiving the opening window (wait)	K= 1.8 secs	-
+ Accessing memory	Mr=0,1 secs	Mr=0,1 secs
Thinking about moving the cursor	Mr=0.05 secs	Mr=0.05 secs
Moving the cursor	K=0.2 secs	K=0.204 secs
Thinking on Clicking on the mouse	Mr=0.05 secs	Mr=0.05 secs
Clicking on the **Normal Question Upload** button	Mo=0.15 secs	Mo=0.15 secs
Perceiving the operation (wait)	K= 5 secs	K= 2.4 secs
TOTAL	**16.11** secs	**11** secs

Mr   : Mental reach.
Mo   : Show item with mouse.
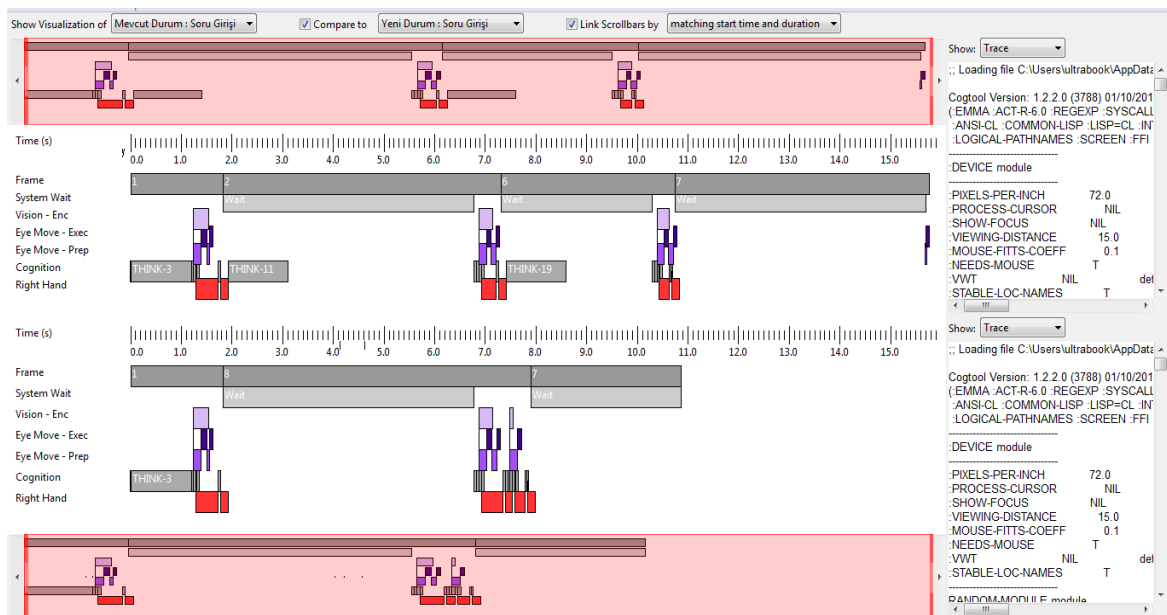K   : Pressing a button on keyboard.

Figure 2. CogTool Screenshot of the Question Uploading Practice

Task 2: The before and after design process steps of the "Council Question Records" task were simulated by CogTool. The time spent on before and after design process steps are presented in Table 12 as a result of evaluation conducted using CogTool. Moreover, CogTool Screenshot of the practice can be seen in Figure 3.

Table 12. The Time spent on process steps of "Council Question Records" practice.

Procedure	Pretest	Posttest
Thinking on the operation to be made.	Mr=1.2 secs	Mr=1.2 secs
+ Accessing memory	Mo=0.05 secs	Mo=0.05 secs
Hand on Mouse	Mr=0.357 secs	Mr=0.357 secs
Thinking about moving the cursor	Mr=0.05 secs	Mr=0.05 secs
Moving the cursor	K=0.458 secs	K=0.392 secs
Thinking on Clicking on the mouse	Mr=0,05 secs	Mr=0,05 secs
Clicking on the **Enter** button	Mo=0.15 secs	Mo=0.15 secs
Perceiving the opening window (wait)	K=2.0 secs	K=1.2 secs
+ Accessing memory	Mr=0,1 secs	-
Thinking about moving the cursor	Mr=0.05 secs	-
Moving the cursor	K=0.474 secs	-
Thinking on Clicking on the mouse	Mr=0,05 secs	-
Clicking on the **Question** link	Mo=0.15 secs	-
Thinking on the operation to be made.	Mr=1.2 secs	-
+ Accessing memory	Mr=0,1 secs	-
Thinking about moving the cursor	Mr=0.05 secs	-
Moving the cursor	K=0.294 secs	-
Thinking on Clicking on the mouse	Mr=0,05 secs	-
Clicking on the **Council Question Records** button	Mo=0.15 secs	-
Thinking on the operation to be made.	Mr=1.2 secs	-
+ Accessing memory	Mr=0,1 secs	Mr=0,1 secs
Thinking about moving the cursor	Mr=0.05 secs	Mr=0.05 secs
Moving the cursor	K=0.313 secs	K=0.409 secs
Thinking on Clicking on the mouse	Mr=0,05 secs	Mr=0,05 secs
Clicking on the **Save** button	Mo=0.15 secs	Mo=0.15 secs
TOTAL	**8.84 secs**	**4. 208 secs**

Mr   : Mental reach.
Mo   : Show item with mouse.
K   : Pressing a button on keyboard.

When the Table 12 is examined, how much time the participants spent on council question records cognitively and physically can be viewed. When the data of pretest and posttest is examined, it can be observed that removing the "council question records" from the top menus and fixing it on the left menu made it possible for the operations to take less time.
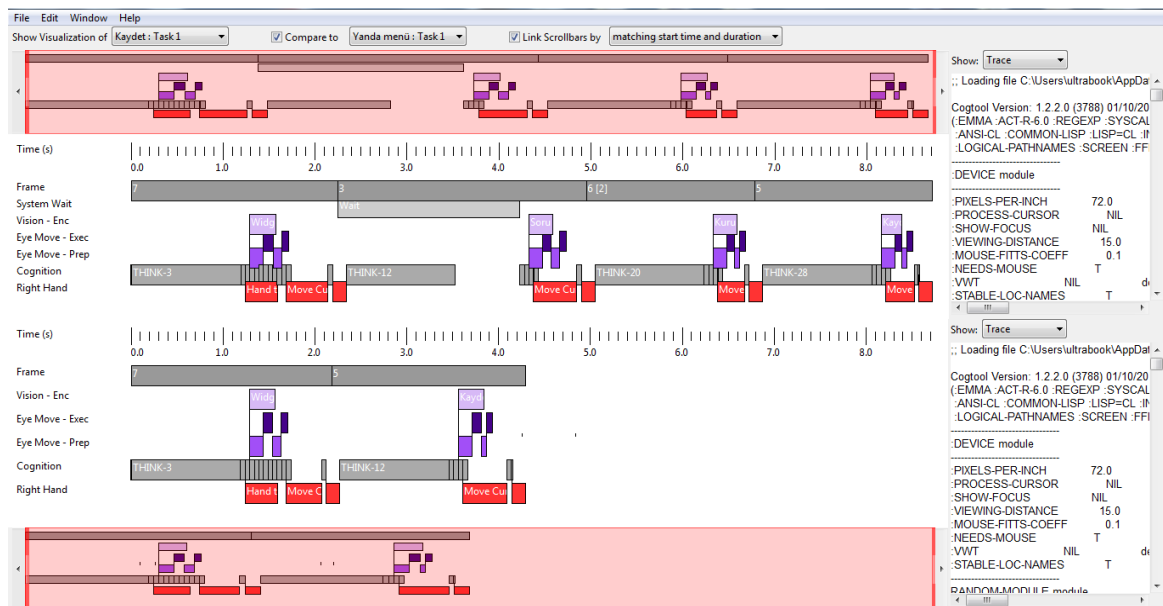
Figure 3. CogTool Screenshot of the Council Question Records Practice

When the Figure 3 is examined, it can be observed that the 8,8 secs duration of participants' accessing to the council question records screen improved to 4,3 secs thanks to the changes on the system. The relevant link on the left menu was placed on the edge of the page moving together with the scrolling and was made visible all the time in the light of the data obtained from the pretest, which was conducted through expert review and user centered approach. Thus, both the number of process steps was reduced and leaving without saving the council was prevented.

Task 3: The before and after design process steps of the "Question Statistics" task were simulated by CogTool. The time spent on before and after design process steps are presented in Table 13 as a result of evaluation conducted using CogTool. Moreover, CogTool Screenshot of the practice can be seen in Figure 4.

When the Table 13 is examined, how much time the participants spent on question statistics cognitively and physically can be viewed. When the data of pretest and posttest is examined, it can be observed that replacing the "question statistics" link made it possible for the operations to take less time.

When the Figure 4 is examined, it can be observed that the 7,5 secs duration of participants' accessing to question statistics screen improved to 4,3 secs thanks to the changes on the system. The question statistics link was added to the pop-up menu in the light of the data obtained from the pretest, which was conducted through expert review and user centered approach.

Table 13. The Time spent on process steps of "Question Statistics" practice.

Procedure	Pretest	Posttest
Thinking on the operation to be made.	Mr=1.2 secs	Mr=1.2 secs
+ Accessing memory	Mo=0.05 secs	Mo=0.05 secs
Thinking about moving the cursor	Mr=0.05 secs	Mr=0.05 secs
Moving the cursor	K=0.419 secs	K=0.419 secs
Thinking on Clicking on the mouse	Mr=0,05 secs	Mr=0,05 secs
Clicking on the **Enter** button	Mo=0.15 secs	Mo=0.15 secs
Searching Academician link in the new window	Mr=1.2 secs	-
Searching statistics link in the new window	-	Mr=1.2 secs
+ Accessing memory	Mr=0,05 secs	Mr=0,05 secs
Thinking about moving the cursor	Mr=0.05 secs	Mr=0.05 secs
Moving the cursor	K=0.319 secs	K=0.348 secs
Thinking on Clicking on the mouse	Mr=0,05 secs	Mr=0,05 secs
Clicking on the Academician link	Mo=0.15 secs	-
Clicking on the **Statistics** link	-	Mo=0.15 secs
Finding the academician on the menu	Mr=1.2 secs	-
Finding the question link on the menu	-	-
+ Accessing memory	Mr=0,1 secs	-
Thinking about moving the cursor	Mr=0.05 secs	Mr=0.05 secs
Moving the cursor	K=0.319 secs	K=0.204 secs
Thinking on Clicking on the mouse	Mr=0,05 secs	Mr=0,05 secs
Clicking on the **Select** button	Mo=0.15 secs	Mo=0.15 secs
Finding question statistics link on the menu	Mr=1.2 secs	-
+ Accessing memory	Mr=0,1 secs	-
Thinking about moving the cursor	Mr=0.05 secs	-
Moving the cursor	K=0.204 secs	-
Thinking on Clicking on the mouse	Mr=0,05 secs	-
Clicking on the **Question Statistics** button	Mo=0.15 secs	-
TOTAL	**7.36 secs**	**4.22 secs**

Mr : Mental reach.
Mo : Show item with mouse.
K   : Pressing a button on keyboard.

3.4. What are the effects of user centered and model based approach usage on the gulf of execution and gulf of evaluation?

The data obtained from the think aloud technique and web based system evaluation in user centered approach were used while answering this research question. Moreover, the data about the Norman's gulf of execution were obtained through CogTool. The findings about the gulf of execution and evaluation are as follows.
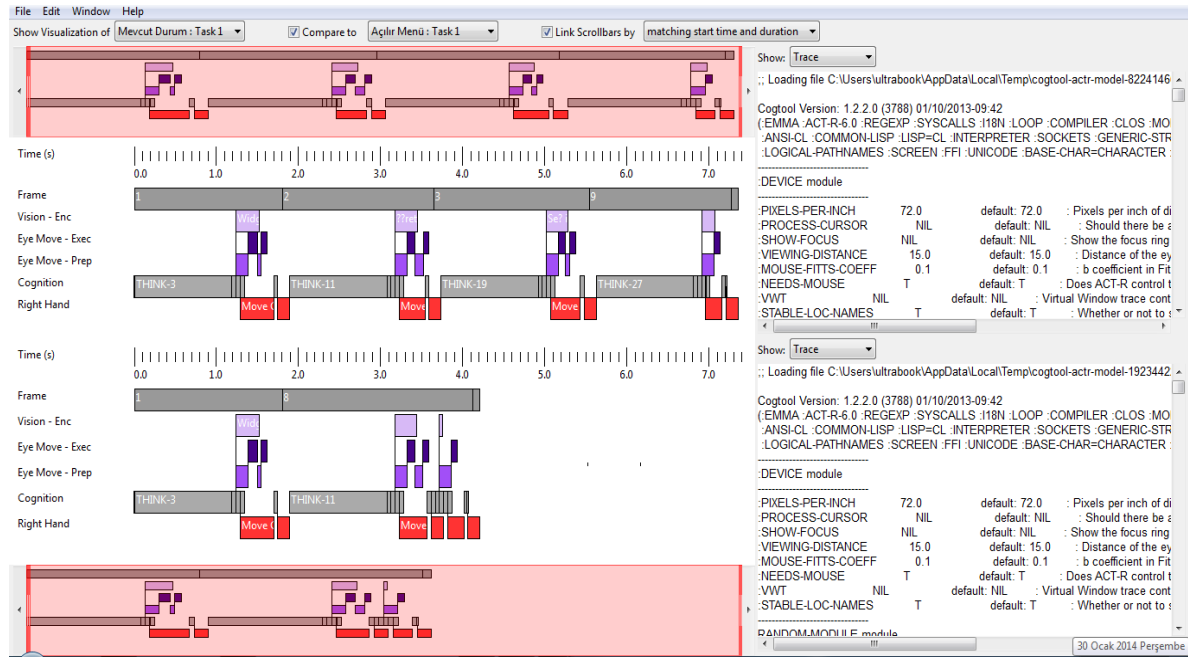
Figure 4. CogTool Screenshot of the Question Statistics Practice

3.5. The Findings about the Gulf of Evaluation

The findings about the targets and aims of the users are presented in this section. Thus, the reactions of the users against what the physical system presented were tried to be determined. Within this context, the data obtained through especially the think aloud technique are presented in six items below:

1) The function of category based question search is unknown.
2) The function of question uploading options is unknown.
3) The options in category based question search are incomprehensible.
4) The functions of buttons on the editor are incomprehensible.
5) Where the question statistics menu is unknown.
6) How to go to the council question records is unknown.

3.6. The Findings about the Gulf of Execution

The findings about the reactions of the users against the aims are presented in this section. Thus, the physical reactions of the users against the things on their mind were tried to be determined. Within this context, the data obtained through think aloud technique and model based approach are presented below.

1) The lack of feedback after the operation is completed makes the users have a suspicion.
2) The lack of feedback on the completed operations makes the users feel anxious.
3) It is indicated that the right click function of the mouse doesn't work in uploading question in the text editor.

Along with the think aloud technique, the prospective process time in the old system and the newly designed system was determined by CogTool. Thus, the duration of the task completion in the gulf of execution was tried to be minimized. The related findings are presented in Table 11.

Table 11. The Estimated Task Completion Durations by Model Based Approach

	The Old System	The Newly Designed System
Task 1	15,9 secs.	11,0 secs
Task 2	8,8 secs.	4,3 secs.
Task 3	7,5 secs.	4,3 secs.

4. Conclusion and Discussion

The ultimate goal of the interface designers is to design usable interfaces. There are different methods to assess the usability of these interfaces. The most common of these methods is the think aloud method. The data obtained through the think aloud technique is useful in the identification of the problems at endpoints [17]. Think aloud is a technique that is used with user centered approaches. Within this context, it was tried to identify the usability problems using both user centered and model based approaches in the research. Three tasks were defined in order to identify the problems, and both approaches were used within the scope of these tasks.

The estimated pretest completion durations were estimated to be 31,99 seconds, 26,13 seconds and 11,88 seconds, respectively, as part of the three tasks of user centered approach. During these time periods, the problems that the users faced with were identified with the help of think aloud technique and the necessary alternations were made. After the modifications on the system, the completion durations of three tasks were estimated to be 14,68 seconds, 10,20 seconds, and 3,5 seconds, respectively. These results show that the a total of 66 seconds pretest completion duration decreased to 28,28 seconds. The similar studies conducted using user centered approach indicate that the modifications in accordance with the data increases the usability of the interface and the satisfaction of the users [18,19].

The estimated pretest completion durations were estimated to be 15,9 seconds, 8,8 seconds and 7,5 seconds, respectively, as part of the three tasks of model based approach. After the modifications on the system as a result of the data obtained through expert review and the pretest conducted with user centered approach, the completion durations of three tasks were estimated to be 11,0 seconds, 4,3 seconds, and 4,3 seconds, respectively. These findings show that the assessment of newly designed interfaces by CogTool can contribute to usability. In relation with this situation, John (2010) states that CogTool is one of the best tools that can be used for the duration estimations of operations in the steps of the specific tasks [20].

The data of the gulf of execution and evaluation were obtained using the both methods. It can be said that the user centered approach presented more efficient data about the gulf of evaluation since the messages from the system couldn't be understood by the users. On the other hand, both of the methods presented efficient data about the level of response from the system to what the users wanted to do, which is called the gulf of execution. By the user centered approach, the data about the problems and expectations of the users about these gulfs. On the other hand, by model based approach, the data about how the problems and expectations of the users can be fulfilled were obtained.

By using the both methods, some usability problems in the old system were determined. However, when the findings of the methods were examined, it was observed that the two approaches revealed different usability problems. CogTool is widely used in model based approach in order to determine whether the system is congenial with the users' cognitive structures [21]. This tool makes it possible for the designers to analyze their preliminary designs quickly [22]. However, the data about the solutions corresponding to the users' expectations couldn't be obtained although it presented data about whether the system is congenial with the users' cognitive structures. When the literature was reviewed, it was concluded that the use of cognitive methods in understanding the usability problems are efficient in the phase of setting actions [23].

In the light of the findings, it can be indicated that using different usability methods together can give efficient results for the solution of usability problems.

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