International Journal on Advanced Science Engineering Information Technology

Vol.8 (2018) No. 4-2
ISSN: 2088-5334

Improvement of the Usability of Online Mentoring Website

Dae-Seop Kim[#], Jae-Kyeong Lee[#], Dong-Gu Shin [$], Mi-Hwan Hyun[*]

[#]*Idea Commercialization Center, Korea Institute of Science and Technology Information, 02456, Republic of Korea.*
E-mail: daeseoby@kisti.re.kr, gngee@kisti.re.kr

[$]*Convergence Service Center, Korea Institute of Science and Technology Information, 02456, Republic of Korea.*
E-mail: lovesin@kisti.re.kr

[*]*Open Access Center, Korea Institute of Science and Technology Information, 02456, Republic of Korea.*
E-mail: mhhyun@kisti.re.kr

***Abstract*— The purpose of this study is to improve the usability of the current online mentoring website by deriving what should be improved through assessment and reflecting it on system improvement. The related data such as search log and Think Aloud were collected from user groups (9 users in total), and usability was tested according to the predefined test procedures. The collected data were analysed, using quantitative methods. Regarding search log, the related items including effectiveness, efficiency, satisfaction, and error were quantified according to usability testing standards. Then, descriptive statistics were performed. According to usability comparison before and after system improvement, it has mostly improved such as improved effectiveness (increase by 15 points), better efficiency (reduction by 41 seconds), increase in satisfaction (by 8 points) and decreases in error frequency (decrease by 1.2 times). Usability testing should be viewed as a process, not outcome itself. Therefore, it could be used during system prototype in addition to the current system and useful in system improvement.**

***Keywords*— usability test; online mentoring; user log analysis; user experience; HCI(Human-Computer Interaction)**

I. INTRODUCTION

There have been attempts to improve interface and usability by reflecting users' service experiences in diverse fields. For this, service providers have tried to analyze usability and reflect it on system development, using multiple tools against users. In usability analysis, unlike conventional technology-centered methods, the interaction between the system and users is observed, and knowledge to have insight on user behavior using diverse research methods such as questionnaire, interview and search log can be obtained. Through this kind of process, what the problems are and what should be improved regarding system function and design are detected and reflected on the development for system improvement. In ISO 9241-11, 'usability' is defined as follows: Usability is a degree of effectiveness, efficiency, and satisfaction certain users experience when they use a product to achieve a particular goal under certain circumstances [1]. In other words, it refers to how well users can learn and use a system and how much they are satisfied with the process. It would also represent a way to measure product usability and studies on the theories which support perceived efficiency and aesthetics. In human-computer interaction, 'usability' would mean an analysis of users' experience on computer or websites. In usability, the basic concept is to design a product, considering generalized users' psychological and physiological characteristics. For example, they might be able to fulfill (efficiency) a certain task fast through products or experience a certain degree of satisfaction (satisfaction) through their use. In addition, they may not have to read the user manual (intuitiveness) to use the product. The general components of usability include the followings: learnability ('how easily users can handle basic works'), efficiency ('how fast users can get their job done'), memorability ('how easily users can revisit the website and reuse the data'), error frequency and severity ('how many mistakes users make'), satisfaction ('how convenient users use the website') [2], [3]. The measuring elements, which have been most widely used in usability studies, include effectiveness ('if a task is successfully fulfilled'), efficiency ('implementation speed') and satisfaction ('site preference'). These three elements are the test items, which have been proposed by the ISO 9241-11. A general research method to secure usability is to test current systems against actual users. Actual users are asked to handle certain tasks, using the system. Then, researchers observe them and Figure out what the loopholes are in the system. The problems detected are being solved, and the effectiveness of the improved site is retested. The successful

development and operation of an information system start with the understanding of users. During such development and operation, there should be an evaluation on the user-participatory system from the users' perspective, not from the developer's view. To improve system use efficiency, it is needed to develop continued user test base and test the system in a consistent manner. Experience has shown that the theoretical approach can understand and justify the model choice, but it does raise the problem of insufficient models to include due to the insufficient insight of modelers.

Conversely, a data-driven approach has a potential benefit because it does not rely heavily on expertise [4], [5]. The study suggested using click analysis techniques to evaluate web pages and identify areas of potential usability issues. The disadvantage is that the effects of the results depend on the analyst's ability to interpret and expertise in using the click analysis tool. This should include the modeling of the database as well as the user's questions and experiences. The purposes of this study are to Figure out what should be done to improve the system through usability testing on online mentoring websites and enhance their usability by reflecting the findings on system operation and development.

The studies on web user behavior by Nielsen well reveal the characteristics of the information users on the web [2], [6]. According to him, web users usually cannot stand complicated design or lagging website. They do not like waiting and learning new things on the web. They want to visit a website and expect to use all functions within seconds. Otherwise, most of them just leave the site or search for an alternative. In his study, Lund emphasized the importance of the understanding of general human psychology and physiology as well as an understanding of users in testing website design and usability [7].

It can observe user-system interaction through the user-centered testing method and Figure out what should be done in the system and interface to support task execution efficiently. After generating the profile by measuring the user's first cognitive ability, it should be reflected in the interface based on the user's next behavior information [8]. There are diverse definitions of usability in human-computer interaction and user interface literature. Preece described usability as the main concept of HCI, defining it 'development of an easy-to-learn-and-use system' [9]. A user interface is a field of human-computer interaction. Many studies in this field have their theoretical background in computer engineering and cognitive science.

Regarding a method to test Nielsen's heuristic usability, which applies a series of predefined standards, it is focused to Figure out problems by observing and analyzing the system-user interaction [10]. From the function of the system recognized during the test, its strength and weakness are examined. For example, in testing system personalization, it would be able to detect the problems after developing specific test items on such personalization and observing how well the users use such personalization functions. Regarding standard usability testing-related literature, there is ISO/TR ("Ergonomics of Human-System Interaction-Usability Methods Supporting Human-Centered Design") designed by the International Organization for Standardization (ISO) [11]. This ISO usability testing guideline provides user-centered usability methods, which can be applied to design and assessment and describes their advantages, disadvantages and other factors. The weaknesses to the interface are click-analysis, which is expressed in a heat map, which helps to visualize and improve the user experience of the website [12]. In addition, the implications by life cycle stage according to individual project characteristics and examples on contextual usability methods as well as an explanation on the selection of usability methods are provided.

II. Materials and Methods

A. Test Procedures

In this study, data were collected through a search log and Think Aloud. Usability testing was performed in a one-on-one, face-to-face interview between the tester and testee. In addition, pretest plan and scenario were developed and defined. As illustrated in Fig. 1, data were collected in 4 stages. In stage I, test procedures and instructions was introduced before testing. In stage II, as a warm-up stage, the participants' profile was examined, and pre-interview items, usability test time and equipment were checked. In stage III, there was a preliminary interview to check if the testees were good for usability testing (computer, Internet, site experiences). In stage IV, user tasks were implemented and observed. They were performed in sequence according to the scenario. During the implementation, what they had in mind were freely expressed.

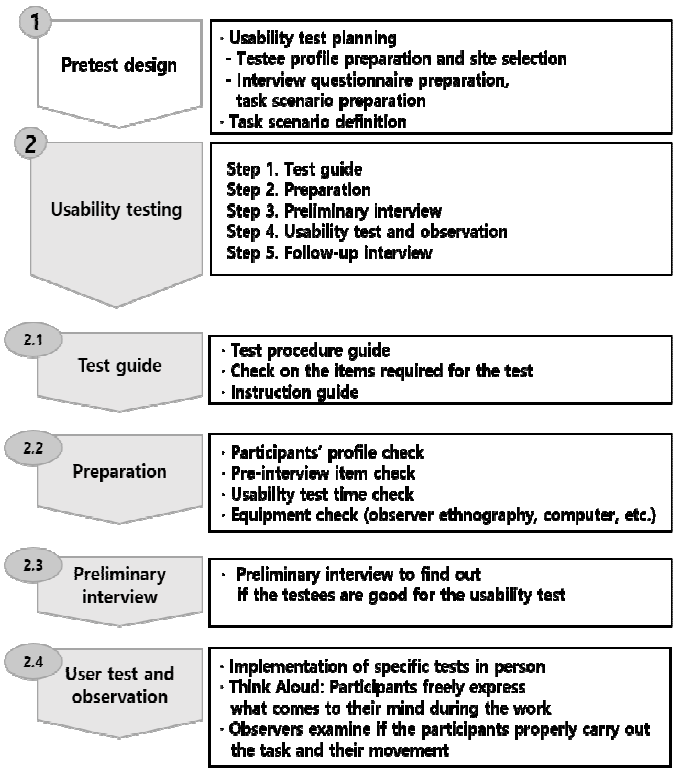

Fig. 1 Usability test procedures

B. Data Collection

Throughout the test, the log by time zone and verbal data were recorded, using observer ethnography. In other words,

user-visited website addresses (URLs), consecutive screen shots (action) and think-aloud data by time zone were collected through observer ethnography. In particular, these types of data are useful in analyzing consecutive act patterns and page change. Using this kind of technology, it can analyze users' log file easily and collected data on each user's process and act. User log is a common method for a user to understand user characteristics and behavior during the system-computer interaction.

'Think Aloud' is to express what you have in mind. In particular, it represents the expression of the reasons for a particular act. This kind of language flow goes thorough texturization and analyze after recording using the software. Verbal protocol analysis is a research method commonly used in cognitive psychology. It is used to find out what users are thinking of while handling a task or problem [13]. The advantages of verbal protocol techniques are that they are accurate and non-interfering and can get data in real-time. These data can collect and handle software automatically. In contrast, their disadvantages include data analysis, privacy issue and data amount [14].

C. Testee Sampling

Usability testing is divided into two parts: before (1st) and after (2nd) system improvement. The first test was performed on April 23 and 26, 2017 while the 2nd one was conducted on August 17 and 18, 2017. Nine users participated in both 1st and second tests, and they were comprised of non-member users who have not used any testing website. Since these testing websites provide online mentoring services for startups, the users who used a similar website before were targeted among those having interest in startup or online mentoring. For the evaluation of the users, the evaluators consisted of 3 persons each in their 20s, 30s, and 40s who use the homepage most frequently. In general, usability testing does not require a large participant group. According to Nielsen, it was able to solve usability problems up to about 80% with 5 test users as shown in Fig. 2 below [15]:

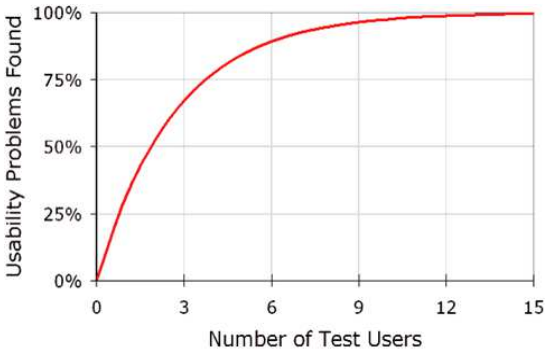

Fig. 2 Correlation between No. of usability test users and problems found

The tasks and task scenarios designed for usability testing feature the functions which reflect the characteristics of current websites. Focusing on the website use processes from the user's perspective, tasks and task scenarios were prepared. Users' general use patterns from a visit to the website to sign-up, online mentoring, information search and participation in the exhibit are referred to. In this study, therefore, a total of 8 tasks include signup, online mentoring information search, apply for online mentoring, exhibit information search, exhibit proposal and participation in the commercialization support program. Fig. Three below reveals each task scenario. Task analysis is an important step to understand the purpose of users' use of services and their access patterns. Furthermore, it explains more specific tasks, which should be performed to achieve the ultimate goal, and describes what processes are gone through to handle such tasks.

No.	Task	Task Scenario
1	Sign-up	Signs up to see other user's proposals
2	Online mentoring information search	Searches the data needed for mentoring such as online Mentoring
3	Apply for online mentoring	Uploads a topic for mentoring and applies for the service
4	Exhibit search	Searches interested Exhibit in progress
5	Exhibit proposal	Submits a proposal to the ongoing Exhibit
6	Commercialization support program search	Searches the commercialization support programs
7	Participation in commercialization support program	Participates in a commercialization support program
8	Interested contents search	Searches interested contents

Fig. 3. Tasks and task scenarios

III. Results and Discussion

A. Improvement of Mentee-Mentor Matching Process

In this study, the collected data were analyzed quantitatively. In general, the purpose of a quantitative method is to generalize a phenomenon while a qualitative method aims to have a deep understanding of such phenomenon and human. This study utilized a user data collection method through search log analysis and Think Aloud to enhance result reliability and increase inter-complementing.

Regarding user search log analysis, user path during task implementation was analyzed, using a heat map. This study analyzed how long task execution would take depending on the menus clicked by users and path complexity and attempted to investigate redundant paths and make an improvement. Figs. 4, five below illustrates the log analysis results during task implementation:

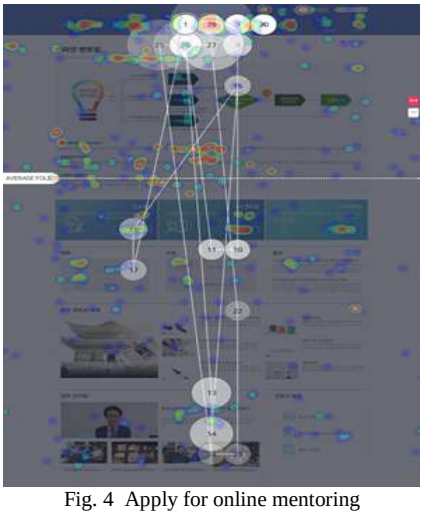

Fig. 4 Apply for online mentoring

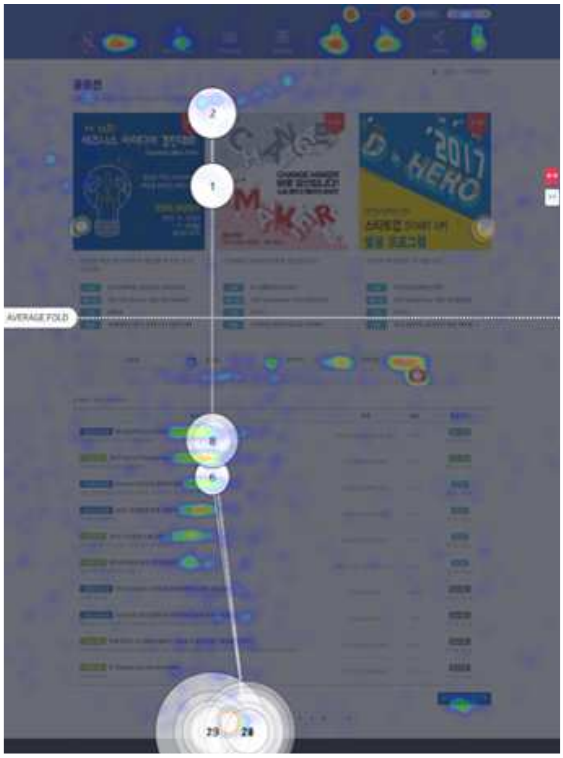

Fig. 5 Apply for the exhibit

Also, the data collected through users' task implementation were analyzed after quantifying effectiveness, efficiency, satisfaction, and error according to usability testing measurement standards as stated in Fig. 6.

Measuring Item	Definition	Measurement	Remark
Effectiveness	If the task is successfully completed or failed	[100 points – (Degree of Satisfaction by Level) × Error Frequency)]	Satisfaction by level after task fulfillment: A: Very Satisfied – 5 points, B: Satisfied – 5 points, C: Neither Satisfied nor Dissatisfied – 10 points D: Difficult – 15 points E: Very Difficult – 20 points
Efficiency	The time being taken to complete the task	[Total time spent during the task – Excluding the interview time (user-researcher)	-
Satisfaction	Check on the level of difficulty in use after implementing each task	A: Very Satisfied – 100 points, B: Satisfied – 90 points, C: Neither Satisfied nor Dissatisfied – 80 points, D: Difficult – 70 points, E: Very Difficult – 60 points	-
Error	Failure or problems after implementing the task	Measurement of error frequency	-

Fig. 6 Usability testing standards

'Effectiveness' refers to a degree of successful task fulfillment. It can be calculated by deducting the value obtained by multiplying task satisfaction by error frequency (out of 100 scores) from 100 points. To measure task satisfaction, testees were asked to answer the uhttp://apps.webofknowledge.com.ezproxy.utm.my/CitationReport.do?product=UA&search_mode=CitationReport&SID=C3IegMUDGKgFHf2u6ag&page=1&cr_pqid=7&viewType=summaryse satisfaction on a 5-point scale after completing each task (A: Very Satisfied, B: Satisfied, C: Neither Satisfied nor Dissatisfied, D: Dissatisfied, E: Very Dissatisfied). Regarding the conversion of the 5-point scale into scores, they were increased by 5 points based on the scores from 'A' to 'E'. However, when a testee selected 'Satisfied' or 'Very Satisfied' after completing the task, the degree of an error felt seemed pretty same. Therefore, 'A (Very Satisfied)' and 'B (Satisfied)' were given 5 points each. Regarding satisfaction, participants were asked to respond to the 5-point scale after each task A: Very Satisfied, B: Satisfied, C: Neither Satisfied nor Dissatisfied, D: Dissatisfied, E: Very Dissatisfied). Regarding conversion of 5-point scale into satisfaction scores, they were reduced by 10 points (out of 100 points). 'Efficiency' means total time spent when testees implement tasks. In addition, error frequency means the number of problems during error frequency.

Fig. 7 above shows general usability testing results before (1st) and after (2nd) system improvement. At the 1st testing before improvement, signup, online mentoring information search, and online mentoring registration revealed relatively high error frequency, long execution time and low satisfaction. In the exhibit search, mid-level usability was found. Regarding the supply of commercialization information such as commercialization support program search, high scores were obtained in low error frequency, efficiency and effectiveness.

Tasks	1st (Before Improvement)				2nd (After Improvement)			
	Effectiveness	Efficiency	Satisfaction	Error	Effectiveness	Efficiency	Satisfaction	Error
1. Signup	70	270	87	3.5	88	130	90	1.2
2. Online mentoring information search	68	170	78	2.0	98	50	88	0.8
3. Apply for online mentoring	72	165	84	4.0	97	65	95	1.5
4. Exhibit information search	85	48	89	1.5	93	30	90	0.7
5. Apply for the Exhibit	80	30	82	3.0	94	45	93	1.3
6. Commercialization support program search	90	50	88	1.3	91	48	98	0.9
7. Apply for commercialization support program	85	31	90	1.4	99	80	96	1.0
8. Interested contents search	82	44	82	0.9	92	32	94	0.6
Mean	79	101.	85	2.2	94 (+15)	60 (-41)	93 (+8)	1(-1.2)

Fig. 7 Usability testing results: before and after improvement

The findings from the 1st usability testing were reflected on system improvement. Figs. 8, 9 below shows 'apply for online mentoring' before and after system improvement. According to the 2nd usability testing after the improvement, the level of usability on signup, idea search and idea suggestion has mostly increased. For example, the number of signup task errors dropped from 2.2 to 1 while a satisfaction level increased from 79 to 94. The time shortened from 101 sec. to 60 sec. Lastly, effectiveness improved from 85 to 93 points. In overall, effectiveness (increase by 15 points), efficiency (shortened by 41 sec.), satisfaction (increase by 8 points) and error frequency (decrease by 1.2 times) improved with better usability.

Fig. 8 Apply for online mentoring(before)

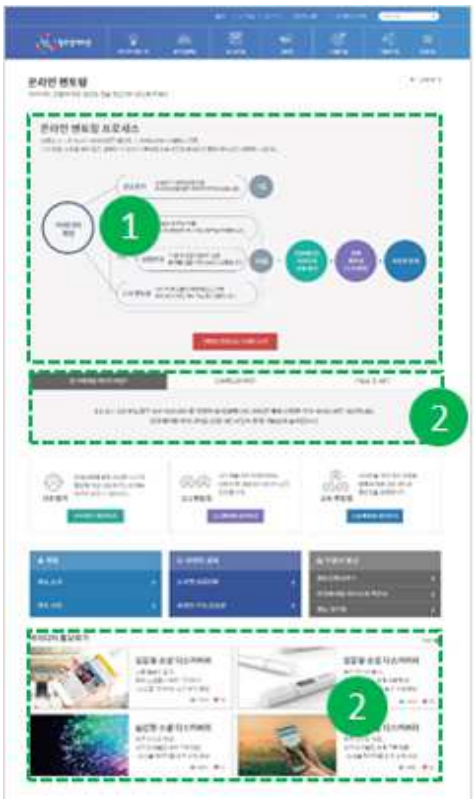

Fig. 9. Apply for online mentoring(after)

IV. Conclusions

This study was performed as a part of the projects to improve user-centered online mentoring services. The design of user-centered web services requires the understanding of user needs. The purposes of this study are to Figure out what should be done to improve the system through usability testing on online mentoring websites and enhance their usability by reflecting the findings on system operation and development. For this, usability data on a total of 9 users were collected, using data collection methods such as user log analysis and Think Aloud. Usability testing in a one-on-one, face-to-face interview between the tester and testee was performed according to the test procedure. The collected data were quantified according to usability testing standards such as effectiveness, efficiency, satisfaction and error, and then descriptive statistics was conducted. With the verbal data collected through Think Aloud, quantitative test results were improved, and improvement implications were derived. After improvement, effectiveness (increase by 15 points), efficiency (shortened by 41 sec.), satisfaction (increase by 8 points) and error frequency (decrease by 1.2 times) improved with better usability. The tasks performed in this study do not cover the usability of all functions. For the continued improvement of system quality, therefore, usability testing should be carried out regularly according to standard test procedures. Furthermore, usability testing should be viewed as a single process, not outcome itself. Therefore, it could be used during system prototype or pilot testing in addition to the current system and useful in system improvement.

Acknowledgment

This research was supported by the Korea Institute of Science and Technology Information (KISTI)

References

[1] ISO, IOFS, "ISO 9241-11: 1998: Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs)-Part 11: Guidance on Usability", *International Organization for Standardization*, 1998.

[2] Nielsen, Jakob, Designing web usability: The practice of simplicity. New Riders Publishing, 1999.

[3] Shneiderman, Ben, et al, “Designing the user interface: strategies for effective human-computer interaction”, 2016.

[4] Hooshyar, Danial, Moslem Yousefi, and Heuiseok Lim, "Data-Driven Approaches to Game Player Modeling: A Systematic Literature Review", *ACM Computing Surveys*, 50.6, 2018.

[5] Hooshyar, Danial, Moslem Yousefi, and Heuiseok Lim, "A systematic review of data-driven approaches in player modeling of educational games", *Artificial Intelligence Review*, 1-21, 2017

[6] Nielsen, J., Usability Engineering, Academic Press, Boston, MA., 1993

[7] Lund, Arnold M, “Expert ratings of usability maxims”, *Ergonomics in Design*, 5.3: 15-20, 1997

[8] JI, Hyesung, et al, “An adaptable UI/UX considering user’s cognitive and behavior information in distributed environment”. *Cluster Computing*, 1-14, 2017.

[9] PREECE, Jenny, et al, Interface Metaphors and Conceptual Models. Human-Computer Interation, 1994.

[10] Ågerfalk, Pär J., et al. “Setting the scene for actability evaluation: understanding information systems in context”. *In: Proceedings of the 9th European Conference on IT Evaluation*, p. 15-16, 2002.

[11] Standard, I, “Ergonomics of human-system interaction–usability methods supporting human-centered design. ISO Standard TR 16982: 2002”, *International Organization for Standardization*, 2002.

[12] Kaur, Kawaljit; Singh, Hardeep. “Analysis of Website using Click Analytics. International Journal of Science”, *Engineering and Computer Technology*, 5.6: 185, 2015

[13] Ericsson, Karl Anders; Simon, Herbert Alexander. “Protocol analysis: Verbal reports as data”, *Rev. the MIT Press*, 1993.

[14] Wang, Peiling; Hawk, William B.; Tenopir, Carol. “Users’ interaction with World Wide Web resources: An exploratory study using a holistic approach”, *Information processing & management*, 36.2: 229-251, 2000.

[15] Nielsen, Jakob. “Why you only need to test with 5 users”, 2000.