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AN APPLICATION OF THE ISO/IEC 25010 STANDARD IN THE QUALITY-IN-USE ASSESSMENT OF AN ONLINE HEALTH AWARENESS SYSTEM

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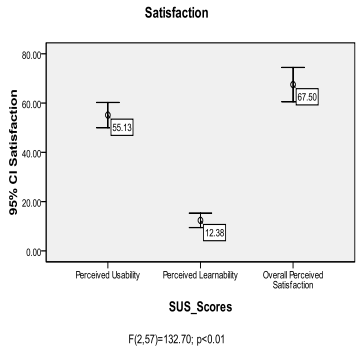
Graphical abstract



Abstract

Research studies show that there is an upsurge in the number of users surfing the Internet for online health related information. This increase in information seeking behavior on the Web gives rise to the need to ensure that Web based portals meet basic quality in use standards. The ISO/IEC 25010 standard was developed as a model for evaluating such quality in user expectations. In this paper, this standard was used to assess the quality in use of e-Ebola Awareness System, an online health awareness portal. The results provide some insights into the quality into the use of the online portal and also pointing to some issues that impact negatively on the quality in use of the portal, demanding attention and improvement.

Keywords: Quality in use, ISO/IEC 25010, e-health awareness system

1.0 INTRODUCTION

There is an increase in the usage of online or Web systems for important tasks [8]. Web portals provide online services and information that attract different kinds of users. Studies have also shown that the Web is an important source and resource for health related information. These studies reveal that there is a rise in surfing of the Web based portals for health related information. Increasing number of users access free healthcare information online [6] [7] [5] [16] [13]. Because of this surge in the use of health-related online systems and portals, there is the need to ascertain the quality of these Web portals. Their quality is a precursor to their continual success, usage and usefulness and their ability to attract new users and maintain existing ones [8]. The International Organization for Standardization (ISO) sees software quality in different perspectives, namely: internal and external quality, and quality in use [8]. The focus of this study is on quality in use. The quality-in-use of E-Ebola Awareness System (an online e-health awareness portal) will be assessed using the most recent ISO model on quality in use (the ISO/IEC 25010 quality in use standard) [12].

The ISO has developed software models/standards with the goal of describing and evaluating software quality. There are two ISO models and standards for software quality: ISO 9126-1 [10] and its successor, ISO 25010 [12]. These models describe software quality in use in general [14]. However, there is a dearth of literature on the use of these standards in the evaluation of software quality in the e-health awareness domain. This paper seeks to leverage on this gap to evaluate the quality in use of e-Ebola Awareness System portal within the e-health awareness context using ISO 25010 standard. The e-Ebola Awareness System is a Web portal created to

provide online Ebola related health information to users [18].

The remaining part of this paper includes four sections: the section 2 focuses on review of related works; section 3 is for methodology, section 4 presents the results of analysis and section 5 is for discussion and final conclusion.

2.0 RELATED WORKS

The earliest standard/model for usability developed by the ISO is the ISO 9241-11 [9]. This standard explain usability from an ergonomic point of view, as consisting of three components: effectiveness, efficiency and satisfaction. According to ISO 9241-11 [9], usability is "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO 9241-11 [9] and also cited by Bevan [2]. This definition of usability, although the most popular, has some demerits. It does not consider some aspects of software quality in use, such as flexibility and safety [15]. Also, the model defines satisfaction in terms of only comfort and acceptability of use [3]. The model describes usability in terms of user performance and satisfaction which has been criticized as being too narrow [3].

2.1 ISO 9126 Quality in Use Standard/Model

The first standard on software quality in use produced by the ISO is the ISO/IEC 9126-1 [10]. ISO/IEC 9126 is a comprehensive specification and evaluation model for the quality of software products [1]. It consists of the following six characteristics: functionality, reliability, usability, efficiency, maintainability, and portability. The model of quality in use is hinged on the characteristics of effectiveness, productivity, safety and satisfaction without any further elaboration of further sub-characteristics [17] [1]. Usability in the ISO/IEC 9126 is defined as "the capacity of the software product to be understood, learned, used, and attractive to the user, when used under specified conditions" [11]. However, this model has been criticized for not being comprehensive, very difficult to understand, and arbitrary, in terms of its selection of characteristics and sub-characteristics, of which some were unverified and perhaps unverifiable [1]. These critiques lead to its revision in 2001 and 2002. Even with the revision, Al-Kilidar et al. [1] in their experimental study found that the model was still plagued with ambiguities and subjective interpretations due to ambiguous metric definitions and mix ups [1].

2.2 ISO 25010 Quality in Use Standard/Model

The ISO/IEC 25010 standard was developed to replace the ISO/IEC 9126 standard. It sees usability as a constituent of quality in use and as a software quality attribute composed of three elements as in the ISO 9241-11 standard, but having a focus on quality in use. The components are: effectiveness in use, efficiency in use and satisfaction in use. The model dissects the notion of quality in use into usability in use, flexibility in use, and safety in use. It further defines satisfaction in use as likeability, pleasure, comfort, and trust [15]. ISO/IEC 25010 also defines flexibility in use as context conformity in use, context extendibility in use, and accessibility in use [15]. ISO/IEC model of quality in use overcomes the deficiencies of both ISO 9141-11 and ISO/IEC 9126-1. It broadens the narrow definition of usability in ISO/IEC 9126 [2]. ISO/IEC 9126 and ISO/IEC 25010 both define the quality of a system as the extent to which the system satisfies the stated and implied needs of its various stakeholders [8]. ISO/IEC 25010 defines quality in use as "the degree to which a product used by specific users meets their needs to achieve specific goals with effectiveness, efficiency, safety and satisfaction in specific contexts of use" [3]. Effectiveness in use, efficiency in use and satisfaction in use (derived from ISO 9241-11 [9]) constitute satisfaction in use. The model also incorporates safety in use and flexibility in use into the quality in use model. Flexibility in use is the characteristics of context comprehensiveness of the model [14].

3.0 METHODOLOGY

In this study, the ISO/IEC 25010 Quality-in-Use model served as a guide to the methodology. As aforementioned, the model consists of the following constituents: Usability in use, flexibility in use and safety in use. The usability in use component is further broken into three sub-components: effectiveness in use, efficiency in use and satisfaction in use. In this study, these attributes were captured by usability testing, attitudinal questionnaire and by observation. Effectiveness in use, and efficiency in use metrics were collected from the usability testing, satisfaction in use metrics was captured with attitude questionnaire while safety in use and flexibility in use attributes were obtained by observation. The usability test was conducted with 20 students of the Universiti Utara Malaysia. The test was conducted on Laptops.

To collect effectiveness-in-use metrics, users were given some defined tasks and their task completion rates and task error rates were measured. Also, to capture efficiency of use metric, from the same usability test, the user's task times were collected. The satisfaction in use metrics includes task ease metrics captured from users after each task scenario and the system satisfaction metrics collected after the entire test session. A single question questionnaire was used to get the task ease metric. The questionnaire is a 7-point Likert-type instrument that ranges from 1-strongly disagree to 7-strongly agree. The question is "Overall, how difficult or easy did you find this task Higher scores indicate task ease while lower scores indicate task difficulty. The System Usability Scale (SUS) was used as a proxy to measure satisfaction in use. The scale

comprises of ten items, eight of which measures perceived usability and the remaining two measures perceived learnability [4].

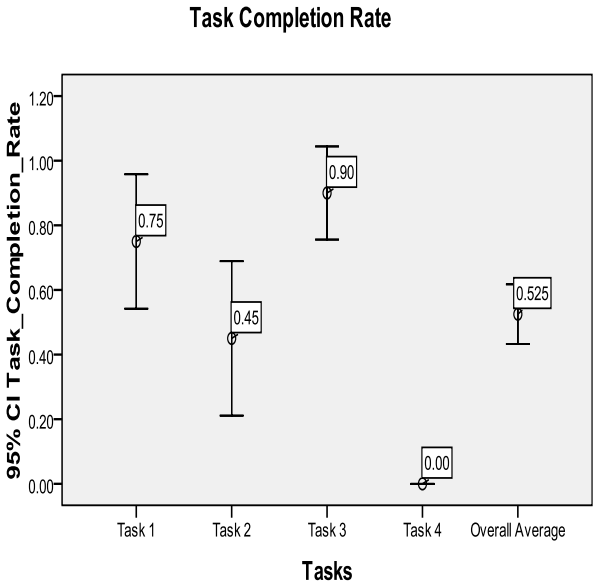
The task scenarios include: task 1: Open three news contents on Ebola in new tab and write out the name of the news media; task 2: Find three tweets on Ebola and write down the name of the source of the tweets; task 3: Search for information on Ebola symptom and Ebola prevention and write out one symptom and prevention each; task 4: View the content on Ebola causes and Ebola treatment in any language of your choice other than English. More so, flexibility in use, which covers operability and context, completeness and comprehensiveness was captured via observation while safety in use, which protects users from adverse consequences of use was also obtained by observation.

4.0 RESULTS

This section presents the results of the analysis with regard to the quality in use assessment following ISO 25010 standards

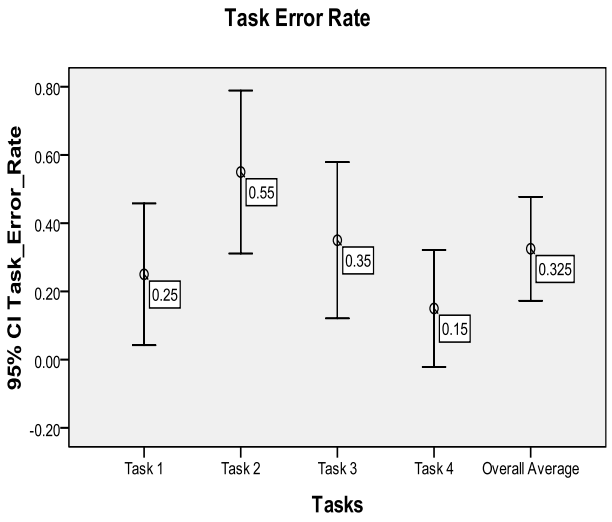
4.1 Effectiveness In Use

Figure 1 presents the task completion rates. There is a significant difference in the task completion rates, F(4, 95)= 19.97, p<0.01. In terms of task completion rates, task 2 is significantly different from tasks 3 and 4, p<0.01. Also, task 3 is significantly different from tasks 2 and 4, p<0.01. Task 1 is significantly different from task 4, p<0.01 while task 4 is significantly different from all other tasks. The task with the highest task completion rate is task 3 (90%), followed by task 1 (75%), and then task 2 (45%). However, task 4 had the least task completion rate (0%). All users failed the task, suggesting that there is an issue with the functionality associated with the task, as users cannot access it. The overall task completion rate is 53% on the average.



F(4,95)=19.97; p<0.01

Figure 1 Task completion rate

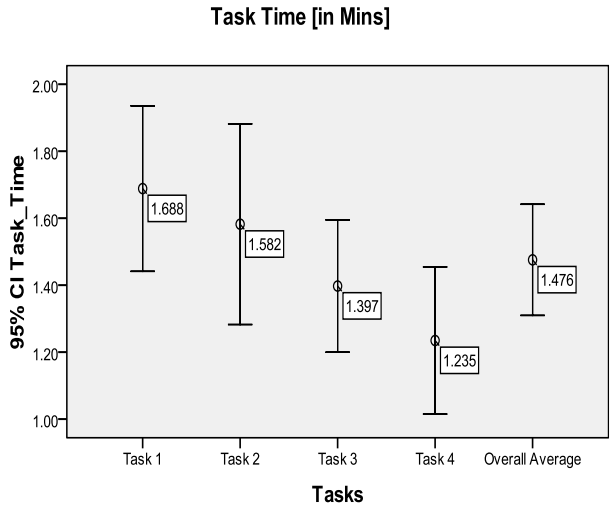


F(4,95)=2.33; p>0.05

Figure 2 Task error rate

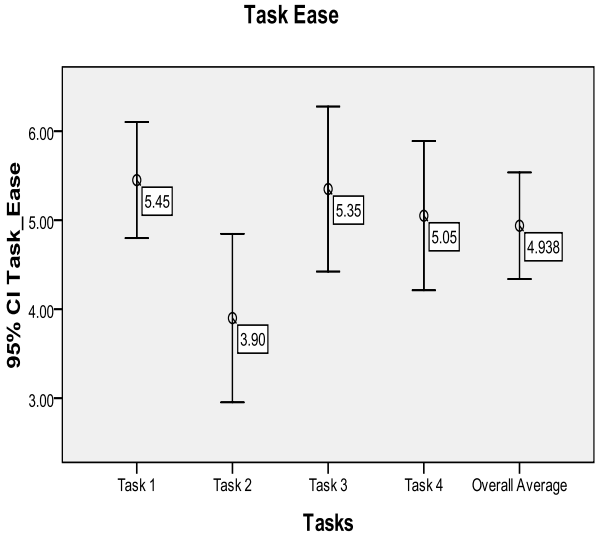
The task error rate (Figure 2) result shows that there is no significant different in task error rates. However, there are some observed differences. The task with the highest error rate is task 2 (55%), followed by task 3 (35%), and then task 1 (25%) and lastly task 4 (15%). It is noteworthy to observe that though task 4 has the least error rate, all user nonetheless failed it. On the overall, the average task error rate was 33%.

4.2 Efficiency In Use



F(4,95)=2.49; p<0.05

Figure 3 Task time



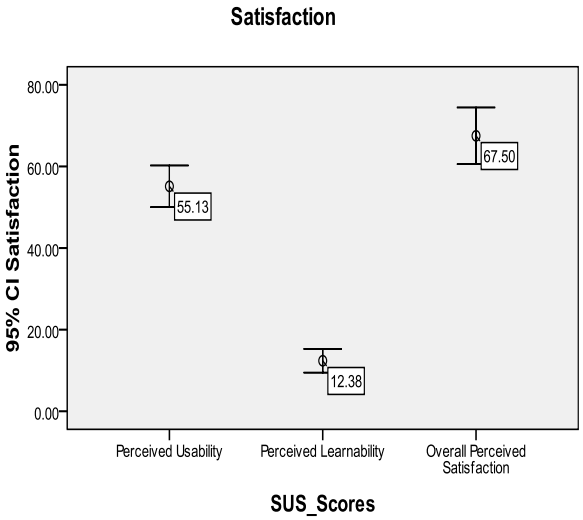
F(4,95)=2.57; p<0.05

Figure 4 Task ease

The task time was measured in minutes (Figure 3). The result indicates that there is a significant difference in task timing, F(4, 95)=2.49, p<0.05. Further analysis revealed that with respect to task time, task 1 was significantly different from task 4, p< 0.05, but all other tasks are non-significantly different from each other. From figure 3 above, task 1 had the highest task time, this is followed by task 2, then task 3. Task 4 had the least time. Since task 4 had particular issues, users seem to abandon it, this is the reason for the lesser task time for the task. On the average, users spent about one and the half minutes on the tasks with all tasks below 2 minutes on the average.

4.3 Satisfaction In Use

Figure 4 shows the task ease for satisfaction in use. There is a significant difference in task ease among the four tasks, F(4, 95)=2.57, p<0.05. Task 1 is significantly different from task 2 but all other tasks are non-significantly different from each other. The task with the highest ease is task 1, followed by task 2. The task ease of task 4 appears to be exaggerated as the task was failed by all users or perhaps, the users felt it was easy even though they all failed it. Task 2 was difficult for the users on the average. This is a pointer to an issue with the quality in use of the functionality associated with task 2.



F(2,57)=132.70; p<0.01

Figure 5 System satisfaction

Figure 5 above shows the result for system satisfaction. The result reveals that the perceived usability score was 55.13, while the perceived learnability score was 12.38. The overall satisfaction score was 67.50. Users were fairly satisfied with the interface on the online portal (e-Ebola Awareness System). Further analysis indicates that there is a significant difference between the three scores, F(2, 57)=132.70, p<0.01. All the scores are significantly different from each other, p<0.01.

4.4 Flexibility In Use

The Web portal was flexible in use to the users as its contents were in English Language (a common international language). Also, the Web portal was designed to display local contents in some other languages, however, users were unable to access the contents in other languages as seem from their 100% failure of task 4. This affected the quality in use. Also, the Web portal can be accessed on mobile devices as the interface was designed using responsive web design that permits adjustable interface that can be fittingly displayed on all devices irrespective of varying screen sizes. Also, as the system is Web-based, it can be accessed anywhere and at any time, so long as the users have access to the Internet.

4.5 Safety In Use

With respect to safety in use, the system does not provide help facility and searching functionality to users who may be in dire need of it. This impacts negatively on the quality in use users who wanted to use them, could not. Also, since the contents are health related content, the system ensures that only information from credible sources are displayed to the users.

5.0 DISCUSSION AND CONCLUSION

From the analysis and results presented, the e-Ebola Awareness System have a fairly good level of quality in use. In terms of effectiveness in use, user task completion rates were fairly okay except for task 4. The mean overall task rate was 53%. Also user task error rate was average (33%). The efficiency in use was also fairly well with all task time being done under 2 minutes on the average. With regard to satisfaction in use, all tasks were fairly easy except task 3 that was fairly difficult. The task ease of task 4 was exaggerated. The overall satisfaction score was good (67.50). The flexibility in use reveals that the system to some extent has good flexibility in use, but with some negatively impacting non-flexibility. With respect to safety in use, safety in use quality is fair as well, though the lack of some functionality impacts negatively on the safety in use quality of the system. Further studies, will consider assessing the quality in use of the system in the mobile context and also comparing the quality in use of system on laptop and mobile contexts of use.

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