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Usability Evaluation for Near East University Student Information System

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Abstract

By increasing the number of young people who choose the academic way of life, large-scale universities are faced with information administrative challenges. A Student Information System (SIS) is one of the solutions that provides management facilities for educational and financial aspects. An SİS can be accessed and used by university students as well as all levels of academic staff and university stakeholders. Determining the usability level of the SİS from a Human Computer Interaction perspective is an important consideration for universities. The aim of this paper is to evaluate the usability of the Near East University (NEU) SIS by using ISO/IEC 9126 standards. The ISO/IEC 9126 model has the most suitable metrics for evaluating the internal usability of the systems. The result of this study will be helpful for the NEU SIS developer team when considering improvement possibilities for future versions of the system.

Keywords: Usability; İSO/İEC 9126; Human Computer Interaction; student information system; quality model

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1. Introduction

Quality testing and assurance is an important part of software design and development that is used for various fields such as education, transportation, health sector, finance, etc. Successfully developed user-centered-design techniques such as HCİ lead to satisfied users, especially in the education sector where they can have a direct impact on students' cognitive psychology (O'Bryan et al., 2010). Furthermore, Bian, Jin and Zhang (2010) underlined that HCİ with a cognitive tendency based on "Human-Oriented" design increases students' achievements**.** Guaranteeing the quality of the software in use is vital in order to maintain the balance of activities in these areas (Galin, 2004). Usability testing plays an important role in Human Computer Interaction (HCI) and relies on the systematical collection of data regarding the interface and accessibility of data for users in a software program. It helps designers to increase the quality of their software through constant usability testing and improves the interface by applying various improvements in upgraded designs. These improvements aim to decrease the users' learning time, while increasing overall satisfaction and efficiency when working with specific software (Chao, 2009).

Over the last decade, a new kind of ISO (International Organization for Standardization) standard for Human-Computer Interaction (HCI) has emerged, which is related to hardware and software interfaces. This standard is concerned with the value of user-centered design and develops methods for users to use interfaces in easy and safe ways (Bevan, 2001). HCI standards are the result of synergies between two organizations: ISO and the International Electro technical Commission (IEC). HCI standards include explicit specifications for user interface types and this provides various design guidance results. A broad range of users and tasks have emerged from high-speed developing technologies. Therefore, the fundamental ideas of HCİ standards are not concerned with detailed specifications, but moreover provide principles to produce an interface that can meet the needs of users and complete tasks. Experiments show that a product or a service that is the result of using these standards is safe, reliable and is of high quality. Like other products, software or other services that have interaction with users should also have standards. Using particular standards in these fields help customers or users to evaluate products by the standard criteria. On the other hand, customers or users can achieve satisfying output (ISO, 1998).

A Student Information System (SIS) is a vital platform in universities in which usability is an important aspect. Maintaining an up-to-date system that is capable of satisfying the needs of students and academic staff, while also providing them with an understandable and user friendly system is important in order to sustain the smooth flow of academic operations. In the current study, ISO/IEC 9126-3 was applied to a usability evaluation for the Einstein SİS at Near East University (NEU). ISO/IEC 9126-3 provides the best concurrent practice facility to evaluate how Einstein software behaves (Palmius, 2007). Thus, ISO/IEC 9126-3 is the most eligible model due to its usability sub-characteristics and metrics that are much more capable of evaluating the internal aspects of the Einstein SIS.

2. Quality Models Comparison

Usability testing plays an important role in HCİ and it relies on systematical collection of data regarding the interface and accessibility of the data for the users in a software program. McCall, Dormey, FURPS and ISO/IEC 9126 models all provide usability testing. However, among the above-mentioned models, only the ISO/IEC 9126 model supports the criteria for HCO standards.

McCall's quality model, proposed by McCall et. al (1977) mainly focuses on the system development process by defining and evaluating the quality of a software product from three major perspectives, which consider both the user's perspective and the developers' main concerns (Kitchenham and Pfleeger, 1996). These perspectives are namely product revision, product transition and product operations (Samadhiya, Wang & Chen, 2010). These three sub-factors were inadequate for our purposes of evaluating the Einstein academic information system. Dormey's quality model was presented by R. Geoff Dromey and aims to obtain a large enough model that is capable of working with different systems (Dormey, 1995; Dormey: 1996). Dormey's model aims to enhance the understanding of the relationship between the attributes and sub-attributes of quality by specifying the properties of the software product that influence the attributes of quality (Ortega, Perez & Rojas, 2004). Dormey's model evaluates the quality level of each product in four categories: correctness, internal, contextual and descriptive. One down side of Dormey's model is the lack of consideration for the efficiency of the software when determining the overall quality level (Pande et. al, 2010). The FURPS quality model was proposed by Robert Grady and Hewlett-Packard Co. and evaluates software characteristics in two main requirement categories: functional requirements and non-functional requirements (Samadhiya, Wang & Chen, 2010). The main disadvantage of this model is the lack of portability factor. None of the above mentioned quality models were adequate for our study and, therefore, ISO/IEC 9126 was preferred to evaluate the Einstein SİS.

ISO/IEC 9126 is a quality model that was proposed in 1991 and is based on both McCall and Boehm's models that represent product effectiveness by identifying the external and internal quality characteristics of a software product (Samadhiya, Wang & Chen, 2010). In addition, ISO/IEC 9126-x provides a comprehensive framework to evaluate software (Palmius, 2007). The ISO/IEC 9126 model includes functionality as a parameter, which is not present in either of the McCall or Boehm models. It evaluates the quality characteristics of a software product through six quality factors: functionality, maintainability, usability, efficiency, portability, and reliability (Pande et. al, 2010). Identifying both internal and external quality characteristics of a software product is one of the advantages of the ISO/IEC 9126 model. However, the lack of a clear definition on how to measure these aspects is a disadvantage of this quality model (Ortega, Perez & Rojas, 2004). Overall, ISO/IEC 9126 is the most complete quality model available, due to its comprehensive characteristics and ease of use (Fahmy et. al, 2012). We chose this quality model for our study because it has the most suitable characteristics for evaluating the usability of the Einstein system in use at NEU.

Table 1: Usability metrics comparison

McCall	Dormey	FURPS	ISO 9126
+Operability +Training +Communicativeness	+Component +Dependent +Evaluation	+Human Factors +Aesthetics +Consistency in the user interface +Aid in line +Assistant +Documentation +Material of Training	+Understandability +Learnability +Operability +Attractiveness +Compliance

3. Implementation of the Study

ISO/IEC 9126-3 (2003) explains software measurements by using internal metrics. These internal metrics refer to usability. The software product’s capabilities of understanding, learning, operating and attraction to the final user are evaluated by İSO/İEC 9126-3. The usability character has five sub characters: understandability, learnability, operability, attractiveness and compliance.

İn order to evaluate the usability of the system, it is necessary to assign weight to each quality sub-characteristic. These weights explain the importance of the sub-characteristics in the software usability evaluation. İSO/İEC 9126-3 allows various ranges of values to be assigned for metric scores and weights, depending on the nature of the software that is subject to usability testing (ISO/IEC TR 9126, 2003). Therefore, three weight levels were assigned for the sub-characteristics in this study. These weights represent the target score and multipliers for each sub-characteristic, where a high weight represents a target score of 3, a medium weight represents a target score of 2 and a low weight stands for a target score of 1. Table 2 shows the weights and descriptions for each of the sub-characteristics.

Table 2: usability sub characteristics and level of weight

Sub characteristics	Weight level	Definitions
Understandability	Medium weight	User understanding of the software to complete a task
Learnability	High weight	Assesses the user's ability to learn how to operate and control the software product
Operability	Low weight	Assesses the effectiveness of the product, i.e. length of time it takes users to learn to use the software product
Attractiveness	Medium weight	Assess the attractiveness of the software user interface to the user.
Compliance	High weight	Assesses the software product's capability of complying with standards, guidelines and regulations relating to usability

By increasing the number of university students, large-scale universities are increasingly faced with management challenges and information management in higher education is one of these challenges. Student admission, academic management, financial and asset management etc. are some of these problems. SIS provides facilities to overcome the aforementioned problems (Rochimah, Rahmani & Yuhana, 2015). Previous research has shown that effective and efficient management in all user and stakeholder groups are advantages of SIS (Widodo, Kertahadi & Suyadi, 2015; Guarin, Guzman & Gonzalez, 2015). Thus, in order to evaluate these benefits, it is necessary to understand the main features of SİS and consequently prepare suitable criteria to evaluate them. BTSI ITS. (2013) underlined that the SİS main features can be categorized into twelve fields: view biodata, view student status, view prerequisite courses, view courses schedule, view students trustee, print attendees lists, view all data employees, change password (all types of users: students, teachers and etc.), view curriculum list, view courses schedule, view lecturer schedule and view all subjects.

Among the above-mentioned SİS features, view profile, change password, view students status, view prerequisite courses, view courses schedule and view list of curriculum are student user group features in Einstein SIS, which are the current study evaluation features as Shown in Table 3.

Table 3. Student user group features

Users	Features
Students	View bio-data
	Change student password
	View student status
	View prerequisite courses
	View courses schedule
	View curriculum list

4. About Einstein

Near East University (NEU) is a large-scale university in north Cyprus with 25,000 registered students. NEU consists of 16 faculties, comprising 220 departments and programs. The admission process takes place every fall and spring semester, with more than 4,500 international and native students enrolling. The NEU software development team, named "YOUNG DEV", was established in 2009 and its main goal is to analyse the requirements and developing specific software for the administrative needs of the university.

The Einstein SIS was developed in order to provide various facilities to all user groups including students, academic staff and system stakeholders ranging from maintenance teams to senior managers. The main purpose of Einstein is to overcome administrative challenges, such as student admission, academic management, financial and asset management etc. According to statistical data obtained from Einstein development team, the SİS is accessed approximately 6,000 times on a daily basis during term time, while the daily access rate increases above 25,000 during registration and exam periods. All registered students must obtain an Einstein user name and password from the registration office before they can access the system processes that can be in Figure 1. These are editing profile, viewing financial and academic status, obtaining information about announcements and university news, and other student related operations. This study evaluates the usability characteristics of the Einstein Student Information Module.

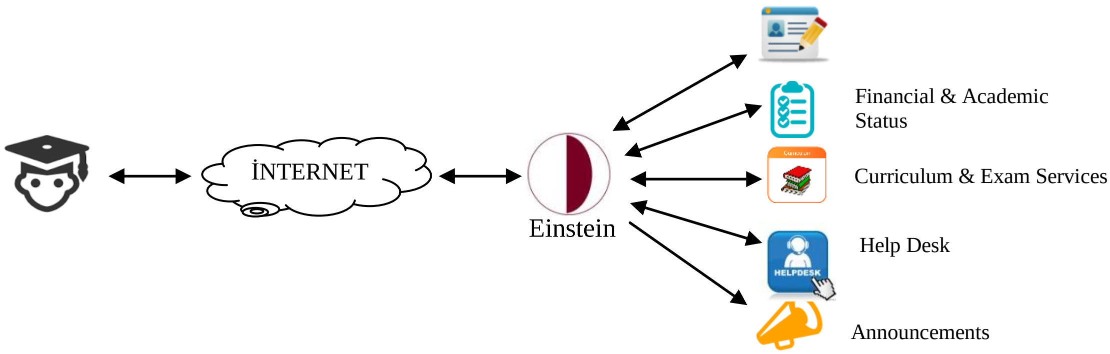

Figure1. Einstein Students' Facilities Working Flow Diagram

5. Evaluation Process

The first step in conducting this study was to conduct an open-interview with the Einstein development team and to collect the necessary software documentation from the design team. This included software requirements specification documents and design documents that were reviewed in order to identify the attributes needed for evaluation of the Einstein SIS.

The next step was to define the evaluation attributes and adjust the weight format accordingly for this evaluation. The attributes that were obtained from the design documents were double-checked with the Einstein SIS to ensure that facilities and availabilities were in the current version of the system. These attributes regarding the Einstein student Information System are: Announcements panel, view and change profile, change student password, course registration and withdrawal, view student status (academic, financial and library), view curriculum, exam services (exam entrance paper, exam and quiz results, exam result objection), help desk.

After defining the attributes and adjusting the weights for the evaluation, the evaluation team that consisted of three developers, two software testers and one software engineer, were informed. All the details regarding previously identified data attributes and system features were given to each evaluator, along with the usability metric tables that would allow them to conduct their evaluation in a proper ISO/IEC 9126 format.

The results were gathered and manually analyzed based on values issued by the evaluation team. For evaluation of the metrics, a value between zero and one indicated the performance of that metric and a value of N/A indicated that the metric was not assessable in our study. According to our assessment of sub-factor scores, a value that was greater than at least 75% of the weight meant that no immediate changes were necessary for the related features of the system. A feature that scored less than 75% meant that immediate attention was required by the Einstein development team.

After evaluating each metric separately, we prepared a final result table in order to evaluate and compare the overall efficiency of the system according to the given ISO/IEC 9126 sub-factor categories. Below are the tables that show the usability evaluation of the metrics separately and the final evaluation results according to the ISO/IEC 9126 format.

Table 4 explains the understandability metrics of the study. Understandability included four metrics in total, and it deals with measuring the suitability of the existing functionality in the system and the understandability of these functions for the users.

Table 4. Understandability metric of the study

	Metric Name	Parameter A	Parameter B	Result
Result = A/B	Completeness of description	Number of functions (or types of functions) described in the product description	Total number of functions (or types of functions)	1
	Demonstration capablity	Number of functions demonstrated and confirmed in review	Total number of functions requiring demonstration capability	N/A
	Evident functions	Number of functions (or types of functions) evident to the user	Total number of functions (or types of functions)	1
	Function understandability	Number of user interface functions whose purpose is understood by the user	Number of user interface functions.	1
	Total			1

Learnability sub-characteristics, as shown in Table 5, deal with the capability of the software components to enable users to learn and operate the software. In this case, there is a single metric for evaluation of the completeness of the documentation and the help facilities.

Table 5. Learnability metric of the study

	Metrics Name	Parameter A	Parameter B	Result
Result = A/B	Completeness of user documentation and/or help facility	Number of functions described	Total of number of functions provided	0.75
Total				0.75

The next metric as shown in Table 6 includes the operability sub-characteristic according to ISO/IEC 9126. The operability sub-characteristic has the largest amount of metrics and deals with the ability of users to operate and control the software. While most of its metrics are measured by the same formula - 240parameter A/240parameter B - the only variation is in the operational consistency metric where a different formula is used in order to do the evaluation, which is - 1 – Parameter A/Parameter B.

Table 6. Operability metric of the study

	Metric Name	Parameter A	Parameter B	Result
Result = A/B	Input validity checking	Number of input items which check for valid data	Number of input items which could check for valid data	0.71
	User operation cancellability	Number of implemented functions which can be cancelled by the user	Number of functions requiring the precancellation capability	0.41
	User operation undoability	Number of implemented functions which can be undone by the user	Number of functions	1

	Customizability	Number of functions which can be customized during operation	Number of functions requiring the customization capability	0
	Physical accessibility	Number of functions which can be customized	Number of functions	N/A
	Operation status monitoring capability	Number of functions having status monitoring capability	Number of functions that are required to have monitoring capability	1
	Message clarity	Number of implemented messages with clear explanations	Number of messages implemented	1
	Interface element clarity	Number of interface elements which are self explanatory.	Total number of interface elements	1
	Operational error recoverability	Number of functions implemented with user error tolerance	Total number of functions requiring the tolerance capability	0
Result = 1-A/B	Operational consistency	Number of instances of operations with inconsistent behavior	Total number of operations	1
Total				0.68

The attractiveness sub-characteristic deals with the capability of the software to attract and appeal to the users. It has two metrics, which are shown in Table 7. One of the metrics was assessed through a questionnaire given to users in order to measure the attractiveness of the interface and the second metric is related to customizability of the user interface elements.

Table 7. Attractiveness metric of the study

	Metric Name	Parameter A	Parameter B	Result
Result = A	Attractive interaction	Questionnaire to assess the attractiveness of the interface to users, taking attributes such as colour and graphical design into account.	-	1
Result = A/B	User İnterface appearance customizability	Number of types of interface elements that can be customized.	Total number of types of interface elements.	0
Total				0.5

The usability compliance sub-characteristic has only a single metric for evaluation. This sub-characteristic deals with the ability of the software components to adhere to the software standards and conventions. Table 8 shows the detailed information for evaluation of this sub-characteristic.

Table 8.Usability compliance metric of the study

	Metric Name	Parameter A	Parameter B	Result
Result = A/B	Usability compliance	Number of correctly implemented items related to usability compliance confirmed in evaluation	Total number of compliance items	0.66
Total				0.66

The results obtained from the metrics analysis for each sub-characteristic were multiplied by the weight factor assigned for each corresponding sub-characteristic, as shown in Table 9. The final results provide an overall indication for the system's performance. These results together with the detailed metrics analyses were delivered to the Einstein development team for further investigation of issues and to determine improvement possibilities for future versions of the system.

Table 9. Results of the Study

Sub-characteristics	İdeal Value	Result Value
Understandability	2	2
Learnability	1	0.75
Operability	3	2.04
Attractiveness	2	1
Compliance	3	1.98

6. Conclusion

The study results as shown in Table 9 revealed that understandability of the system achieved the optimum value. Thus, it is possible to say that Einstein is understandable to the student user group. The learnability sub-characteristic results indicate that the system is sufficiently learnable, but may still be improved in future versions. Operability as an important sub-characteristic of the system yielded a result that fell below the predetermined 75% margin. Attractiveness and usability compliance results were not perfect, which shows that implementation of future improvements are possible. The obtained results revealed that Einstein needs to provide more facilities and documentation to assist the students with operating the system properly.

From an educational perspective, we consider the most vital aspects of an SIS to be understandability, learnability and operability. Among these three sub-characteristics, the only sub-characteristic that did not satisfy our 75% margin was operability. The main issues regarding the operability sub-characteristic are the customisability and operational error recoverability metrics, which both scored zero. Furthermore, both the final result and the separate metric results of the attractiveness sub-characteristic revealed that the Einstein design team needs to focus on improving the interface design of the system, considering the HCI design principles.

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