User Experience Test For A Knowledge-based Tool

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Abstract

This study is built on the prior work done on a proposed knowledge-based tool in facilitating course exemption process in Institution of Higher Learning in Malaysia. In this study, an experiment is carried out in the faculty and the purpose of the experiment is to allow end users to evaluate the prototype, at the same time gather further requirements from the end users. This experiment is carried out at a business faculty and ten respondents who made up of dean, associate deans and program leaders are involved in the experiment to evaluate the usability of the tool. The evaluation report shows that the respondents are not fully satisfied with the proposed tool although the idea of developing the tool is good. However, they find the tool useful and help to increase the efficiency of their work. Even though the proposed knowledge-based tool, which contains knowledge-based engine, is not meant to replace program leaders, it is supposed to facilitate and make recommendation to the program leaders during the course exemption process. It is believed by doing so; the program leaders are able to conduct their work efficiently and effectively.

Keywords: Course Exemption, Effectiveness, Efficiency, Satisfaction

1. INTRODUCTION

Course exemption is one of the important enrollment processes to any institution of higher learning; as it helps students who wish to enroll into programs offered by institution of higher learning determine courses to be registered. The process is time-consuming and error-prone. Furthermore, even though when a course exemption is completed, it has to go through verification process. Many times, the entire process will go through duration of one week to one month to complete before students can proceed with course registration (Thong and Yu, 2011). Therefore, to ease the processes of course exemption, a prototype of a knowledge-based tool taking full advantages of Java and graphical user interface is developed. The proposed tool is a computerized web-based solution, which will ease the work of program leaders and result in faster and more accurate course exemption compared to traditional approach. The organization of the paper is as follows: section II discusses the background of this study; Section III presents the revised system design and user interface; Section IV presents the evaluation report. Section V concludes the paper.
2. BACKGROUND

2.1 Importance of Knowledge

Knowledge refers to insights, understandings, and practical know-how that we all possess, and it is the fundamental resources that allow us to function intelligently (Wigg, 1996). There are two types of knowledge involved in higher education settings: academic knowledge and organizational knowledge. Academic knowledge is the primary purpose of the university and colleges. Organizational knowledge refers to knowledge of the overall business of an institution: its strengths and weaknesses, the markets it serves, and the factors critical to organizational success (Coukos-Samuel, 2003). Academic knowledge is used to support teaching and learning whereas organizational knowledge is used to support educational administration. Organizational knowledge is now becoming an important resource in the organization (Theece, 1998). Therefore, there are much effort has been focusing on software application that capture and retrieve knowledge such as data warehousing and document repositories (Jungpil & Mani, 2011). In view of the importance of knowledge in higher education setting, a knowledge-based tool is proposed to support administrative task such as course exemption of a program leaders who are providing course exemption advice to students.

A prototype has been developed based on user requirements in prior work and evaluation is carried in this study to determine the usability of the proposed tool. There are three criteria being measured, and they are: effectiveness, efficiency and satisfaction.

2.2 Usability Model for User Evaluation

According to ISO 9241-11 (1998) [6], usability is a multidimensional construct and can be assessed using various criteria and these criteria are: effectiveness, efficiency and satisfaction. The guidance in ISO 9241-11 (1998) can be used in procurement, design, development, evaluation, and communication of information about usability and the guidance includes how the usability of a product can be specified and evaluated. It applies to product intended for general application and product being acquired for or developed within a specific organization (Amir & Rusli, 2010).

The first criteria being assessed in this study is effectiveness. Based on ISO 9241-11 (1998), effectiveness means specific goals are to be achieved with completeness. Preece and colleagues (1992) mentioned effectiveness can be understood as “how good a system is at doing what it is supposed to do”. This group of researchers further explained effectiveness as “to the extent to which the system provides the right kind of functionality so that the users can do what they need or want to do”. Grudin (1992) relates effectiveness to the “utility” of the system. The indicators of effectiveness include quality of solutions and error rates. Moreover, quality of solution is used as the primary indicator of effectiveness, i.e. measure the outcome of the user’s interaction with the system (Preece et. al., 1992). In this study, effectiveness refers to the system provides right kind of functionality and information needed effectively. It is determined by the users’ experience during the experiment.

The second criterion is efficiency. Based on ISO 9241-11 (1998), efficiency means specific goals are achieved with as little expenditure of resources as possible. Bevan (1995) mentioned another way of measure efficiency is relate the level of effectiveness achieved to the expenditure of resources. Bevan (1995) explained resources may be ‘mental or physical
effort, which can be used to give measures of human efficiency, or time, which can be used to give a measure of temporal efficiency, or financial cost, which can be used to give a measure of economic efficiency”. The indicators of efficiency include task completion time and learning time (Amir & Rusli, 2010). ‘Task’ is defined in terms of activities requires to achieve goal [6]. In this study, efficiency refers to the system assists in shorten the task completion time. It is determined by users’ experience during the experiment.

The third criterion is satisfaction. Based on ISO 9241-11 (1998), satisfaction is determined when users are comfortable with, and have positive attitudes towards the use of the system. Davis (1989) and Mathieson and colleagues (1998) relates satisfaction to concepts such as ease of use, user satisfaction and usefulness. The indicators of satisfaction include the areas of ease of use, organization of information, visual attractiveness and error handling. In this study, satisfaction refers to the perception of users on the ease of use of the system, system’s layout and structure, user interface including labeling and terminology used are easy to understand, the accuracy of the information and content provided and the overall system design. Again, it is determined by users’ experience on the said indicators during the experiment.

3. METHODOLOGY

This is a qualitative research and the type of qualitative research used is interview. Interview is particularly useful for getting the story behind a participant’s experience (McNamara, 1999). The interview protocol is posing questions to the interviewees who made up of one dean, two associate deans and seven program leaders who manage course exemption process. The participants involved in this study have had at least two years of experience in granting course exemption in IHL. The interview was conducted one time only for half an hour each interview session. The purpose of interview is to evaluate the prototype developed based on user requirements in prior work. Data analysis technique used in this research is content analysis and identifies phrases, keywords, sentences and phrases to come up with results.

3.1 Experimental Design

The experiment was conducted at a business faculty in University A. University A is located in the capital city of Malaysia and it is a comprehensive university offering undergraduate and postgraduate programs to over 10,000 students. The programs offered by University A are accredited by Malaysian Qualification Agency (MQA) in Malaysia. The business faculty is the largest faculty in University A and it offers more than 15 programs ranges from diploma programs to doctoral programs. The business faculty is made up of 80 full time academic staff and 2500 students. The business faculty is selected in this study and out of 12 management staff who involve in processing course exemption directly and indirectly, 10 are being interviewed to evaluate the effectiveness, efficiency and satisfaction of the system.

The users were interviewed individually. Prior to the interview session, the users were briefed about the objective of the interview, functionality of the system and several questions were asked to understand the background of the users including number of years of experience in providing course exemption in IHL and the experience in using automated for course exemption. Interview questions are enclosed in appendix.
4. PROTOTYPE DEVELOPMENT

Based on the prior work, the problems encountered by program leaders during course exemption are: it is a tedious, error-prone and time-consuming’s task. Moreover course exemption granted is also lack of standardization (Thong & Yu, 2011). In view of the problems raised by program leaders, user requirements were gathered and subsequently a prototype is a system in its own right, but it may be incomplete or may not be exactly match the final set of user requirements (Satzinger et. al., 2002). According to Satzinger and colleagues, there is two types of prototypes that are commonly used in software development, and there are discovery prototype and developmental prototype. Discovery prototype is prototype used to discover or refine system requirements or design parameters where developmental prototype is a prototype that is iteratively developed until it becomes a final system (Satzinger et. al., 2002). For the purpose of this study, developmental prototype is applied.

The prototype developed in this study will be used to grant course exemption fulfilling the requirements set by accreditation body. With the support of the proposed system, update of the requirements are with respect to both University and accreditation body. It would not be interminable; using the proposed system, time and human error will be significantly reduced in tackling such task. Later, subject matching will take place. Program leaders only require navigating the report generated by the system, to check and make recommendation if necessary. Comparing with traditional approach, the approval process has been reduced. Four steps have been reduced to three steps instead as counselor no longer need to go through faculty administrator for document passing. Since one step is eliminated, reducing one step has saved time (Thong & Yu, 2011).

In fact, the system framework and architecture were proposed in prior work. In order to make the system more robust and flexible, the researchers develop the system incrementally by involving users and stakeholders at maximum level. Therefore, this study presents the stakeholders’ evaluation feedback and report. The main purpose of providing the summary of the evaluation report is for the researchers to further enhance the tool to meet the needs of the users to a maximum level.

The following subsections present the revised system design, user interface and design techniques.

4.1 System Design

The developed system follows Model-View-Controller (MVC) guideline which hides the domain logic into lower level view from the end users.
Referring to Figure 1 which is architecture of the proposed system, it uses three Java frameworks: Struts, Spring, and Hibernate. Struts framework handles the mapping calls between Java Servlet Pages (JSP) and Java classes via Struts Action class as the controller. The Spring framework registers the Hibernate framework as a web service that performs data query from the Oracle Database through Data Access Object (DAO) which is handled by Hibernate framework. The Hibernate framework provides mapping on the database table attributes and its corresponding models within the Java class.

The components of the system are represented in oval shape while the arrows are used to determine the flow of the function. Dashed arrows are the response towards the caller that calls the component. The workflow of the system begins from the Java Servlet Pages (JSP). Any request sent from the JSP is mapped in Servlet mapping redirector to the Struts Action class. Whenever JSP sends a request, it will be redirected by Servlet mapping redirector to locate the correct Struts Action class to process the request. Each of the Struts Action class imports Java classes and query from the tables in the database by Hibernate defined database mapping handled by the Spring web service. After the request processing is done, it sends response back to the corresponding JSP page specified by the Struts forward mapping in order to display the result of the request on that JSP page.

There are five actors in the system and these five actors are: admin, signer, staff, and approver as well as knowledge engine. The role of knowledge engine in the system is to automate the decision-making process using a knowledge base algorithm which will be discussed in subsection 4.3.

Admin maintains the database of the whole system mainly on course offered by the university, and user data. The signer which is the program leader is tasked to view course exemption form submitted by the student and provide courses to exempt. The signer verifies the exemption suggested by the system’s algorithm and make modifications if there is found any adjustments to be made. As for the staff comprising marketing staff and the counselor, they have the permission to view the workflow of the course exemption process. In some cases where there occurs lack of supporting documents, they will be contacted by respective user to obtain or inform the student to provide more documents. Approver acts as the final
decision to approve the exemption form. He has the similar functions except exempting new courses which usually signers do the job. The following Figure 2 shows the use case diagram of the system.

**Figure 2: Use Case Diagram**
*(Source: Developed for this research)*

4.2 System Functionality

There are a few main functionality that contribute towards the main goal of the system, which is to eliminate such as the deployment of knowledge engine, exemption workflow, internal message service, and alternative account. Knowledge engine is used to aid the program leaders in cognitive processing on exempting courses of a particular student based on defined rules. This functionality can be activated every time he performs an exemption process on a course exemption application submitted by the students. This functionality will generate results based on course exemption application for program leader to make confirmation.

Every exemption process is traced by the exemption workflow. Student can access the progress of their course exemption application to enquire for their exemption status. As for the program leader, they are able to view and access any available exemption application to work on the exemption process and forward to the upper bodies to further validate and confirm the exemption.

The message service allows user to communicate internally within the system in a simple text message. Nevertheless, student could not send any message to any users unless contacted by respective users with that privilege in the system.
Alternative account enables key users such as approver or signer to assign new substitute user to act as substitute while they are not available to use the system. Hence, the substitute user will take place of the key user’s task in the exemption process. The substitute user’s action towards the course exemption process is tracked by the workflow. The substitute user’s account will be terminated once the key user who assigns the substitute calls to suspend the account. Each key user can only establish one substitute account. The purpose of introducing this key feature is to ensure the course exemption process is carried out smoothly when the approver or signer is not available to perform their duty.

4.2 Design Algorithm and Techniques

There are three rules set in the course exemption system known as marks rule, manual exempt rule, and matching rule. These three rules filter the courses gradually and allocate related courses that suit the courses that submitted for exemption.

The marks rule is the first layer in the knowledge-based engine to perform and specify the minimum mark value for the subject to meet, then only it can allow for exemption matching or manual exemption. In addition, marks rule is able to filter repeat courses from the exemption process.

Pseudo-code for marks rule:
if course mark is > 45 then
//get next course else
else
//filter this course

After marks rule has been applied to the courses within the exemption request, then matching rule that acts as second layer to look for the matching subjects. On the first step, this rule matches by subject title and then followed by matching the course outline. Natural languages are filtered in this process to allow more precise matching scope. First University X with a course of Java Programming 1 matches 100% with Java Programming 1 in University Y. This will skip the remaining matching process of the course outline.

The last rule is manual exempt rule which tracks the user (program leader) behavior whose manually exempt courses for a particular subject, namely Course E. Every courses manually exempted by the user will increase the value by 1 into the total score. Continuous increment will add the value further with the algorithm, a = 2a. As long as the total score remained positive, the knowledge-based engine will refer from the manual exempt list from its database to add into the exemption list if Course E persists in the future. If user began to remove recommended course (Course R) from the exemption list added by the knowledge engine, the positive increment value will reset to 0 and deduct by -1 regardless the size of increment. The decrement value rises similar to that value as long as the user continuously removes Course R, b = -2b. If the Course A’s total score reaches negative value, the course will not be recommended by the knowledge engine for the following exemption that apply for the same course to be exempted. The following pseudo-code explains the above algorithm as shown below:
if CourseE is manual added then
if score is negative value, score = 1 total score increment by (score x 2)

if Course recommended by system is manual removed then if score is positive value, score = -1
total score decrement by (score x 2)

5. EVALUATION REPORT

This section discusses the results of users’ evaluation of prototype in facilitating course exemption. The evaluation process is conducted using case study and it is carried out in a business faculty at University A. The report is organized according to three criterions mentioned in section II and they are presented in the following subsections.

5.1 Effectiveness

In this study, effectiveness refers to the right kind of functionality and information provided by the system effectively. It is determined by users’ experience in the experiment.

During the experiment, the researcher noticed the first respondents who have had six years of experience in performing course exemption in University A finds the system useful and contains the right kind of functionality. However, the information provided is not accurate. He suggested the system provides more intelligent components such as intelligent character recognition component in order to match the applicants’ documents with data stored in the database repository. The second respondent also shared the same concern about having intelligent component to perform course matching and he suggested more complex rules which allow the system to scan for synonyms of keywords within the course syllabus. As per third respondent’s suggestion, functionality needs to be included is automating the course exemption process for internal transferring and returning students. For example, if internal students who graduated from diploma program entering into degree program, the system should automate the process and it is believed by having such functionality, the program leader’s job becomes easier and simpler. The third respondent has positive view towards the implementation of the system in the future. The fourth respondent with accounting background has been doing manual course exemption for four years. He mentioned the information provided is not accurate as he describes the system cannot provide accurate information by just doing course matching with one course provided by other institution. The reason behind is under certain circumstances some private institutions breaks a course into two or more courses. Hence the one-to-one course outline matching provides inaccurate information. He desires to include filter and search capability in the system and this is to enable the program leaders to search from a list of hundreds to thousands of applicants to work on. The fifth respondent who is the head of department has no comment on the functionality of the system. However, he commented the user interface needs much improvement (see part C: satisfaction). The sixth respondent who has IT background, he has had two years of experience in performing course exemption during his work tenure in other IHL. He has been performing his task manually and finds the system provides right kind of functionality. However, he suggests the system should include email capability and use email as communication tool. The seventh respondent hopes the system is able to allow multiple users (program leaders) handling one course exemption, as this will ease the work of program leaders during their absence. The eight respondents holds an important administration
position in business faculty, being the dean of the faculty, he has eight years of experience in handling course exemption. He stressed that course syllabus is the most important data for decision-making in course exemption; hence it has to be stored in the database repository accurately. Due to some technical issues, the interview did not complete. However, the respondent did highlight the effectiveness of the system is to provided right kind of information to perform their task well. The ninth respondent is handling the largest program that has the most students. He suggests the system should be flexible enough to allow one user (program leader) to handle more than one program and system should display who is handling the program and what program the applicant is applying. He subject between local universities and external universities that the applicant transfers from. The tenth respondent with 3 years of experience in doing course exemption is able to operate the system without guidance. He commented the system lacks of some functionality such as provide course syllabus for user to view and compare.

5.2 Efficiency

Efficiency refers to how system is able to assist users in shortening task completion time. It is determined by users’ experience in the experiment. All respondents agreed that the system is able to assist them in shortening task completion time. The first respondent stressed on the system able to assist in reducing human error, efforts and increase productivity in performing their task. The third respondent commented the pre-screening process of the system help to shorten completion time in spite of short notice. Normally performing task within short notice will increase human error; however with the system, despite short notice, work is able to be performed efficiently. The system helps to reduce repetitive task and minimizing the hassle of contacting the applicants in requesting for additional documents. This will help to reduce effort and skip the steps on contacting the faculty administrator and counselor for additional document [1]. One suggestion given by the third respondent is system able to generate summary report before approval is granted so that the program leaders can do checking to avoid mistake as the system is not meant to replace human being but to supplement and assist them to perform their task efficiently.

5.3 Satisfaction

Satisfaction refers to perception of users on the ease of use of the system, system’s layout and structure, user interface including labeling and terminology used are easy to understand, the accuracy of the information and content provided and the overall system design. It is determined by users’ browsing experience in the experiment.

Most respondents are satisfied with the system. However, they are area of improvement suggested by some respondents and there are as follows:

- key terms used are inappropriate as they have broader meaning, confusing and not understandable (third, fourth and fifth respondents)
- user interface is complex and the layout is poorly designed (fifth respondent)
- table layout is cluttered (ninth respondent)
- too much details display on one page, as a result user spend more time reading and look for information (fifth respondent)
- text color and font size are to be revised (fifth respondent)
- drop down list and web page content such as sorting list view are needed (seventh respondent)
6. CONCLUSION

Based on user evaluation report, the system has many areas of improvement in order to increase effectiveness, efficiency and satisfaction. Since this is an initial study, it is hoped by acquiring user feedback will help improving the system further as involving stakeholders in evaluation is critical.

7. REFERENCES


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