Support System for Novice Researchers (SSNR): Usability Evaluation of the First Use

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Abstract: *Scholars make use of research output in the form of conference proceedings, journal and theses as references as guideline in generating new knowledge for the use of future generations. Support in the early stage of study is crucial for novice researchers as it will give them some insights of where to seek for extra information on relevant literature, institutions, people and research trend without having to go through tedious process of identifying this information all by themselves. The result of the implementation of SSNR shows significant information that can be utilized by novice researchers in accelerating research process. Thus, this paper will discuss on the evaluation of SSNR by novice researchers, in terms of its usability. The results are promising which indicated that SSNR work as it should.*

Keywords: *SSNR, novice researchers, usability, human-machine system*.

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1. Introduction

In recent years, a number of studies have sought to investigate and profile the way students use electronic information services within higher learning institution [3, 26] concluded their experiences in observing student searching behavior on the web as follows:

1. Students use the web for everything.
2. They may spend hours or just a few minutes in searching for information.
3. Searching skills vary among students and they will often assess themselves as being more skilled than they actually are.
4. They will regards information from discussion list as having the same academic weight as peer-reviewed journal articles.

Research by [12] shows that students:

1. Usage of academic resources is low.
2. Find it difficult to locate information and resources.
3. May trade quality of results for effort and time spent searching.
4. Usage of search engines influences their perception and expectations of other electronic resources. They also indicated that.
5. Students prefer to locate information or resources via a search engine above all other options.
6. Google search engine is dominating the students' information-seeking strategy. The studies above indicated that the students are prone to rely on non-scholarly information based on the results of generic search engine such as Google. The study also pointed out that the current state of the web does not support the information seeking behaviour of users.

Understanding the information seeking behavior of the users will lead to the understanding on the type of system that would assist them in the information seeking process. Several studies have been conducted to differentiate the information seeking behavior of web users particularly between the novice and experts. For instance, study by [23] found that experts are more proficient in using search engines as compared to novice. Similar study by [29] found that expert exhibit better performance in relation to time taken to solve the given problem, specifically on the number and type of search and accessed pages. On the other hand, novice users are found to heavily reformulate queries where they have to reiterate repeatedly due to the small and ineffective changes to their queries [14].

The above studies showed that experience is essential in determining the quality of the search results. These were followed by other studies that seek to understand information seeking behavior in order to come out with appropriate system that would facilitate research habits [7, 8, 24]. However, there is little attempt to associate information seeking behavior of novice researcher to the design of an ideal system. In the case of novice researchers, expert opinion and view need to be gathered to identify the type of support features needed to accelerate the research work. Similar studies that solely focused on novice researchers information seeking behavior seems to be lacking. Thus, studies that are related to novice users in seeking the information from the web would give some

insights on predicting the actual behavior of novice researchers. This will eventually leads to the identification of the features that would help them in supporting the research work.

A questionnaire survey on students web searching behaviour is administered in the Faculty of Computer Science and Information Technology (FCSIT), University of Malaya. The outcome of the survey provide an understanding in providing a support environment for the research activity in local academic-based repository [17]. An interview with research practitioners in the ICT area is administered in the faculty of computer science and information technology, university of Malaya. A total of 15 respondents are interviewed in order to seek the answers for the research question based on supervisory perspective, reviewer or academic articles (journals and proceedings) and special needs or research interests in a specific field of research. The interview is done based on the [19] study which attempted to identify some important research questions made by scholars. Additional questions in determining the special interest of researchers in different specialization is posed to the respondent to deduce any patterns that distinguish research approaches between these researchers based on their field of specialization [18].

Analysis of survey and interview has resulted in the actual requirements of the novice researchers in searching for the right information for the research purposes. The requirements which are the common access to the scholarly repositories and support features needed in accessing the right information is translated into the architectural design of a Support System for Novice Researchers (SSNR). The screenshot of SSNR's front page is shown in Figure 1 below.

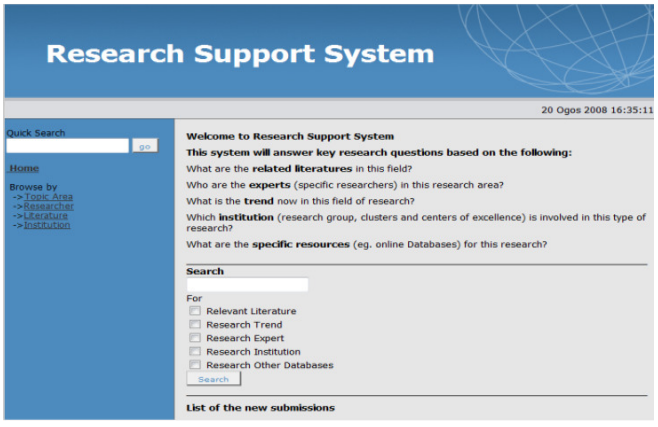

Figure 1. Screenshot of the front page of SSNR.

Existing systems such as CAS (Computer Science AKTive Space) by [31], ScholOnto by [2], E-Scholar Knowledge Inference Model (ESKIMO) by [19, 20], and OntoPortal by [25] have demonstrated the usage of ontology in providing intelligent inferring for academic-based resources such as proceeding articles and journals. However, [18] listed some specific features required by users and these features are found to be lacking from existing systems. SSNR is developed to include these features. Table 1 below shows the comparison of features in the above mentioned systems with SSNR.

Table 1. Comparison of support features between existing system and SSNR.

Criteria/ Systems	Relevant Literatures	Trend Detection	Expert Detection	Research Centres	Other Related Resources
CAS (Computer Science AKTive Space)	X		X	X	
Schol Onto	X		X		
E-Scholar Knowledge Inference Model (ESKIMO)	X		X	X	X
Onto Portal	X		X		X
SSNR	X	X	X	X	X

The discussion on each criterion of SSNR can be found in [15, 16]. SSNR provides an environment where research process for novice researcher would be eased based on the requirements provided by expert researcher. Furthermore, we considered the interoperability of the scholarly data by the mean of scholarly database integration. Even though the solution is far from complete, it provides some guidelines for the important features needed on electronic academic-based repository such as journal, theses and conference databases. The prototype system of SSNR can be accessed at http://10.100.3.154/SSNR/.

Usability evaluation is imperative especially for user-centred system design [6]. SUMI is a method that comprehensively measured the quality of software from the end users perspective [31]. It consists of 50 sets of questions which have been internationally tested and validated. The questions are further divided into five subscales of SUMI i.e., affect, efficiency, control, helpfulness and learnability [33]. The output of SUMI studies would be useful in gauging the attitude of the system user with regards to its usability.

Technology Acceptance Model (TAM) is a widely known model in predicting the users acceptance in information technology application [4, 5]. Two imperative factors in TAM i.e., perceived usefulness and perceived ease of use are used as significant indicators which lead to the believed that user will use and accept one particular technology is shown in Figure 2. Four constructs from the TAM model i.e., perceived usefulness, perceived ease of use; attitude

and behavioral intention are populated with relevant questions.

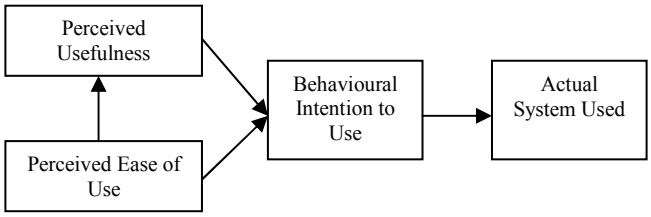

Figure 2. Technology acceptance model.

2. Usability Evaluation of SSNR

Usability is defined by ISO 9126 (ISO 1991) as a set of attributes that bear the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users. Based on the definition, emphasize is put on the "effort" that individual user need to make based on sets of rules or standard. In this study, the usability dimension is linked to the functionality of the SSNR system through the user interface. The user interface is defined by [27] as the parts of the program that link the user to the computer and enable him to control it. [21] stated that the evaluation of a product by the users are measured based on the quality of its user interface.

The attributes for assessing the usability of SSNR are taken from two highly renowned sources for usability evaluation i.e., Software Usability Measurement Inventory (SUMI) and TAM. As SSNR is developed as a proof of concept that novice researchers are in need of a system that will assist them in undergoing the research process, TAM is also utilized to predict the acceptance of such system which have been discussed in chapter three. Table 2 below defines each of the attribute used in the usability questionnaire where attribute number 1 to 5 are taken from SUMI and attributes number 6 to 9 are taken from TAM. The definition of SUMI's attributes are taken from SUMI questionnaire homepage [22] and the definition of TAM's attribute are taken from [5, 30].

2.1. User Group

The respondents are randomly selected from the participants of the earlier survey. Five of them volunteered to take part in the observational study and also the SSNR usability evaluation. Two respondents were invited which make a total of seven respondents. [28] stated that the usability testing produce the best result when not more than five users are involved at one particular time. The reason is that with the addition of more users, less new information will be learned from the usability testing. This is due to that fact that similar results will be obtained for the sixth, seventh, eighth user and so on. The attributes above are segregated in the usability questionnaire given to the respondents. Relevant questions for each attributes are customized towards the SSNR.

2.2. Usability Testing Procedures

The usability testing of SSNR is done based on one to one basis. The user testing is conducted separately based on the agreed time and date. Seven respondents who agreed to take part in the study are given an email which stated the time and venue for the test. The testing was administered in the lab setting in which a clear instruction is given to the respondents on what are the things that need to done. First, respondents are required to get themselves familiar with SSNR environment. No instructions whatsoever are given to the respondents on how to operate SSNR. This is because the interface are intuitively developed in which the respondents can use it after a few clicks. Average time given to the respondents to try out the system is 5 minutes.

Table 2. Definition of constructs used for usability study.

No.	Attributes	Definition
1	Affect	"The user's general emotional reaction to the software" [25]
2	Efficiency	"The degree to which users feel that the software assists them in their work" [25]
3	Helpfulness	"The degree to which the software is self-explanatory, as well as more specific things like the adequacy of help facilities and documentation" [25]
4	Control	"Measures the extent to which the user feels in control of the software, as opposed to being controlled by the software, when carrying out the task" [25]
5	Learnability	"Measures the speed and facility with which the user feels that they have been able to master the system, or to learn how to use new features when necessary" [25]
6	Perceived Usefulness	"Subjective probability that using a specific application system will increase his or her job performance..." [22]
7	Perceived Ease of Use	"The degree to which the user expects the target system to be free of effort" 22]
8	Attitude	"The individual user's positive or negative feelings (evaluative affect) about performing the target behavior" [22]
9	Behavioral Intention	"The measure of the strength of one's intention to perform a specified behavior" [22]

Later, the respondents are required to try out each of the modules in SSNR. Each of the respondents is given sets of keywords that can be tested on each of the module. Examples of query terms are database management, knowledge management, distributed systems and few others. The query terms are given to the respondents in advance because of the rich sources in terms of scholarly documents classified under each term. The chosen terms also consist of various types of resources such as theses, conference papers and also journals. Users are given the freedom to explore SSNR and restriction is given on which module should be tried first. Average time taken by each of the respondents to complete all the modules in SSNR is 10

minutes, which mean that each module took about 2 minutes each to finish. Respondents are given usability questionnaire surveys that need to be completed after they have done exploring the SSNR. The survey consists of two sections which are general information and usability evaluation criteria. The purpose of general information section is to elicit specific information of the background of respondents in terms of the current mode of study and gender. The second section focused on the main criteria used to measure the usability of SSNR.

3. Results of Usability Evaluation

In general, all nine attributes tested shows encouraging result. The SUMI scale i.e., the "global" scale is used as a benchmark in determining the overall judgment of usability [33]. Based on the gathered data, it can be stated that the global value has the average score of 50 or 3.0 with reference to the Likert scale used for the questionnaire. The mean which is the average score of each attribute shows the above average results. The mean is calculated based on the "positive" types of questions for each of the assessed attributes such as "I would recommend this learning environment to my friends" and "Working with this learning environment is mentally stimulating" which is taken from the attribute "Affect". However, "negative" types of questions such as "There are too many steps required to get something to work" and "Sometimes SSNR behaves in a way that I don't understand" which are also taken from the "Affect" attributes shows good results where respondents are found to be disagree with all the negative statements. The "negative" types of questions are included in the survey to act as a check and balance in producing an unbiased evaluation. The results is summarize in Table 3 below.

Table 3. Mean scores of usability of SSNR.

Attributes	Mean
Global	3.00
Efficiency	4.07
Affect	4.31
Helpfulness	4.14
Control	4.00
Learnability	3.94
Perceived Usefulness	4.25
Perceived Ease of Use	4.50
Attitude	4.24
Behavioral Intention	4.29

4. Analysis

The results in Table 3 above are relatively encouraging. Generally, the users satisfaction for the SSNR system are said to be high and the system is successful in fulfilling the need of the novice researchers. The lowest score from the attributes tested came from "Learnability" factor which is 3.94. This might due to the fact that no proper training have been given to the users on how to operate SSNR which resulted in the slow learning experience. Moreover, the users might not have expected to have some new features such as trend detection and expert detection to be embedded inside a scholarly repository. All in all, it can be concluded that SUMI usability attributes used in evaluating SSNR have apparently shows that the prototype system is working properly as expected and SSNR is able to reflect the requirements needed for a system that was meant to assist novice researchers in carrying out the research work.

Similar results are obtained from the attributes that form the TAM attributes. TAM, which provides parsimonious purpose in predicting user acceptance of a technology before the users get heavily involved in the technology [11], is added as part of usability study for SSNR. However, due to the small sample used for the study (N=7), any statistical analysis such as correlation study for hypothesis testing would not bring any significant results. Inline with TAM, [18] defined user acceptance as "the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support". In addition, according to [4], user acceptance is important in determining the success or failure of an information system. Analysis on the individual scale of TAM model which are perceived usefulness, perceived ease of use, attitude and behavioral attention shows that users are perceived to be highly satisfied with SSNR. Detailed discussions for each of TAM subscales in accordance to this particular study are discussed below:

- *Perceived Usefulness (PU):* Perceived usefulness refers to the perception or awareness of novice researchers to the system that could fulfill their information needs. The system is perceived to be useful if its users belief that it could increase the research performance, productivity and effectiveness which is depicted by the mean value of 4.25 based on four subscales of PU. Performance can be also measured in terms of the "right" information obtained within a short period of time. In this sense, SSNR demonstrate a considerable good performance in the sense that it produces the "right" information which is measured by the recall and precision values for selected user queries. The time taken to obtained specific information is shorten due to efficient procedures embedded in each of the SSNR modules. The improvement of research productivity is demonstrated by the increase number of relevant information obtained as opposed to the small amount of input supplied. For instance, in measuring software productivity, a formula adapted from [30] is used as example:

$$Productivity = \frac{Output\ produced\ by\ the\ process}{Input\ consumed\ by\ the\ process}$$

[30] stated that the productivity of software is determined by the increase of its output over the decrease of its input. The productivity of users (who used SSNR) are said to be increased because with a single user query, five different information that were identified to be useful in assisting novices researchers in assisting the research work are presented to the users in organized manner. Effectiveness is defined by [13] as "the extent to which an activity fulfils its intended purpose or function" and by [10] as the "measure of the match between stated goals and their achievement". In the other words, effectiveness of SSNR in particular can be qualitatively measured by how the users perceived that the system would fulfill its function as it supposed to be. SSNR is promised to be some sort of tool that would assist novice researchers. By looking at the score given by users of the effectiveness factor of SSNR which is 4.00, it can be concluded that SSNR is believed to be the kind of assistant needed by novice researchers. The final subscale of PU construct (mean= 4.43) confirmed the positive perception of users towards admitting that SSNR is useful in supporting early staged of research work.

- *Perceived Ease of Use (EU):* EU is another dimension of TAM attributes that is used to determine the acceptability of new technology. Ease of Use is defined by ISO 9241 standard as "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". In the other words, ease of use refers to the situation when users find it easy to operate a tool (in this case the SSNR) that might due to the simplicity of the tool, users' past experience in handling tools with similar functions and intuitive reaction while dealing with interactive user interface. With regards to the subscales of EU used in the survey, the overall perception mean which is 4.50 shows that users highly regards the process involved in handling SSNR as so easy. The fact that EU received the highest score in the terms of user perception evaluation can be interpreted as the strong tendency for such system to be accepted as part of supporting tool for research.
- *Attitude (A):* Attitude or intention to use is another factor in TAM that is used to predict the level of user acceptance of a system or technology. In TAM, the attributes of PU and EU were used as effective predictor on the intention to use a particular system in the near future [5]. [19, 32] Echoed stated that the "intention to perform a particular behavior has been shown to be an effective predictor of the actual behavior itself". In the context of this study, construct Attitude from TAM can be directly interpreted as the intention to use SSNR which will eventually lead to the acceptance of SSNR by novice researchers. Moreover, the attitude constructs which yielded the mean score of 4.24 shows that users are adamant that SSNR could fulfil their information need for research.
- *Behavioral Intention (BI):* The BI construct in TAM demonstrated the direct effect of the positive perception of the previous constructs i.e., attitude. [1] Define behavior as "anything that a person does involving action and response to stimulation" and intention as "a determination to act in a certain way". In the other words, if users are found to be keen that a system (i.e., the SSNR) is easy to use, which will lead to belief that it is useful, consequently there will be a positive response to accept such system. The average mean received by the construct BI i.e., 4.29 shows that novice researchers in this study admitted that SSNR is beneficial.

The final part of the usability survey which is the open-ended question on the suggestions or comments to further improve SSNR shows varied responses from the participants:

- I think SSNR is a good system for FCSIT's research students. The subject scope can be broaden so that it can be used for other research students in the other faculty as well.
- It would be nice if SSNR has an advance search and allow the search results to be sorted according to the researchers' name and year of publications.
- In my opinion, this system is very helpful for students and researchers because it can save our time and enhance the accuracy of the results of our search.
- The system would be better if it can have an automated spelling error checking.

Only four participants answer the final question. Out of the four responses, two participants found that SSNR is good as it is and another two participants reciprocated on the functionality of SSNR that could further enhanced the information search and presentation.

5. Conclusions

A decision to utilize a system is preceded by a belief that one system is good. As for usability study, a plausible assumption can be made that if usability is a prerequisite of acceptance, and all constructs of SUMI and TAM shows positive results, it can be deduced that SNNR is desired as part of supporting tool for research work. The main contribution of this study has been in identifying the type of information expected and offered from the interaction between the components of Human - Machine system i.e., users, tasks, tools and environment. The environment Institutional Repository (IR) interacts directly with the user by providing the scholarly resources. These resources need to be

integrated and properly stored to serve the need of the users (Novice Researchers) as the reader of IR. Users interact with the task element by emphasizing the need for the resources to be homogeneously viewed and specifying the type of support needed to conduct early stage of research work. The task element offers five type of supporting features needed to assist the users, on top of the integrated resources. Tools SSNR offer the automation of the identified tasks based on the requirements of the users. Semantic web technology is utilized to realize SSNR and provide the integration needed for the scholarly resources inside IR. The evaluation of the prototype of SSNR shows that users perceived the system as useful in assisting a research work and the retrieval of information is of adequate quality.

The work reported in this study is a positive step in attempting to associate information seeking behaviour of novice researcher to the design of an ideal system. However, more additional studies need to be done to provide a complete support environment for novice researchers. The challenge in ensuring that novice researchers is provided with all the support needed lies in the hand of experienced supervisors, who are varied in expertise and research approaches.

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