

Heuristic Evaluation of Dalhousie Repository Interface

by

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DEDICATION PAGE

To every member in my family for their love and support.

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ABSTRACT

The number of Institutional Repositories (IRs), such as DalSpace, has been growing in the past few years. However, most IRs are not widely used by the intended end users. Evaluating the user interfaces is an essential part of any process to increase users' acceptance of IRs. There are two foci of this thesis: to evaluate the usability of DalSpace's interface using Nielsen's heuristics to uncover usability problems for development purposes and to examine the differences between user-interface experts and non-experts in uncovering problems with the interface.

To apply the heuristics to the interface, I formed user profiles (also known as personas) to represent potential end-users groups. These profiles helped to communicate users' needs, abilities, tasks, and problems. To produce a reliable list of usability problems by applying the heuristic evaluation approach, I examined the impact of expertise on the quality of the results. From the individual heuristic analyses (by both experts and novices), I distilled 66 usability problems classified by severity. Also, the frequency of each violated heuristic was used to assign priority to the uncovered usability problems as well as the severity level.

The results of applying the heuristic evaluation show that both experts and non-experts can uncover usability problems. In fact, the ability to find difficult and easy problems was recorded for both types of evaluators. However, experts tend to reveal more serious problems, while novices uncover less severe problems. Interestingly, the best evaluator (who found 21% of the total number of problems) was a novice. Our results indicate that we cannot rely on one evaluator even if the evaluator is an expert.

The administrative interface is out of the scope of the thesis; however, the usability of the interface should be examined for improvement purposes. More user profiles should be formed to represent additional user groups for more interfaces including the end user and staff's interfaces. Both results from the user profiles and the list of usability problems will be given as tools to the development team for improvement.

LIST OF ABBREVIATIONS USED

IR	Institutional Repository
OA	Open Access
DalSpace	Dalhousie Institutional Repository
DL	Digital Library
GEMS	Gateway to Electronic Media Services
GUI	Graphical User Interface
DR	Discipline Repositories
VDC	Virtual Data Center
UP	User Profile
FCS	Faculty of Computer Science
ID	Identification number
H	Heuristic
HCI	Human Computer Interaction
TA	Teaching Assistant

CHAPTER 1 INTRODUCTION

There are two foci of this thesis: to evaluate the usability of DalSpace's interface using Nielsen's heuristics to uncover usability problems for development purposes and to examine the differences between user-interface experts and non-experts in uncovering problems with the interface.

The user interface of Open Access (OA) repositories has an effect on their users' performance and satisfaction. To add to the ongoing development of these types of repositories, usability evaluations need to be implemented on the user interface. In this thesis, the main focus is to apply the heuristic evaluation approach to Dalhousie Repository interface "DalSpace". The number of Institutional Repositories (IRs), such as DalSpace, has been growing in the past few years. Users want to navigate easily and retrieve the information they need by using usable interface to help them achieve their goals (Ping et al., 2004). Therefore, the usability of IRs should be examined to ensure the acceptability of this particular type of system. Chapter One highlights the reasons behind choosing DalSpace as a framework to be examined, and the research questions for two main studies regarding DalSpace users and usability considering the effect of evaluators' expertise and number on the results reliability.

1.1 MOTIVATIONS

The motivation behind conducting a usability evaluation of the Dalhousie Repository interface 'DalSpace' includes many aspects. First of all, the usability of Dalhousie Repository interface DalSpace has not been tested which acts as the most significant reason behind the motivation as mentioned by DalSpace team. In addition, the benefits from previous studies would create more focused aspects as I can build on the existing research. However, the research in this thesis can be considered as the first step toward improving DalSpace service.

Second, investigating the potential user groups of such service is another motivation. As mentioned earlier, DalSpace users have not been either known or studied. Knowing the potential user group for a growing technology is crucial. Users play a vital role in increasing the acceptability and effectiveness of the IR systems.

Another motivation is to investigate the application of the heuristic evaluation method on DalSpace interface. Does applying the heuristic evaluation to the DalSpace interface produces a reliable list of usability problems? Another aspect of studying the application of the method is to

investigate evaluators' performances of to the interface regarding the number and type of problems they uncovered and the difficulty to uncover these problems. Finally, in Saudi Arabia there are “21 government universities, 24 private universities, 12 technical colleges, 37 colleges and institutes” (MOHE Saudi Arabia, 2010). Only four of them have Institutional Repositories as an Open Access archive (Ahmed et al., 2012). Knowing that only four universities out of 94 gain the advantage of IRs systems motivates me to start with DalSpace as an example of an IR as the first step toward building the needed solid background. The experience gained from conducting usability evaluation on DalSpace interface would help me to start developing the already existing IRs in Saudi Arabia. This helps me to participate in creating new ones by applying what I have learnt. The need to improve the already existing four IRs is vital because there has not been research conducted regarding their usability yet (Ahmed et al., 2012).

The technique of heuristic evaluation introduced by Nielsen & Molich (1990) proscribes the use of expert evaluators. However, later researchers (notably Levi & Conrad in 1996) experimented with a variation on the technique using non-experts. If a way could be found to obtain similar benefit from heuristic evaluations without the necessity for as many experts then heuristic evaluation could become more useful for usability inspections.

1.2 RESEARCH OBJECTIVES

The main objective is to uncover usability problems in DalSpace interface which will increase the system usability and users' acceptance when fixed. To reach the ultimate goal, we need to establish user profiles that represent the potential end users with a precise description of their needs, abilities, tasks, and problems. The user profiles created are the first step toward conducting the heuristic evaluation, usability evaluation, to communicate users' needs, abilities, goals and problems. Therefore, this thesis covers a user study and a usability evaluation.

1.2.1 Application of User Profiles

The study aims to answer these research questions, and they were used to guide the user profiles process with precise focus and direction.

- Who are the users of DalSpace?
- What do they want to achieve using DalSpace?
- What are the problems that users face?
- What should DalSpace provide them with?

The user profiles created from the study will be used as follows:

- To know DalSpace users' needs, goals, tasks and problems which helps in creating focused task scenarios;
- As a tool given to the development team in order to communicate users' needs while studying the final lists of problems and for further users' studies assistance.

1.2.2 Application of Heuristic Evaluation

DalSpace as the interface to Dalhousie's IR is considered to be an extension of Dalhousie library services that enables users to browse the university collections and academic scholarly output (DalSpace online help document, accessed 2012). DalSpace interface should be evaluated to improve its ease-of-use to enhance the usability of the website, to encourage students, faculty, members of Dalhousie University' to use and also return to it while searching and exploring collections. Therefore, the research objectives of evaluating Dalhousie Repository interface include:

- To determine the usability problems of Dalhousie Repository interface “DalSpace”.
- To provide solutions and guidelines regarding the uncovered problems.
- To provide the development team in Dalhousie University with the suggested solutions to be used in the iterative design process for development purposes.
- To evaluate applying the heuristic evaluation approach to DalSpace interface by investigating number and type of problems along with the number and expertise of evaluators'

The result of the heuristic evaluation will benefit the university through improving the user interface and encouraging users to use the library services. To sum up, both user profiles and list of usability problems will be provided to the development team as tools for improvement purposes.

1.2.3 Evaluation of a Variation of Heuristic Evaluation

Part of the thesis will be an investigation of a variation of heuristic evaluation in which non-experts and experts apply a slightly altered version of the standard technique. The performance of the two groups will be compared using the same measures that Molich and Nielsen (1990) originally applied.

CHAPTER 2 BACKGROUND

2.1 INTRODUCTION

In this chapter, I define the Institutional Repository (IR) characteristics and discuss the benefits of the IR along with examples of this software. Keeping with the focus of the research for this thesis, Chapter Two presents the breakdown for conducting a heuristic evaluation approach to assist in designing the heuristic evaluation method of the Dalhousie Repository Interface “DalSpace”. There are a number of factors that affect the results of the heuristic evaluation including the necessary number of evaluators for maintaining a quality assessment.

Aligned with the research objectives of evaluating Dalhousie Repository Interface including determining the usability problems of the Dalhousie Repository Interface "DalSpace," with specific goals in providing solutions and guidelines regarding uncovered problems, this chapter discusses the background of this process. Defining the basis for determining the usability evaluations frames the understanding of this part of the methodology characteristics. In addition, further discussion of the importance of usability evaluations in general and for Institutional Repositories (IRs) specifically is discussed to lead to a better understanding of the pragmatic approach to assist making best practices of Digital Repositories.

As the investigation process continues as explained in this background chapter to provide insights to self-guided exploring or following task scenarios and individual inspection versus team inspection. Further background information for this chapter includes the usability of Digital Libraries (DLs). The heuristics in this chapter are the 10 characteristics provided by Nielsen as well as a modified list.

2.2 WHAT IS USABILITY?

In 1998, the term “user friendly” reached a level of vagueness and subjective definitions, which led to the start of the use of the term “usability” instead (Bevan, Kirakowsk and Maissel, 1991). The International Standards Organization (ISO) in 1994 defines usability as

Usability: 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.

The term usability can be understood from different point of views. Whether an IR or any other type of website, every user interface has its fair share of usability problems. Nielsen (1993)

suggests that usability cannot be measured by one dimension; these five attributes are associated with the usability components which include learnability, memorability, efficiency, error recovery, and satisfaction. While Hix and Hartson (1993) suggest that usability relies on the following factors which include first impression, initial performance, long-term performance, and user satisfaction. Also, Booth (1989), Brink et al. (2002) share similar viewpoints that define usability as the effectiveness, efficiency, ease to learn, low error rate and pleasing. Nielsen's and ISO's usability definitions are the most widely used (Jeng, 2005b). Paithankar and Ingle (2012) have created a novel approach to rank the usability attributes to include practicability, operability, learnability, affect, access control, and resilience. I have summarized some of the usability factors according to the authors in Table 1.

Researchers	Usability Factors
Booth (1989)	The effectiveness, efficiency, ease to learn, low error rate
Hix and Hartson (1993)	First impression, initial performance, long-term performance, and user satisfaction
Nielsen (1993)	Learnability, efficiency, memorability, low error rates, and satisfaction
ISO (1994)	Effectiveness, efficiency, satisfaction
Brink et al. (2002)	The ease of use, learn, remember, tolerate to errors and pleasing
Paithankar and Ingle (2012)	Practicability, operability, learnability, affect, access control, and resilience.

Table 1. Usability Factors

Scholars, students, researchers, and educators who experience using Institutional Repositories ideally encounter ease of interface with optimum productivity characteristics for their individual projects-in other words-its usability. Ensuring interactive computer product usability requires a systematic usability effort using established usability engineering methods (Nielsen 1993) (p.13).

2.3 USABILITY EVALUATIONS

“It is nearly impossible to design a user interface right the first time, we need to test and plan for modification by using iterative design,” Nielsen suggested (1993). Evaluation is considered as a basic step in the iterative design process. Moreover, there are varieties of approaches to follow in

evaluating the usability, which include formal usability inspection (Kahn and Prail, 1994), the cognitive walkthrough (Wharton et al., 1994), heuristic evaluation (Nielsen, 1993), Contextual Task Analysis (Usability Methods, 2013), paper prototyping (Lancaster, 2004). The definitions of these usability inspection methods are summarized in Table 2.

Authors	Methods	Definitions
(Nielsen,1993)	Heuristic Evaluation	Heuristic evaluation is done by a small set of usability experts and according to a set of heuristics to produce a list of usability problems in a user interface.
(Kahn and Prail, 1994)	Formal Usability Inspection	Formal usability inspection is accomplished by designers and development teams reviewing the users' tasks performance.
(Wharton et al., 1994)	The Cognitive Walkthrough	The cognitive walkthrough method focuses on the learnability and the ease of use of a user interface.
(Lancaster, 2004)	Paper Prototyping	Evaluating the paper-version of an interface which can be done in early design stage.
(Usability Methods, Accessed 2013)	Contextual Task Analysis	It is a research method that focuses on observing users while performing tasks and conducting one-on-one interviews regarding users' behaviors.

Table 2. Usability evaluation methods

In addition, Riihiaho (2000) in his thesis classified usability evaluation methods into two main categories: either by expert-based methods or user-based methods. Researchers need to decide to follow a certain method according to what they are evaluating. Are they going to evaluate the interface, content, functionality or design?

Any of these methods can be implemented to find the usability problems in Dalhousie Repository Interface “DalSpace”. However, I chose to apply the Heuristic Evaluation method due to its popularity in evaluating user interfaces without the involvement of end users, which reduces resources and requires lower costs. The low-cost is mentioned in terms of time and money because it can be accomplished in few hours and cost less. Testing interfaces and

products with actual end users is expensive as Hollingsed et al. (2007) suggested. Another important reason is that the set of Nielsen's heuristics are well documented in a way that can be understood easily (Nielsen 1994a) and modified to suit any type of user interface. Interestingly, non-usability experts can easily adapt the method and use it successfully as mentioned by (Nielsen 1994a). Moreover, a small number of evaluators from (three to five) can identify approximately 75% of usability problems (Nielsen 1994a). These reasons were behind adapting the Heuristic Evaluation method. I added some new aspects to the method which help to consider to all these factors to increase the methodology success.

2.4 INSTITUTIONAL REPOSITORIES

This section defines the Institutional Repositories, their benefits, and a DSpace as an example.

2.4.1 What are Institutional Repositories?

Over the past fifteen to twenty years, research libraries have been used to create, store, manage, and preserve scholarly documents in digital forms and make these documents available online via digital Institutional Repositories (Zimmerman and Paschal, 2009). IRs draw their name from hosting documents that are considered as local or for an institution such as Dalhousie University in the case of DalSpace that host only the scholarly output. IRs host various types of documents that include academic documents, news papers, photographs, films, legal documents, and proceeding (Zimmerman and Paschal, 2009).

In terms of definition, according to Lynch (2003), institutional repositories (IRs) provide universities with “a set of services that a university offers to the members of its community for the management and distribution of digital materials created by the institution and its community members.” It is the commitment of stewardship of the “long-term preservation where appropriate, as well as organization and access or distribution”. This long preservation has led to considering IRs as important extension of digital Libraries (Tansley et al., 2003).

2.4.2 Benefits of Institutional Repositories

Institutional repositories are popular among universities worldwide (Bailey, 2008). According to Lynch (2003), fundamental to the basics of IRs “remains recognition that the intellectual life and scholarship of our universities will increasingly be represented, documented, and shared in digital form.” At the same time, the IR as a channel allowing the university structuring its

contribution to the global community, there exists the responsibility for reassessment of both culture and policy and their relationship to one another (p. 2).

IRs have their potential benefits in improving the scholarly communication, providing open access service (unless there are some legal restrictions), and allowing content management (Heery and Anderson, 2005). Further, Institutional Repositories act as an opportunity to increase efficiency through any organization's various departments by eliminating practices that include exchanging scholarly documents as hard copies instead of digitally (Gibbons, 2004). Moreover, “in a university setting, an IR provides a centralized digital showcase through which community members can highlight their work” (Gibbons, 2004). Therefore, these benefits might not reach the users if there are usability problems in the IR interface.

2.4.3 Example of Institutional Repositories

This section shed the lights on DSpace as an Institutional Repository example.

2.4.3.1 DSpace

In 2000, the Hewlett-Packard Company (HP) at MIT Libraries was authorized by the Hewlett-Packard Company (HP) to, cooperatively, build DSpace, which is as Institutional Repository for hosting the intellectual output of “multi-disciplinary” organizations in digital formats (Smith et al., 2003). The DSpace Model is shown in Figure 1.

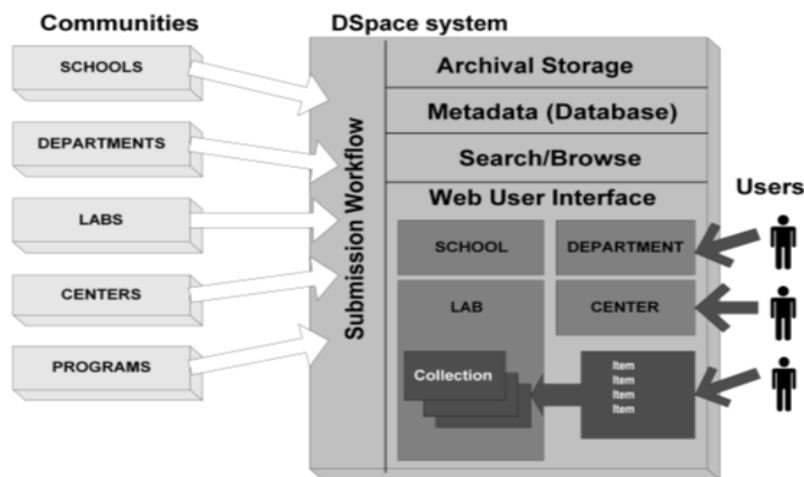


Figure 1. DSpace Model (Smith et al., 2003) (p.1).

DSpace¹ is organized around communities, and in the case of MIT, communities are schools and departments labs. In 2004, DSpace was released to be freely adapted by any organization and extended to meet these organizations needs (Smith et al., 2003).

Moreover, the system consists of two interfaces: an end-user interface or “public interface” for searching the content or submitting to DSpace and the administrative interface (Smith et al., 2003). According to its website, DSpace allows saving, sharing and searching digitized research images, conference papers, preprints, peer-reviewed scholastic articles, technical reports, working papers (DSpace, 2013). In my thesis, DalSpace is an Institutional Repository that is organized around Dalhousie University's communities, which include faculties, departments, libraries, and administration.

2.5 HOW TO CONDUCT A HEURISTIC EVALUATION

In this section, the Heuristic Evaluation is presented in detail. Heuristic Evaluation is a method in which a small set of evaluators (experts) examine a user interface according to a set of principles or “heuristics”. The Heuristic Evaluation method was proposed by Nielsen and Molich in 1990. The result from the heuristic evaluation method is a list of usability problems in the user interface. Then, these problems should be aggregated in final report and presented to the development team in which they can decide on the fixes. As part of the inspection process, evaluators perform several passes and they should do so no less than twice. The first pass allows time to familiarize themselves with the interface as well as get an idea of the system's possibilities. The second pass is to allow evaluators to enlist the usability problems compared to the heuristics. In order to increase the reliability of the uncovered problems, Nielsen suggests performing a severity rating that starts with 0 and ends with 4 (Nielsen, 2013). The scale is presented in Table 3.

Severity Rating	Description
0	I don't agree that this is a usability problem at all
1	Cosmetic problem only: need not be fixed unless extra time is available
2	Minor usability problem: fixing this should be given low priority
3	Major usability problem: important to fix, so should be given high priority

¹ <http://dspace.org>

Table 3. Nielsen's Severity Rating Scale adopted from (Nielsen, 1995).

The evaluation process and severity rating should be accomplished independently and evaluators should not have contact until they finish evaluating to avoid bias and ensure that evaluators do not have an influence on each other's evaluations. It is important that evaluators receive training on how to use the system in order to increase their knowledge about the particular interface. They do not have to be experts in using the system but they need to be familiar with the system interface (Loitzl, 2006).

2.5.1 Aspects to Consider with Conducting a Heuristic Evaluation

This section highlights the aspects that should be considered in order to optimize the methodology results.

2.5.1.1 Number of Evaluators

The heuristic evaluation could be accomplished by one evaluator; however, Nielsen and Rolf Molich have conducted several studies that showed only one evaluator can find 35% of usability problems in a user interface (1990). Therefore, to produce a more reliable and better list of usability problems, the evaluation should be performed by several evaluators and the results should be aggregated to achieve better results (Nielsen and Molich, 1990) (Nielsen, 1993). The curve for the number of the usability problems uncovered by different evaluators is presented in Figure 2.

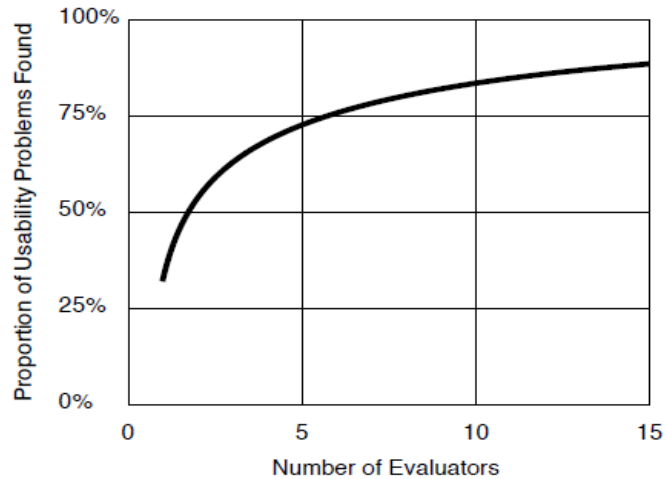


Figure 2. The number of the usability problems uncovered by the Heuristic evaluation method by different number of evaluators (Nielsen, 1993) (p. 156).

The minimum number of evaluators would be only three because the number of uncovered problems increases strongly from this point as shown in Figure 2. The ideal number of evaluators should be in the range of four to five evaluators. This is proven by Nielsen and Molich (1990). Tan et al. (2008) advise “using from three to five evaluators if ‘single expert’ usability specialists were utilized.” Two to three evaluators is recommended for double expert who have experience with both the system and usability. Therefore, more evaluators should perform the heuristic evaluation if the system is more complicated.

2.5.1.2 Expertise of Evaluators

Choosing the right group of experts or evaluators is an important aspect because their expertise affects the way they inspect the interface (Tan et al, 2008; Nielsen, 1992; Nielsen & Mack, 1992; Molich & Nielsen, 1990; Loitzl, 2004, Qing & Ruhua, 2008; Baker, 2002; Nielsen & Bellcor, 1992; Heery & Anderson, 2005). A “novice” evaluator has experience on neither the system nor usability evaluation process. A “single or regular expert” is an evaluator who has experience with usability evaluation while “double expert” is the evaluator who has experience on both the system and the usability evaluations while the “user” is the work-domain experience as shown in Table 4.

Type of evaluator	Expertise
Novice (Nielsen, 1993)	no usability expertise
User (Muller et al. 1998)	work-domain experience
‘Single Expert’ or ‘Regular Expert’ (Nielsen, 1992)	usability specialist
‘Double Expert’ (Nielsen, 1992)	usability specialists who also has experience with the particular kind of interface

Table 4. Evaluators' level of expertise

Novices usually find around 35 % of the usability problems in a heuristic evaluation according to Nielsen (1993). Tan et al. (2008) advise “using 3-5 evaluators if ‘single expert’ usability specialists were utilized.” Nielsen (1993) suggests the same idea of having at least three evaluators in one study if they were single experts. Moreover, Tan et al. (2008) advise two to three evaluators as recommended for double experts to focus on the domain usability. “Double experts find 60% of the usability problems, making them 2.7 times as good as novices and 1.5 times as good as single experts” as Tan et al. (2008) suggest.

2.5.1.3 Scenarios or Self-guided Inspection

While performing heuristic evaluations, experts have two options: either they start the process with a list of tasks (scenarios) or have self-guided freedom in their evaluations. Both ways have advantages and disadvantages. In terms of scenarios, they are designed to assist evaluators in understanding how the system responds to user actions. The key advantage of using scenarios is to assist evaluators, who have little experience on the particular interface, with the knowledge they need to perform the evaluation smoothly (Karat, 1994; Nielsen 1993). Loitzl (2006) agrees and suggests “a specific task scenario can be presented to the evaluators which can serve as the basis for their evaluation.” Therefore, it would draw evaluator's attention to specific parts of the system that should be evaluated.

However, giving the evaluators a certain list of tasks would limit the evaluation to specific features on the interface which would decrease the evaluators' exploration. This would have a clear impact on the results produced. Giving the evaluators the freedom to decide the way that they want to inspect the interface would allow evaluators to create their own tasks that might

reveal some new usability problems that would not be covered by the list of scenarios (Karat 1994; Baker, 2002).

2.6 NIELSEN'S LIST OF HEURISTICS

In 1990, Nielsen and Molich created a list of original heuristics depending on several years of teaching experience and usability engineering consultation. This set of heuristics was constructed from some usability aspects and interface guidelines (Nielsen and Molich 1990, Molich and Nielsen 1990). The ultimate goal of creating these heuristics is to make the process of conducting a heuristic evaluation as easy as possible to teach and apply (Nielsen, 1994b). In addition, the set of heuristics is small (e.g. 10) to help evaluators remember them and apply them effectively (Nielsen and Molich 1990). The list of heuristics is listed in detail in Chapter Five of my thesis and Nielsen explained it in Chapter Five of his book “Usability Engineering”. This set of heuristics was refined in 1994 by Nielsen as a result of several studies to include:

<ul style="list-style-type: none"> • Visibility of system status • Match between system and the real world • User control and freedom • Consistency and standards • Error prevention 	<ul style="list-style-type: none"> • Recognition rather than recall • Flexibility and efficiency of use • Aesthetic and minimalist design • Help users recover from errors • Help and documentation
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Figure 3. The modified list of Heuristics (Nielsen, 1994).

2.7 CONCLUSION

Aligned with the research objectives of evaluating Dalhousie Repository Interface including determining the usability problems of the Dalhousie Repository Interface “DalSpace,” with specific goals providing solutions and guidelines regarding uncovered problems, Chapter Two discusses the background of this process. With the literature, the characteristics of the heuristic evaluation model as applied to existing software interface systems reveals the activeness of the heuristic methodology.

Providing the foundation of logic for incorporating multiple evaluators when conducting a heuristic model to assessing the usability of interface software, Chapter Two establishes the necessary background information for understanding specific variables of heuristic analysis methodology. In addition, understanding development processes of interface software as discussed in this chapter remains substantial e as a part of the necessary knowledge for

undertaking a thesis of this magnitude. In sum, while the literature establishes a clear background of the need for evaluating the usability of IR interface, the future of the established yet continually developing of the academic based digital repositories remains exciting, challenging, and with a defined purpose.

CHAPTER 3 LITERATURE REVIEW

3.1 INTRODUCTION

By applying a heuristic evaluation approach to Dalhousie Repository Interface or “DalSpace” aim to determine the usability problems and to provide guidelines for which these uncovered problems can be solved. These solutions will be provided to the design and development team at Dalhousie University to help them enhance the usability of DalSpace during the iterative design cycle. Aligned with the research objectives, the literature review remains a vital component. The literature review not only substantiates both the pragmatic and proactive engagement in the usability of these systems but also offers interventions to correct identified usability glitches. Furthermore, the research papers presented in this chapter were chosen because the usability evaluations were conducted on IRs systems. These IRs belong to universities which is the case with Dalhousie Repository DalSpace. The body of the literature review covers studies that are concerned with applying the heuristic evaluation and some that focus on applying the heuristic evaluation in specific areas such as with Digital Libraries (DLs) and Institutional Repositories (IRs) as well as some different usability methods applied on IRs and DSpace software.

3.2 HEURISTIC EVALUATION OF GATEWAY TO ELECTRONIC MEDIA SERVICES (GEMS)

The study, “Heuristic-based User Interface Evaluation at Nanyang Technological University in Singapore”, by Ping, Ramaiah, and Foo (2004) tested "heuristic-based user interface evaluation of the Gateway to Electronic Media Services (GEMS) system. The GEMS system offers variety services through its Graphical User Interface (GUI). The system contains “multimedia courseware, online databases, audio and video resources” (p. 1). The researchers' goal was to evaluate the GUI of the GEMS system by applying the Nielsen's Heuristic Evaluation. The GEMS interface is shown in Figure 4.

The researchers recruited 10 graduate students who were Nanyang University students. Faculty members and staff were excluded from the sample. The research objectives were to investigate both strengths and weaknesses of the GEMS system, and provide some recommendations regarding some areas for improvement. In their findings, Ping et al. (2004) determined that the heuristic evaluation helped them to uncover major problems such as being “unable to find books using ISBN number; inconvenient to retype/change the keywords while

conducting keyword search again; difficulty with cross-media searching; and not knowing how to change expired passwords”. Another important finding is that attractive user interfaces are not always easy to use and simple. The researchers of the study suggested that the uncovering of these problems ensures that the GEMS system needs development.

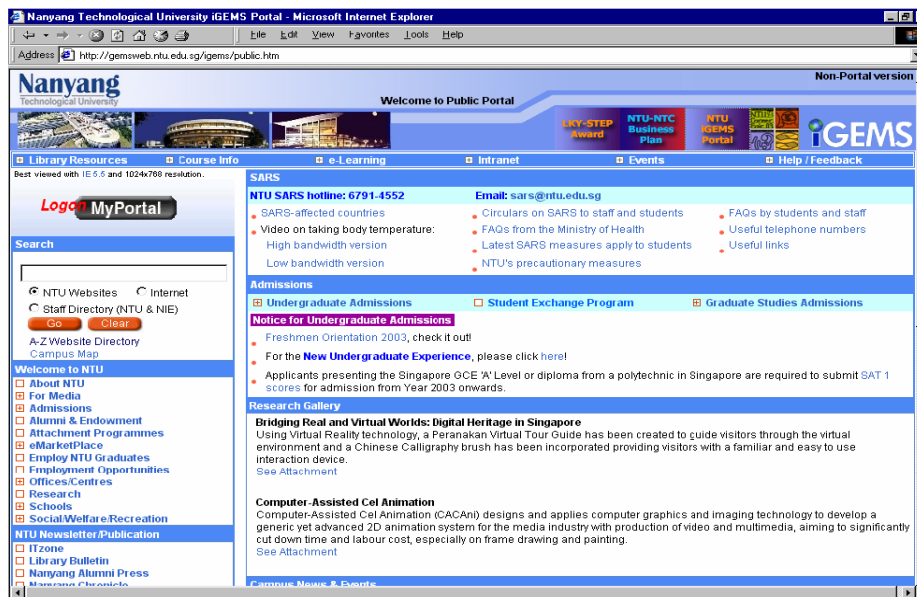


Figure 4. GEMS interface in Nanyang Technological University.

3.3 USABILITY EVALUATION OF DISCIPLINE REPOSITORIES

Through conducting my literature review, a piece that was very important from this study was “Evaluating the Usability of Discipline Repositories” by Qing and Ruhua (2008). In this report they remind us that, as a part of the research process, evaluation has a very basic influence on the development of the digital libraries. Their research was based on the subject of this literature review process and looks at the effect of evaluation pertaining to academic repositories and their rapid growth aligning with the technological open access movement (p. 385).

In their report, Qing and Ruhua (2008) point out that the usability evaluation of Discipline Repositories (DRs) offers the digital library (DL) developers a critical understanding of four areas: understanding the target users' needs, finding the problems in the design, correcting the direction of its development, and the importance in doing so to establish a valid acceptability of such educational interactive technological tool.

In terms of methodology, three DRs were evaluated regarding their usability that includes “arXiv², PMC³(PubMed Central) and E-LIS⁴. These three DRs are different in the subject domain (ArXiv and PMC are about science and E-LIS is about information science), and different in design structures. They were evaluated regarding their effectiveness, efficiency, and satisfaction (p.387). Therefore, IRs should be evaluated according to specific aspects that researchers wanted to improve.

The findings are summarized as follows: in terms of effectiveness, the DRs inherit some of the already successful features from DL's especially with regard to the organization of resources such as with the E-LIS. Moreover, the number of submissions is increasing every year which will attract some researchers, especially scientists who are interested in a specific domain. The increase is due to the novelty of the research submitted to the DRs. Most importantly, the three open access repositories provide limited ways, regarding the advanced search tools, to display and refine the search results (p. 389).

3.4 EXPERT EVALUATION OF LESSIUS UNIVERSITY INSTITUTIONAL REPOSITORY

In her report, “Expert Evaluation of an Institutional Repository based on DSpace” Calvi (2008) provides the results of an expert evaluation of Lessius University's institutional repository based on DSpace. The relevance of including this in the literature review provides further validity to the intentions of this research project for the heuristic evaluation of Dalhousie repository interface DalSpace. Understanding that most of the higher educational institutions in Belgium build their own repositories using DSpace (p. 1) underscores the fact this type of Open Access Repository's popularity continues to expand, signals the importance of achieving means of evaluating such services and, recognizes the limitations without the involvement of actual users. The findings from this study indicate that some of the library jargon was confusing to general users as they do not have the librarian expertise regarding specifying the type of publications. Users in this case needed some explanation of these symbols. Moreover, the experts found that there is a lack of logical order of pages. Interestingly, experts found that “the interface does not give any sort of feedback to users”. For example, in some fields in the interface, the system does

² <http://arxiv.org/>

³ <http://www.pubmedcentral.nih.gov/index.html>

⁴ <http://eprints.rclis.org/>.

not indicate which fields are mandatory to fill out or which ones are optional. Another important finding is that some actions should be automated to help users to not make errors (p. 2).

The expert evaluation that has been conducted on the Lessius University Institutional Repository was targeted at only librarians and cataloguers, while my study targets usability and Human Computer Interaction experts who are specialized in interface designs and usability evaluations. They evaluated the interface in a late phase “after utilization” which is the same case as evaluating Dalhousie Repository Interface “DalSpace”. Calvi (2008) suggests that “early involvement of users in system design, for the adoption of a user-centered approach and the identification of users' needs and preferences via a user and task analysis” is an important step to take (p. 2).

3.5 USABILITY EVALUATION OF A MULTIMEDIA ARCHIVE: B@BELE

Review of the literature provided by Caccialupi, Calvi, Casella, and Conte (2009) from their study “Usability Evaluation of a Multimedia Archive: B@bele” provides the results of the usability of an institutional repository focused on “simple discovery and submission interfaces.” The Repository interface is shown in Figure 5. These characteristics of DL system, according to Caccialupi et al. (2009), “help increase the amount of documents deposit” for scholars who have “very little time to self-archive.” Caccialupi et al. (2009) remind us that there exist few usability evaluations of this type DL functionality leading to it becoming their focus of the study (p. 361).

In their evaluation, Caccialupi et al. (2009) reported results which underscore the shortcomings of the current DSpace interface. These problems include: “difficulties with browsing within communities and collections; problems with the submission interface due to scarcely familiar terminology (metadata) or terms that are not relevant in the specific academic context (community); problems in the submission process due to some ambiguous buttons, to the lack of authority files, and to the lack of clearly marked compulsory fields” (p. 371).

The findings of the Caccialupi et al. (2009) study's assessment offer precisely suggestions to improve not only their system but other systems that are based on DSpace, “...this study will help improve not only B@bele, but also all other installations of DSpace currently available” (p. 371). The results of the Caccialupi et al. (2009) assessment directly align with the intentions of the research thesis objectives in my study.



Figure 5. Multimedia Archive: B@bele interface.

The focus of evaluating Dalhousie Repository Interface includes determining the usability problems of the Dalhousie Repository Interface “DalSpace,” providing solutions and guidelines regarding the uncovered problems. As well as providing the development team in Dalhousie University with the suggested solutions to be used in the iterative design process for development purposes.

The submission changes to the existing DSpace systems are intended to speed up user data entries as well as allow insertion of the most necessary metadata that alters the system with clearly marked required fields. In addition, making the new submission links more visible to users' means is done by placing it in a more easily identifiable location. The Caffialupi report's (2009) last offering of their findings for alterations to the existing DSpace systems aligned with workflow suggests restructuring the insertion page, so the user executing tasks views it from a more logical sequence. Finally, they suggest including a separate component for the reviewer tasks that need to be performed (p. 375).

3.6 USABILITY TESTING OF THE VIRTUAL DATA CENTER (VDC)

Hovater et al. (2002) examined the Virtual Data Center (VDC) interface that is classified as an open access web-based digital library. VDC collects and manages the research in the social science field. The service was developed by researchers from Harvard University, Michigan

School of Information, and Michigan College of Engineering. Moreover, it supports tools that help researchers to analyze “numerical and graphical” data.

The researchers conducted a usability evaluation or “cognitive walkthrough” followed by user testing. The results from the usability evaluation helped them to uncover some usability problems and better understand the system. Then they examined the interface with actual end users in the user testing study. The cognitive walkthroughs aimed to inspect the interface as if the end users were performing some tasks. This was to help them examine whether users would know what to do in each step and if the system provides appropriate feedback.

In terms of findings, they found both minor and major problems that included “lack of documentation, unfamiliar language, and inefficient search functionality”. One of the important aspects that the researchers emphasized is that the language used is too specific for either the system itself (VDC) or for the digital libraries, such as “collections and permissions”. Most importantly, researchers concluded from the walkthroughs that the search function did not match the users' expectations. The system VDC, depending on the recommendations, was developed to match the general criteria of any search engine such as Google. By accomplishing similar features as any search engine, they think that this might improve the quality of the search results. Regarding the study that Hovater et al. (2002) conducted, they focused on a cognitive walkthrough approach while considering only two aspects that include the problems while performing tasks and the system appropriate feedback. The focus of my thesis is to apply the ten heuristics to examine usability of the interface. These heuristics cover most of the important elements that usable interface would support.

3.7 COLORADO STATE UNIVERSITY LIBRARIES' DIGITAL COLLECTIONS WEBSITE

Zimmerman and Paschal examined the digital collection of Colorado State University by recruiting 18 participants who completed some tasks that focused only on the search functions of the website. The tasks were designed first to help users to perform simple search tasks and second to perform search tasks that require some “skills” to find the desired document. The interface of the Colorado State University Libraries' Digital Collections is presented in Figure 6. The participants were graduate students who have studied the usability inspection of user interfaces and faculty members. The talk-aloud approach was used during the study tasks and participants were observed throughout. Then a six-part questionnaire was administered to

address the users' general impression and opinions on specific features. The researchers think that users' computer expertise is important aspect to consider, especially in searching and downloading files and software.

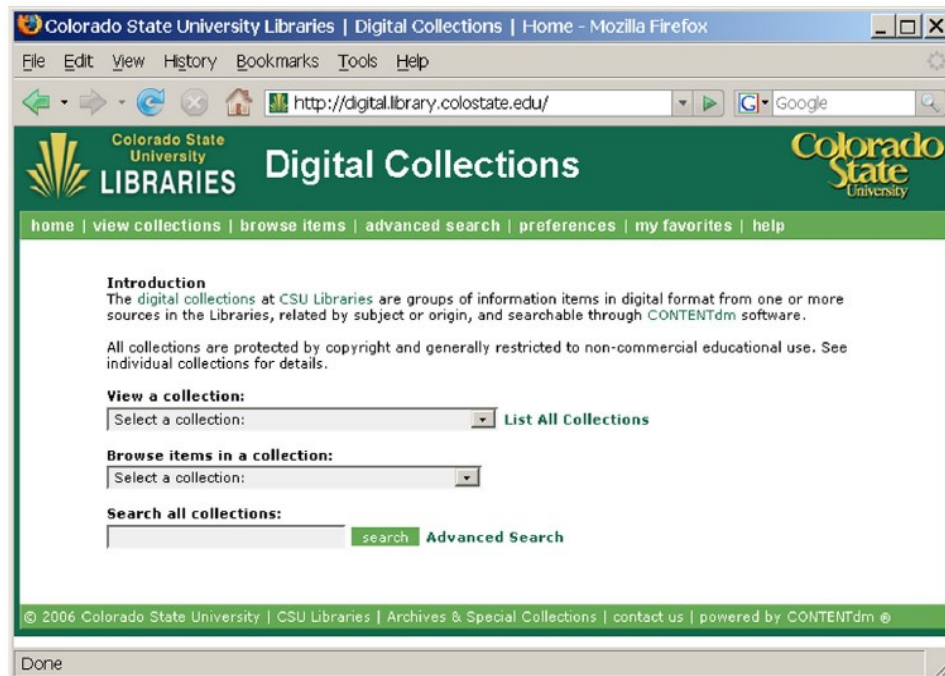


Figure 6. Colorado State University's digital collection.

In terms of the results, researchers found that users spent one minute to find the information they need which can be improved to add the level of efficiency of the search feature. Moreover, two-fifths of users had problems downloading documents that they would use frequently which will discourage them from returning again to the document. The findings suggest that the interface should be evaluated after every step in the redesign cycle to ensure the usability of the features that are powered by the interface.

3.8 A USABILITY EVALUATION OF ACM, IEEE AND IEEE XPLORE INTERACTIONS

Conducting a usability test, Zhang et al. (2009) study evaluated, “How Usable are Operational Digital Libraries – A Usability Evaluation of System Interactions” and determined the “usability evaluation of three operational digital libraries (DLs): the ACM DL, the IEEE Computer Society DL, and the IEEE Xplore DL.” Their report provides both discussion and conclusions. They determined “the differences between/among different types of participants...” as well as “the system differences were dominant in this usability test” (p. 184).

They concluded that the existence of two significant differences among the participants (based upon their academic experience) consequently led to the research findings with “satisfaction with IEEE CS between participants.” In this, Zhang et al. (2009) determined “the LIS users were significantly more unsatisfied with their search results and the search feature of IEEE CS than the UE participants were” (p. 184).

The second significant difference “was the perceived ease of use and satisfaction of browsing design with ACM, for which the LIS and the GE participants were more positive than the UE participants.” Looking at the interface design of the three DLs used in the usability research, X. Zhang et al. (2009) determined the participant users' worst skill performance was in the “Xplore IEEE CS”. Yet at the same time, despite the lower ease of usability documented, the participants nonetheless “seemed fine in objective measures.” Showing the best performance of the three DLs tested for participant's usability proved the browsing characteristics of the ACM digital libraries (p. 184).

According to X. Zhang et al. (2009) report, “These indicated that when the interface design was particularly poor, different types of users would have similar experience.” Interestingly, X. Zhang et al. (2009) determined through empirical methodology that these findings further supported how “the subjects who had prior experiences with the DLs tested actually would make the same mistakes or be frustrated by the system as the inexperienced subjects did” (p. 184).

Further, they observed while those participants admitted they had prior experience with one or even more of the DLs cited in the study, nonetheless, the indications showed similar usability capability as less experienced participants with the resulting implications: “when designing interfaces, efforts first need to be made on a better design for all users.” Pertinent to the results according to X. Zhang et al. (2009) was the limitation to participants having no experience with any DL to those with infrequent use (p. 184).

3.9 CONSIDERING END USERS OF THE DIGITAL REPOSITORIES

The final aspect of my review of the literature looks at Heery and Anderson's (2005) report on “Digital Repository Review”. The focus of their review of existing DRs centered on learner and research usability. In their focus, Heery and Anderson (2005) selectively review methodology of the current DR activities, using personal and phone interviews of stakeholders, engaging

stakeholders in a focus group forums, use email survey questionnaires sent to “selected repository software developers” as well as undertaking “a gap analysis” of the DR system (p. 1). In the review of Heery and Anderson (2005), DRs review the scope of their project for the purpose of this literature review and narrow down the outcomes in the same vein as this paper's thesis on usability of DRs. From the view of the user, Heery and Anderson (2005) look at assuring a guaranteed user success as key stakeholders at the academic and research level. In order to accomplish this, Heery and Anderson (2005) posit the imperative aspect that DRs focus meeting the immediate and temporary user requirements. In this, they urge the continued exploration of user priorities and requirements as the foundation of DR development at every stage and component (p. 15).

In this development centered on the learner and research users Heery and Anderson (2005) clearly look at the articulation of scenarios determining the benefits of DR development aligned with first hand input of real world users. Heery and Anderson (2005) impart, “The process of repository development needs to engage the user community in a real way by such methods as usability studies, participative development process developing and refining use cases on an on-going basis” (p. 15).

3.10 CONCLUSION

Aligned with the research objectives of the study evaluating the Dalhousie Repository Interface including determining the usability problems of the Dalhousie Repository Interface “DalSpace,” the supporting literature of this review prevails. The literature review provided usability evaluation approaches on Institutional Repositories and digital libraries. I included digital libraries in the literature review because IRs act as an extension of the DLs that host the academic output of an organization and provide quick access to the organization's collections. The focus of this literature review is to review the approaches of evaluating the IRs either by using the Nielson's ten heuristics or conducting the walkthrough or talk aloud approaches, which all are considered to be ways of evaluating a user interface as Nielsen suggested in 1994.

The major drawback in “Heuristic-based User Interface Evaluation at Nanyang Technological University in Singapore” by Ping, Ramaiah, and Foo (2004) is that the researchers did not consider other user groups. The participants were only graduate students who were doing their masters in information studies at the Nanyang University. In my thesis, I considered

graduate students as well but they were specialized in usability as a Human Computer Interaction is their field of research and some experience in user interfaces.

The study by Qing and Ruhua (2008) could be conducted to add more usability aspects form the Nielsen usability criteria and not only be limited to effectiveness, efficiency and satisfaction. According to Nielsen (1993) the best practice is to divide usability to include five factors; learnability, efficiency, memorability, errors and satisfaction. In my thesis I followed Nielsen's usability criteria in that I considered his ten heuristics to derive the focus in order to examine the usability of DalSpace interface.

Calvi (2008) in her report, “Expert Evaluation of an Institutional Repository based on DSpace”, evaluates the work that has been done with regard to the Lessius University Institutional Repository. This research was only targeted at librarians and cataloguers while my study targeted usability and Human Computer Interaction experts who are specialized in interfaces designs and usability evaluations. They evaluated the interface in a late phase “after utilization” which is the same case as evaluating Dalhousie Repository Interface “DalSpace”. We might share some similarities in the results.

What my thesis is going to add to the work that has been conducted by Caffialupi et al. (2009) in their paper “Usability Evaluation of a Multimedia Archive: B@bele” is that I derived the focus on specific elements in the interface from the ‘User Profiles’ study that assisted me to design the evaluation study with background information about potential users groups.

The main difference between the method that researchers followed by Hovater et al. (2002) when he examined Virtual Data Center (VDC) and my thesis methodology is that the main focus was on only two aspects which include the problems that users face while performing submission tasks and the system feedback. Whereas my thesis focuses on applying the Nielsen's ten heuristics which aim to examine the most and common aspects of any usable user interface. The ten heuristics were modified to suit the Dalhousie Repository Interface “DalSpace” such as focusing on the searching function and submitting content.

Zimmerman and Paschal (2009) followed a two-step approach to performing the tasks and then a questionnaire to give general feedback and opinions. My approach is to follow four main sessions in order to find and discuss issues and then suggest solutions to the uncovered problems.

In the study conducted by X. Zhang, Li, and L. Zhang (2009), “How Usable are Operational Digital Libraries – A Usability Evaluation of System Interactions”, the participants did not have experience with the three digital libraries they used whereas in my case I considered increasing the evaluators' expertise in providing them with training lecture and training session.

The work of Heery and Anderson (2005) motivated me to conduct the User Profiles Study. Before conducting the heuristic evaluation study, I wanted to engage users and benefits from their needs, problems, and suggestions. They drew my attention to some important aspects that should be considered during the evaluation session.

As the 21st century continues expanding the technology we use in day to day life changes, it remains prudent to conduct ongoing analysis of the DR development aligned with the stakeholder as academic student, researcher, and teacher remain at the heart of the framework of this tool for learning.

CHAPTER 4 USER PROFILES HELP UNDERSTAND USERS' NEEDS, GOALS AND DESIRES IN DALSPACE

4.1 INTRODUCTION

Communicating users' needs, goals and problems help designers and developers to overcome challenges faced by end users. User Profiles or Personas are one of the most common methods to represent end users (Kantola et al., 2007). This Chapter describes the method used to create User Profiles of DalSpace users groups. The User Profiles are needed to address users' needs to help design the heuristic evaluation on DalSpace interface.

4.2 BACKGROUND

This section summarizes the basic information regarding DalSpace service, User Profiles and the importance of User Profiles.

4.2.1 DalSpace

DalSpace is an Institutional Repository in Dalhousie University that “collects, preserves and distributes digital content produced by members of the Dalhousie community” (DalSpace online help document, accessed 2012). The benefits of DalSpace include links to academic papers that remain stable for 20 years. Users also have the ability to apply restrictions on public access to their papers as the content of DalSpace is indexed by Google and Google scholar (DalSpace online help document, accessed 2012).

DalSpace contains many types of documents which can be classified into two main types: scholarly materials and administrative documents. Scholarly materials can include documents from all departments at Dalhousie University including journal articles, proceedings, teaching materials, working papers, preprints, technical reports. Administrative documents represent the Board of Governors minutes, Senate minutes, and committee reports from the library and other university departments (DalSpace online help document, accessed 2012).

4.2.2 User Profiles

“User Profile” is a term that is used in the Human Computer Interaction (HCI) field to represent real user groups (Liu et al., 2010). Alan Cooper introduced the idea of Users Profiles or “Personas” in 1990. According to Kuniavsky (2003), User Profiles and Personas are similar

methods for creating a fictitious person and collecting information to describe a potential user group. One or more user profiles can be used to represent the potential user groups' demographic information, technical background, needs, goals, current problem, and desires (Kuniavsky, 2003; Liu et al., 2009).

The purpose of a User Profile is to establish basic knowledge of a certain type of user groups (Debra, 1990), as well as creating “fictitious, specific, concrete representations of target users” (Pruitt et al., 2006). User Profiles seek to answer three key questions: Who is the product/service user? What task are they going to perform using the product or service? And what do they want from it? The purpose behind creating a user profile is to have a clear insight into who the users are, their needs and abilities. Knowing their desires might not mean anything to the functionality of the website, but it is important for increasing the level of user satisfaction, which is as vital in improving the product's services (Kuniavsky, 2003).

There are a variety of ways to collect data to establish User Profiles such as questionnaires, interviews and meetings with users of the system. Debra (1999) writes that “obtaining the best guess of people know the users will be acceptable when you cannot gain data from real users”. The final profiles help product designers limit the wide range of users and focus only on the targeted users. This saves time and money during the redesign process (Kuniavsky, 2003). It is necessary to note that users have two kinds of needs and expectations: what they say they want and what they actually want (Kuniavsky, 2003).

4.2.3 Importance of User Profiles

Miaskiewicz et al. (2011) have described some benefits of using User Profiles in the design process. One of the most significant benefits is that using User Profiles leads to better decisions about the design and limits the goals to what users exactly need (Miaskiewicz et al., 2011). Liu et al. (2010) agree that designers and developers should use user profiles as the basis of conducting usability evaluation during the redesign process. Alan and Robert (2003) claim that User Profiles support a useful set of features that allow the product to meet the users' needs. To obtain the benefits of User Profiles (UPs), UPs have to be documented clearly and safely stored (Teixeira et al., 2008). In the documentation of the user profile, each profile should include key elements: the name of the profile, a demographic description, the user's goals, needs, abilities to use the user profile as a reference in usability testing and analysis such as heuristic evaluation (Kuniavsky,

2003). User Profiles can additionally be used as a tool to provide accurate information about potential users that support design decisions, evaluate features, meet users' needs and task analysis (LeRouge et al., 2011). Moreover, User Profiles help designers and developers to focus on specific design issues by assisting them in creating tasks and scenarios that focus on only the users' needs (LeRouge et al., 2011).

4.3 RESEARCH QUESTIONS AND OBJECTIVES

The study aims to answer these research questions and they were used to guide the User Profiles process with precise focus and direction.

- Who are the users of DalSpace?
- What do they want to achieve using DalSpace?
- What are the problems that users face?
- What should DalSpace provide them with?

The answers for these questions are located in the data to be gathered to understand users' needs, goals, problems and desires. The main objective is to establish the User Profiles that represent potential user groups who use the DalSpace service. Creating User Profiles is a vital step toward conducting the heuristic evaluation because it helps in creating the tasks scenarios. Also, UPs will be provided to the development team with the needed information regarding the potential users' groups, which can be used in any further research. Therefore, the created User Profiles will be used as follows:

- To create focused task scenarios;
- As a tool given to the development team to recognize users' needs, goals, problems and desires;

4.4 METHODOLOGY

The study is divided into two main parts; the first part is conducting a focus group discussion, the members are Dalhousie undergraduate and graduate students. The second part is conducting interviews with staffs at Dalhousie University who are users or have direct contact with DalSpace users. For both the interviews and the focus group meeting, the targeted population is Dalhousie University students and staff.

The methodology's details for both focus group meeting and interview are described as follows:

4.4.1 Focus Group Meeting

Sample population: six participants were recruited to represent the undergraduate, Master and PhD User Profiles. The participants are student at the Faculty of Computer Science and were recruited using the Computer Science mailing list. Participation is completely voluntary and they were informed that they can withdraw at any time without consequences. The focus group discussion lasted two hours.

Study process: All data were gathered by taking notes on paper and by audio-recordings. The data recorded and collected was qualitative as notes according to each user group. Notes from the focus group meeting were analyzed as following: Participants from the focus group represent three students' User Profiles so the data was used to form these three profiles. Participants primarily discussed particular attributes in the meeting. The list of the attributes discussed is attached in Appendix A. The list was derived from Kuniavsky (2003) and modified to suit the DalSpace context. First, participants suggested some user groups.

First, participants suggested some user groups that might use DalSpace. Then, for each user group, Participants started discussing these attributes for each user group. Each user group was discussed separately. Next, participants assigned a name, and an age for each user group to help the discussion members get involved. This has been done to help the development team to create a focus on the user group represented and think about one person's needs, abilities, problems and suggestions instead of a large number of users. The discussion points were in form of questions and pointes that should be covered during the discussion.

The Data: the data was organized as attributes under the suggested user groups to form the user profiles as follows:

1- Undergraduate student user group:

- **Demographic Information:** Rebecca, 20, programming and graphics.
- **Web use:** Mac laptop, working on her programming skills, experience in exploring webpages, uses Google and Google Scholar.
- **Tasks:** interested in academic articles, they should be organized according to the department, read and download, interface that is easy to perform tasks. Personal account to help her in managing documents. The search function is very important for

her. She wants to have the search results. Typically, she first uses Google and Google Scholar as a first step in searching for a particular document.

- **Frequency:** she is not the target user group and she would not use DalSpace until she has to do some assignments or course work.
- **Problems:** she does not know that there is such a service under the libraries collections. A link in each department would help to know about DalSpace. Tutorial video. No experience with other IRs systems.
- **Desires:** share her projects and assignments, different types of materials, teaching slides, assignments. She wants to be able to comment on the contents, access to faculty members' publications.

2- Master student user group:

- **Demographic Information:** Thomas, 25, Information Science department, first year in the master program.
- **Web use:** personal computer at the department and a laptop, experience in surfing websites and searching databases for academic articles. He uses university's online libraries and free online libraries.
- **Tasks:** submitting to DalSpace is mandatory for masters' theses. thesis structure, style guidelines, conference papers, academic articles and journals, document description before downloading, interested in papers that focus on only his major, well organized, email notification about the recent work in his area of interest. He is interested in reading other students theses who work under a specific faculty member's supervision.
- **Frequency:** for thesis and course related work.
- **Problems:** no previous experience with DalSpace until he knew that he has to submit the thesis through DalSpace. Advanced search function should be implemented and full text documents.
- **Desires:** personal account, list of online libraries and databases, share different types of documents, tutorial on how to reach and use DalSpace.

3- PhD student user group:

- **Demographic Information:** Ishan, international student, PhD program, follows the program timetable, 26 years old, strong in writing and reading academic papers, TA.

- **Web use:** experience in searching libraries and online databases, advanced Web expertise due to his expertise in computer science area.
- **Tasks:** e-mail notifications of upcoming conferences. Easily access to the collection from different places, other IR systems. PDF/A converter. Advanced search feature, uploading and downloading different types of documents.
- **Problems:** find all theses to read in his area of interest. Thesis associated with specific faculty member. Lack of knowledge about the services that DalSpace offers.
- **Desires:** thesis templates, convenient tool, all information about the PhD degree according to the department.

These row data was used to form the user profiles and organized in form of scenarios as follows:

The user profile structure: The collected data about undergraduate, graduate (Master and PhD) students is organized in the following structure: Personal Description with a portrait, Technological Background, Tasks, Current Problem, and Desires. The demographic information helps in creating the background knowledge about the potential user group. Focusing on users' typical tasks and if they are familiar with searching repositories assists in being more precise during creating the UPs. Most importantly, the users' goals and if these goals are met are vital to be investigated and is considered while creating the UPs. The users' needs, knowledge and the way they use DalSpace helped me to explore the users' experience and their needs.

How the user profiles were used to form the tasks is discussed in the Methodology Chapter under the list of tasks section.

4.4.2 Interview

Only one librarian was interviewed to represent the librarians' user group. The interview lasted for almost one hour. Participation is completely voluntary and they were informed that they could withdraw at any time without consequences. The interview questions mainly focused on the same attributes discussed in the focus group meeting. The interview questions are listed in Appendix B. The interview questions helped me gain most of the basic information about the university staff as end users. In order to do so, I had to ensure that he/she had used DalSpace at least once. Librarians and research services staff might have direct contact with students as end users as well, so I asked the question if they know who else would use DalSpace. This question helped me to have a general idea about who would be the ends users. Knowing the end users'

regular tasks would lead the research to focus on specific features that should be examined or fixed. It is necessary to know in which context the interface elements are used to help me increase the scope of the research.

Additionally, the problem they face every time they use DalSpace is one of the core research questions. It is important to know if users will move on or leave DalSpace if they face difficulties to other repositories that offer the same service. This would help to focus on increasing users' satisfaction. Moreover, users' product knowledge about DalSpace is vital in order to identify the kind of users; specifically, are they novices, experts or just anyone from the public. Do they think as staff, who are working in Dalhousie University, that applying improvement DalSpace is going to benefit the university as whole? The answer to this question is required to serve one of the primary goals in improving the university services. As there is not much extensive research on DalSpace, having good answers for the interview questions would assist to build solid background knowledge about the potential users of DalSpace from the staff's point of view.

4.5 RESULTS

The collected data from both the focus group meeting and the interviews has been used to form the User Profiles that represent potential user groups. The names, ages, portraits and personal profiles are fictitious. This has been done to help the development team to focus on the user group represented and think about one person's needs, abilities, problems and suggestions instead of a large number of users.

4.5.1 Focus Group Meeting

The portraits are fictions and used to bring these UPs alive. The results from the focus group are as follows:

4.5.1.1 User profile #1: Rebecca - Undergraduate Student⁵



Personal Description

She is a full-time undergraduate student in the Faculty of Computer Science at Dalhousie University in her second year. She is 20 years old. She is interested in programming and graphics.

Technological Background

Rebecca has a Mac laptop. She is building her technological and programming knowledge through the courses that she studies in the computer science program. In terms of her web use experience, she has experience surfing websites; however, she is more experienced using

Google and Google Scholar to find resources and papers for course work. She is afraid of adopting new systems because she anticipates wasting time learning a new one. If she has any problems with DalSpace, she will abandon the website and use another one instead.

Tasks

What does she want from DalSpace?

- She wants the academic articles and documents to be organized under communities of Dalhousie departments. She needs this feature to assist her in searching for a particular document easily. For example, she needs to check under the Faculty of Computer Science community only to be able to accomplish her assignment. She might use other communities' collections depending on the topic of the assignment.
- She wants to be able to read and download digital documents and sometimes able to obtain printed copies for annotation purposes.
- The interface should be easy to explore. She wants to be able to figure out where she is in the website and where to go next.
- She would not use the DalSpace until she is required to (download or print) some documents from DalSpace. For example, if a professor asks his/her students to find a particular paper in DalSpace as a part of the course work, otherwise she usually starts

⁵ Image courtesy of [Rebecca] adopted from FreeDigitalPhotos.net

searching using Google and Google Scholar and then proceeds to use any seemingly convenient library resource when she cannot find the desired document.

- She wants to have a personal account to help her manage her documents that would bookmark some for future use.
- She prefers to have access to the content of DalSpace from both home and the university campus.
- In terms of how frequently she will use DalSpace, she will use it whenever needed to accomplish assignments, reports and search for course related work.
- She wants to be able to refine the search results by author's name and date in which the document was issued, as well as title, which would require an advanced search tool.

Current Problem(s)

She does not know about DalSpace and she is wondering if she can have a link in the FCS home page or have someone talk about it in the orientation day. She also thinks that having a tutorial video in YouTube about why and how to use DalSpace with a link on the interface of each faculty would be helpful. She is not aware of other universities repositories that she can use beside DalSpace.

Desires

She wants to be able to upload her projects that she completes in every course. She would like to be able to find and access more than academic papers or community collections; she wants to obtain teaching materials, assignments, comments on content, professors' pages and their publications. She needs an automated spelling correction feature in the search bar.

4.5.1.2 User profile #2: Thomas - Master Student⁶



Personal Description

Thomas is a Master student in the School of Information Management (Faculty of Management) in his first year at Dalhousie University. He is 25 years old.

Technological Background

He has both a personal computer at his desk in the university and a personal laptop. He thinks he has some level of technological experience dealing with websites and searching for academic papers. He is familiar with library and academic databases websites. He uses both digital and printed copies

documents. He uses Dalhousie library resources first to find journal articles and uses many free online databases in addition to Dalhousie libraries.

Tasks

What does he want from DalSpace?

- He has to submit his Master's thesis through DalSpace, and every faculty has its own preferred thesis structure. This leads him to have some troubles in deciding which format and structure he should follow. Therefore, he wants to find guidelines for thesis structure or a thesis template structure in DalSpace.
- He wants to browse conference papers, published articles and journals that are associated to a certain research group that shares the same interests with him.
- He needs to read a brief description of the document before he downloads or opens it such as the abstract of the document.
- He, as a graduate student, needs to read about specific topics in the Faculty of Information Management to use these documents in his research.
- He is interested in a particular subject in which he is studying for his thesis or project. He wants to be updated with a notification of every document in his area of interest that is

⁶ Image courtesy of [Thomas] adopted from FreeDigitalPhotos.net

uploaded to DalSpace. He wants DalSpace to send him an e-mail notification about any new study being uploaded to his community collection.

- As is the case with other graduate students who works under faculty member supervision, he wants to explore the students' theses that previously worked with his supervisor.
- Sometimes, he needs some papers for his research and cannot find them in Dalhousie library, so he ends up paying extra money to access these documents while DalSpace might be hosting them.
- He wants to have contact with other graduate students in his department who share the same research interests because he wants to exchange knowledge from each others experience.

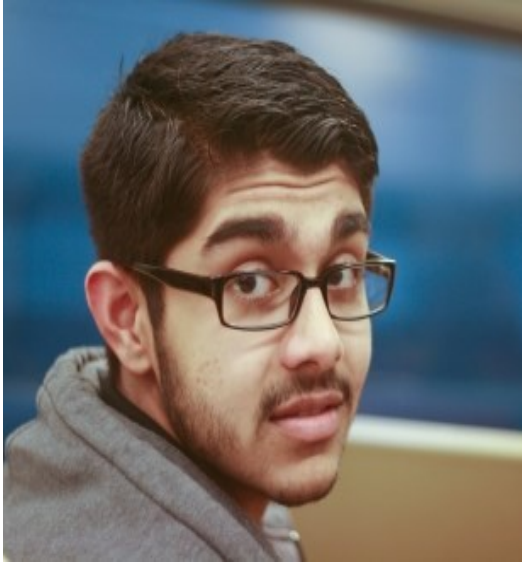
Current Problem(s)

He did not know about DalSpace until he had to submit his thesis to the graduate studies department through DalSpace, so he thinks that there is a lack of knowledge about DalSpace services. He does not want to waste time searching and not getting the desired results. Therefore, he would like to have advanced search features that help him to find a particular paper in a short time. In addition, he is frustrated when he cannot access a full text journal article. He does not want to pay extra money to access academic papers that could be and perhaps should be in DalSpace.

Desires

He would like to have a personal account that supports managing features to help him create his own e-shelf. He would like to have a list of libraries and databases that Dalhousie students have the ability to access without paying extra charges. He prefers to share various types of papers on DalSpace such as studies and data. He would like to have a tutorial on how to use DalSpace because he needs to access the online thesis collection. He would like to have someone who can help graduate students to find documents through something like a live on-line chat service.

4.5.1.3 User Profile #3: Ishaan- PhD Student⁷



Personal Description

Ishaan is an international student, who has just joined the PhD program Dalhousie University in Computer Science and has also finished his master degree from Dalhousie University. He has to follow a certain plan to be able to earn the degree, which includes two graduate courses, research aptitude defense, proposal defense and the final PhD defense. He is 26 years old. He has a strong level of writing and reading academic papers. The use of DalSpace is mandatory for submitting his thesis to the graduate studies

department to be approved.

Technological Background

Ishaan is skilled in dealing with computers and surfing resources websites and libraries. He has advanced web experience. He is used to retrieving scholarly articles through Google, Google Scholar, Dalhousie libraries, and other online databases. He is planning to be a TA for one of the first-year computer science courses.

Tasks

What does he want from DalSpace?

- E-mail alerts of upcoming conferences that are related to his interests or communities. This will help graduate students to be updated with the upcoming conference that they might be interested in publishing their work with.
- He wants to be able to publish his research and studies. He thinks that DalSpace should have an editing tool for academic papers to check the style and the structure.
- He wants to have access to DalSpace collections from both home and the university campus.
- He needs to have a wide range of resources in a variety of departments to assist his research. Therefore, he wants to be able to have a list of all available academic recourses associated with DalSpace.

⁷ Image courtesy of [Ishaan] adopted from FreeDigitalPhotos.net

- He needs to know if DalSpace is associated with other university repositories in order to help him in accessing those universities' collections.
- To upload a thesis, it has to be in a PDF format. He needs a PDF/A converter application to help him convert files and make sure that the style of the document does not change if processed to be accessed in the future (PDF technologies, Accessed 2013). Currently, DalSpace only accepts PDF format.
- An advanced search function is essentially required for all PhD students because they want to enter the name of the professor or a supervisor to retrieve all publications and theses under his/her name.
- He wants to contribute/receive a variety of documents such as PhD theses, research aptitude papers, and proposal papers.

Current Problem(s)

He needs to use DalSpace to find all the theses he wants to read. However, graduate students work under faculty member supervision and they want to explore the other students' theses who worked with the same supervisor. However, the only way to reach these theses is to open each document in DalSpace and check the committee signatures. Unfortunately, some theses do not have the signature. He, as a graduate student, wants to work sometimes as TA, so he needs to be aware of all the services that DalSpace offers.

Desires

He wants to be able to have some templates or samples of document structures needed in the PhD program, such as research aptitudes, proposals, and thesis templates. He wants to have the ability to convert files and upload them without wasting time and having technical difficulties. He needs to be able to find all the information that helps him proceed and successfully complete the degree in DalSpace.

4.5.2 Interviews

The results from the Interviews are as follows:

4.5.2.1 User profile #4: Dona - A construction and reference librarian⁸



Personal Description

Dona is a librarian at Dalhousie University that has been working there for more than 10 years. She was involved in the prototype of DalSpace in 2007 where the goal was to create a website that holds the scholarly output of Dalhousie communities. She participates in digitizing collections that are related to the library and stores them in DalSpace. Using DalSpace is not mandatory in her job as it depends on communities to decide who has to deposit their collections.

Technological Background

She has an excellent background surfing and searching websites. She is aware of other repositories, and she uses them often, especially when she has a request of a certain document from other universities. She can be considered to represent three different end users as she deposits materials as a staff member, deposits her own materials, and searches materials. The three users that this profile represents are a depositor staff member, researcher and ordinary end user.

Tasks

What does she want from DalSpace?

- She uses DalSpace to search for materials such as historical texts that have been digitized, graduate theses, and proceedings of Nova Scotia Institute of Natural Science.
- She is interested in searching for certain authors and scientists who lived and conducted some research in Nova Scotia 60 to 100 years ago.
- Advanced search fields are essential to use precise results because she is interested in searching the content within documents not only subjects and titles.

⁸ Image courtesy of [Dona] adopted from FreeDigitalPhotos.net

- She wants to be able to send e-mail to the authors of some documents if they have put some restrictions on the document.
- She wants to search different documents and formats such as audio files because most of the documents in DalSpace are in text-based PDF files.
- She wants to have a level of visual presentation. For example, a photograph of the individual biographical sketch which will make the interface more attractive.

Current Problem(s)

Librarians can be considered as searchers and depositors of DalSpace. In terms of being a searcher, some of the fields of the advanced search features exist, but she is not sure if they are working because the results do not change after applying them. The search function of the DalSpace, from her point of view, matches only the headings or titles of the document but do not check the information within the record. In addition, it is vital to consider the date in which a particular paper was read publically. If she wants to read documents that were read publicly in June or 19xx to rate them or check the reviews, DalSpace does not support this feature.

All the theses that are stored in DalSpace are organized under the heading ‘online theses collection’. She thinks that every thesis should be mapped to its community or department. For example, if the thesis is in the field of computer science, it should be under the collection of computer science, not under the graduate studies collection. She thinks that the online theses collection is a vast ‘mishmash’ of all theses that should be more organized and mapped to the proper departmental collections.

Not all students know that DalSpace hosts most of the graduate theses. Therefore, she suggests that the graduate coordinators or supervisors inform students about DalSpace and how they can find the documents. Students should be aware of repositories because researchers put all their work in these places and this can help them find papers without paying extra money. Graduate students should have tutorials on the depositing process. However, she strongly recommends that the search mechanism be reviewed before teaching students how to use DalSpace.

Desires

An important feature that DalSpace should support is rating the documents so that other students, faculty members or staff of any type can see other's reviews. She thinks having a statistical package that DalSpace supports is vital because it documents the number of clicks on a certain record, the number of people who are interested in it and most, importantly, from where these

people and clicks are coming. Having the statistical information will help Dalhousie to substantiate the links between the university and other researchers from other countries, and encourage graduate students to be part of the Dalhousie community. This information could help if it were represented in the website for all users to show which are the heavily accessed documents that they might be interested in.

She thinks that having links in the department website that direct not only to DalSpace but also to the theses collection which are related to that department is a good idea. This will help students to go directly to the relevant area of their interests. Moreover, providing Facebook and Twitter icons in every document in DalSpace would help people to promote their papers. For other people, they can easily find who share the same interests with them, which will create an interaction between the content and students.

4.6 DISCUSSION

Our findings from this study suggest four main User Profiles that represents four potential user groups which include:

- User profile #1: Rebecca, Undergraduate Student
- User profile #2: Thomas, Master Student
- User Profile #3: Ishaan, PhD Student
- User profile #4: Dona, A construction and reference librarian

The collected data from both the focus group meeting and the interviews has been used to form the User Profiles that represent potential user groups. The names, ages, portraits and personal profiles are fictitious. This has been done to help the development team to create a focus on the user group represented and think about one person's needs, abilities, problems and suggestions instead of a large number of users. These findings aim to understand users' needs and use them as a tool to communicate these needs and problems of the potential user groups. Compared to other studies that have been conducted to serve the same goal (Muller et al., 2002; Kantola et al., 2007; Blomquist et al., 2002), there are some differences in our context. Blomquist et al. (2002) used personas to help the design team exploring the tasks that users perform by understanding the personas' scenarios while Pruitt and Grudin (2003) have extended the use of UPs to include “developers, testers, writers, managers, marketers and others.” Therefore, most of the UPs are created to service companies and their products (Kuniavsky, 2003). Our context relies on

delivering an academic output to students, members of Dalhousie University and others who include the public. In other contexts, the development team and the customer services meet and discuss the users' needs without evolving of any end users; whereas our study was focused on real end users. They were involved in a focus group meeting and interview which helped in receiving direct feedback from DalSpace actual end users. The key findings are discussed in the following section:

4.6.1 Focus Group Meeting

The focus group session was designed to help students share their needs, problems and desires with regards to DalSpace; however, the study encountered a problem in that four participants out of six did not know about DalSpace until they had to use it for the submission of their theses. They had to try it before starting the discussion, and they were provided with a link to DalSpace. Participants had to use DalSpace on their own time and in their own way of using the interface before discussing the key attributes. They had good background knowledge about what DalSpace is, what it offers and what they actually want to develop about it. I provided them with an introduction about the system and the main goals prior the discussion.

4.6.1.1 Undergraduate Student User Profile

Due to undergraduate students being less interested in the online theses' collection and historical material, they do not appear as the target users' group. However, some of the honors students are interested in searching for and reading graduate theses. In order to attract them to use DalSpace for course work and term papers, the interface should be easy to use, and they should not be required to have a technological background to use it. As Participant # 4 stated:

“Undergraduate students will not use DalSpace until they have to use it. The interface should not require a technological background; they should just scroll the mouse to get what they want.”

Participant #6 identified that having accurate search results will save time and effort while looking for a particular document. The participant strongly suggested having a spelling correction feature as it is vital to producing more precise search results. Moreover, undergraduate students are used to search first through Google and Google Scholar to find a specific document. Every document in DalSpace is harvested by Google, which leads them to the DalSpace when they follow the link. On one hand, this can be considered as an important feature that helps both Dalhousie students and public searchers. On the other hand, it might be considered as a detriment

that makes it easier for undergraduate students to use Google and Google Scholar instead of going directly to DalSpace. The solution to this issue is supporting most of their needs as presented in Section 4.4.1.1.

Participant #1 suggested that undergraduate students want to share their class work starting from projects, seminars and presentations, which would allow them to find other students who share the same interests. From my point of view, this feature is important to attract undergraduates to use DalSpace because they are familiar with social media websites and their styles of sharing content.

DalSpace should provide both printed and digital copies as Participant #1 stated. However, Participant #5 added that the way of reading a document depends on personal preference of students whether they like to read online or from a hard copy. Participant #1 also mentioned that there should be at least the ability to download these digital copies. It is important to note that this feature is already powered by DalSpace.

Participant #6 suggested that if there were a function that allowed others to comment on the content, this would encourage undergraduate students to use DalSpace more often. However, Participant #4 stated that it should only host documents, and there is no need to have a comment function. This difference of opinions has led to an important trade off. On one hand, it is important for a generation who are used to dealing with technologies to communicate with the content to add to the satisfaction level of using DalSpace. On the other hand, some might think that having the ability to comment would create complicated interfaces as Participant #4 pointed out.

Participant #3 stated that students have to be trained about how to use DalSpace; tutorial videos on YouTube with a link to the communities' websites are essential to help promote the use of DalSpace instead of relying on students to teach themselves. For example, it would be helpful if there were a link to a tutorial video on the main interface of the Faculty of Computer Science. All six participants agreed that DalSpace should host teaching materials, slides, assignments. This is important in order to extend the variety types of end users who might be interested in the content. However, this might be frustrating because faculty members already have their own websites that contain their teaching materials. From my point of view, it is easier for students to find all the documents they need in one place (DalSpace) either for their course teaching materials or for the academic documents they need for the course work.

4.6.1.2 Master Student User Profile

Masters students face some particular difficulties when they learn about thesis structure because every department has its own preferred style. The solution is to provide a guideline through DalSpace that explains how each department wants a thesis structured. Participant #5 commented that having some ideas about particular supervisors' approach from previous graduated students' thesis is vital to help masters' students in making the decision of which supervisor to select. Participant #5 stated:

DalSpace should provide us some details about the thesis' structure, style for each supervisor.

Students are interested in having general ideas of previous students' theses not only listed in the online thesis collection, but also listed under the supervisor list of theses. This would help graduate students from around the world who are interested in having opportunities to match their interests and for the graduate research at Dalhousie University.

Participant #1 suggested that masters' students are more interested in exploring the current work in their area of research. Exploring the recent work can be in the form of e-mail alerts after they register and assign an interest area. Having DalSpace to power this feature will help students to stay updated with the newest research that will support their own work. The importance of this feature relies on adding to the graduate students' level of knowledge on the published recent work which, consequently, adds to the level of the scholarly output produced by Dalhousie university graduate students.

Another important observation that was made by participant #6 is that master students want to know more about the researchers and authors of a particular paper and have the ability to explore all their publications. Participant #6 stated:

Grad students may be interested in the people who are related to a particular paper; who are the major contributors to the topic; and how many people cited the paper.

From my point of view, these points are important for graduate students, especially masters students, because this would save their time on doing extra search tasks to get what they exactly want in specific area of interests.

All 6 participants agreed that if Dalhousie University shares some content with other repositories, they want to know if they would be allowed to access these other repositories content. As participant #1 commented:

We do not want to pay extra money while DalSpace can offer the same paper.

The level of students' awareness of other repositories and their accessible contents is important for Dalhousie graduate students because they can find online theses collections and academic output of other universities with paying extra money to have them.

4.6.1.3 PhD Student User Profile

The only way to submit a masters or doctoral thesis to the Graduate Studies is through DalSpace. Participant#3 is a PhD student and represents the PhD user group. This participant had some issues related to DalSpace interface. First of all, the interface could not help the participant to save a draft and then continue working on it before submitting the electronic copy. The participant had to start again every time and upload a new version of the thesis.

For PhD user group, receiving e-mail alerts for upcoming conferences that occur in the current year was an essential function. PhD students are interested in the recent research and studies in the same field as their interests as Participant #3 stated. This would help them to accomplish their own academic goals.

Answering the question: will you, as a PhD student who knows that DalSpace hosts all graduate theses, use it more often? Participant #3 stated:

If it has the information I need, for sure I will use it.

Therefore, students might use DalSpace if their needs are met. Having the opportunity to explore their needs would make them more interested in using DalSpace and its content, and this might see it used more often than before.

For the PhD program, there is a clear plan for each term that includes some courses, research aptitude defense, proposal defense and the final PhD defense. Participant #2 stated that having guidelines and templates of all the research formats and structures to guide them through the program should be included in DalSpace. Participant #3 also said that he was unaware if the research aptitude defense is required to be submitted online through DalSpace or not. Participant #2 stated:

This information about the program plan is very basic and why there are not enough guides or enough information on DalSpace. It should be very clear and this might be a serious issue that graduate student might face.

All 6 participants agreed that they need to be able to access the supervisors' information to include links to all their theses and publications. They want to be able to explore the interests of

their potential supervisor for their theses to help ensure they are making the right choice as discussed in the master student user group.

4.6.2 Interviews

This section focuses on the librarian opinions and answers to the interview questions.

4.6.2.1 Construction and Reference Librarian User Profile

The lack of knowledge from students in the focus group made this question important; if there are few people who are using DalSpace, who would they be? Participant #7 who represents the construction and reference librarian user group stated that faculty members and staff might be interested in what currently happens at Dalhousie. Students who are searching for master and doctoral theses to read or read the references in the bibliography can be potential end users as well. Moreover, depositors can be staff, faculty members and students. Some of the participants represent two roles such as a staff member who is both a researcher and depositor.

There are a public who are from the whole world who have the access to the non-restricted content. Anyone who is interested whether what is happening here in the Dalhousie campus, the researchers, students and professors who have done some research work. Other people who are interested in the digitized collections from the medical schools because they digitized them — Participant #7.

The search fields available in the search function, Participant #7 noticed that the fields do not search the content of document. In the depositing process, the fields are filled to be matched for the search results. However, the results from the search process do not provide the intended documents because she/he thinks that matching the search keyword with these fields does not provide accurate search results.

Now if you try to search you can't pull the material out of DalSpace because for some reason, the search function does not do what should be done. — Participant #7

From my point of view, this problem has a high priority because students from the three users groups placed strong emphasis on the search tool and its results. The search feature is one of the most important tasks that all user groups agreed to its importance.

In addition, DalSpace does not support the function of knowing when the paper has been read publically for the rating purposes and for searching materials from a specific period.

You can't ask DalSpace to show you all the papers of that society that were read in May, we have a files that we can write May 5th, 1967 or something like that, so that is a problem —
Participant #7

Participant #7 suggests that the statistical analysis software is essential. It could provide useful data for the university in terms of having statistics on who is using DalSpace and how many times they used a particular document. The most important statistical data that the package should provide is from which countries the most accessed documents are coming from.

Considering this point will help the university to attract graduate students, researchers who share the same interests to work for Dalhousie University as a kind of substantiation of the links between Dalhousie and people from other countries.

DalSpace provides open access to the documents that are stored in DalSpace. Participant #7 stated that people who are depositing materials in DalSpace are agreeing with the idea of having the documents read publically which promotes their work to anyone in the world. Otherwise, authors can apply some restrictions to their documents. In addition, Participant #7 stated that DalSpace is initially was intended to represent an open access space of the scholarly output from Dalhousie community.

Both library personnel and staff should encourage graduate coordinators to inform students about DalSpace and how they can find documents. Graduate students need to know about the online theses not only from Dalhousie but also from other universities.

In terms of undergraduate students, they are not either willing to use DalSpace or do not know about it. Participant #7 had an interesting answer to the question “How can we encourage students to use DalSpace?”

For undergraduate, I do not see it as a priority to learn how they search in DalSpace as most of the information is at a higher level on what they are going to need unless they are honors students and want to look at some of the master theses.

Interacting with the content is important for the recent generations who are used to dealing with social media websites. Having Facebook and Twitter icons in the document webpage helps both DalSpace and other people around the world to reach some documents. This feature would attract undergraduate and graduate students to use DalSpace.

4.7 CONCLUSION

Four main User Profiles were created to describe the four potential users groups who would use DalSpace. Each UP describes the users' demographic information, technological background, tasks, desires and problems. These profiles helped to bring the user groups to life and think about them during the development of the system. Also, this aims to build our background about who are the users of DalSpace and what do they perform using the service. The results from this study were used to create task scenarios for the Heuristic Evaluation study (Chapter 5 and 6).

Additionally, it will be used as a tool given to the development team in order to communicate their needs during the design iteration.

4.8 LIMITATIONS AND FURTHER RESEARCH

Having a convenience sample of students to discuss the potential user group can be a major limitation; further research should be conducted to have different students from different departments. Knowing whom the users of an Open Repository is critical because some of the users are from the public. However, starting with end users within the limits of Dalhousie University is essential to help in building knowledge about the end users step by step. Creating more user profiles to represent other user groups should be investigated to build on the existing user profiles and help in further user research. Other suggested users profiles would be employees in the Graduate Studies as depositors and special needs students' user groups. Second, investigating the DalSpace administrative interface and interview the intended users should be taken into considerations for future research.

CHAPTER 5 HEURISTIC EVALUATION METHODOLOGY

5.1 RESEARCH OBJECTIVES

User interfaces are an important aspect of Open Access websites in part because they have an impact on so-called system performance (Peng, Ramaiah, Foo, 2004). Evaluating user interfaces is a fundamental step in the development of such software (Peng, Ramaiah, Foo, 2004; Zimmerman, Paschal, 2009). Our focus on evaluating Institutional Repositories (IRs) is motivated by the need to focus on the usability of the interface while the concept of usability evaluation implemented on IRs is fairly new. It is important to note that if there is not investigation conducted on the usability of the IRs, it will lead to ignorance and “near empty” repositories (McKay et al., 2008).

DalSpace is an extension of Dalhousie library services that enables users to browse the University's collections and academic scholarly output. DalSpace interface should be evaluated to improve its ease-of-use because such improvement will enhance the usability of the website and may also encourage students, faculty, members of Dalhousie to use it and return to it while searching and exploring collections. Therefore, the research objectives of evaluating Dalhousie Repository interface include:

- To determine the usability problems of Dalhousie Repository Interface “DalSpace”.
- To provide a solutions and guidelines regarding the uncovered problems.
- To provide the development team in Dalhousie University with the suggested solutions to be used in the iterative design process for development purposes.

5.2 RESEARCH HYPOTHESES

It is hypothesized that applying the heuristic evaluation to DalSpace user interface will provide suggestions to improve the usability of the user interface and encourage users to use the library services. The suggestions are based on a list of usability problems that will be provided to the development team. The priority of fixing the problems can be assigned by investigating the frequency of each violated heuristic and the assigned severity ratings.

Further questions address the application of heuristics in this context. Two key aspects are investigated: Do the expertise and number of evaluators affect the reliability of the results from applying the heuristic evaluation to DalSpace user interface?

To answer the first of those general questions we consider the following hypotheses:

- Severe problems will be uncovered by experts while the minor problems will be uncovered by novices.
- Difficult problems can only be uncovered by experts and easy problems can be uncovered by both experts and novices.
- The best evaluator will be an expert.
- As Nielsen and Mack (1994) reported for the traditional heuristic evaluation, experts will tend to produce better results than novices.
- The average of number of problems uncovered by experts and novices will differ (i.e. the mean number of problems found will differ significantly). Furthermore, experts are expected to find more problems than novices (i.e. the test for difference of means will be one-tailed).

To answer the second of those general questions, does the number of evaluators affect the reliability of the results, we consider the following hypotheses:

- A small set of evaluators (experts) can find about 75% of the problems in the user interface as Nielsen and Mack (1994) suggest.
- More of the serious problems will be uncovered by the group (experts or non-experts) with the most members.

5.3 HEURISTICS

Jakob Nielsen has been applying general user interface heuristics since 1992. In this study, Nielsen's set of heuristics were applied to the DalSpace interface and were modified to suite the DalSpace context. The set of 10 heuristics were created by Nielson and Molich in 1990 and refined by Nielsen in 1994. The heuristics applied in the present study are presented as follows:

- H1: Visibility of system status
- H2: Match between system and the real world
- H3: User control and freedom
- H4: Consistency and standards
- H5: Error prevention
- H6: Recognition rather than recall
- H7: Flexibility and efficiency of use
- H8: Aesthetic and minimalist design
- H9: Help users recognize, diagnose, and recover from errors

- H10: Help and documentation

Some details about each heuristic are gathered from both (Nielsen, 1994b, and Gram, 1994) and presented as the following:

H1: Visibility of System Status. Nielsen (1994b) suggests that the system should keep users informed of the current status of the system. Users form, and then rely on, conceptual models of how the software functions (Norman, 1983). “Familiar user's conceptual model” means that the system should be organized in the same way that the user is representing the system in their minds with no sudden actions. Feedback that results from users' actions, the current status (progress) of lengthy operations, and available or possible future actions are examples of what Norman refers to as visibility of system status. Most importantly, all feedback should be accurate and timely. Although the term ‘visibility’ should not be mistaken as meaning only visual feedback, such feedback is important when icons or other visual objects are shown they must be easy for users to correctly understand them. For example, DalSpace should provide the user with quick feedback while they perform tasks. The system should provide accurate search results and keep users informed of the progress of ongoing search tasks.

H2: Match between system and the real world. This heuristic focuses on the point that “the system should speak the user language”. The system should use phrases and metaphors from the real world that the users are familiar with instead of jargon and technical terms that are relevant to the programmers or other people behind-the-scenes; when the users are all familiar with a particular technical vocabulary and that vocabulary is relevant to the tasks for which the interfaces are being used then it can be right for the interface to use that jargon. Ideally, the system should make information appear in a natural and logical order following real-world conventions. The system should not be any more of a burden for the users to work with or understand what is necessary.

H3: User control and freedom. Recognizing that users will sometimes make mistakes by performing inappropriate actions, the system should provide them with obvious ways to undo and redo all actions. For example, clicking by mistake on a particular icon might lead the user to delete an important document or exit an important task. Clearly marked exits, the ability to re-order or cancel tasks, and flexibility for users to have control on the order they complete steps and sub-steps to achieve goals are all part of the heuristic. Most importantly, users should be allowed to do what they want without forcing some actions or steps to follow which any system

should support it. Therefore, when users click or functions by mistakes, the system should allow them to perform the undo, and redo actions and help them by marking clear exists from the unwanted situation.

H4: Consistency and standards. Consistency means that the system should respond the same way to the same instructions while following a consistent conceptual model such as language and order of steps. Also, it is important to make things look the same every time they are presented. Uniform command syntax should be provided which means that the system should follow the same series of actions that the user is familiar with any system; this includes the generic commands that are provided by any system. Similar information should be presented in the same places at every screen. Users should not be confused about whether some words, situations, or actions refer to different things.

H5: Error prevention. It is important to consider avoiding errors in the first place, instead of providing solutions to those errors. Therefore, either prevent the error-prone situations from the happening or provide good error messages before users are about to perform the task.

H6: Recognition rather than recall. “See-and-point instead of remember-and-type” is important principle that reveals some of the serious problems. The system performance should not rely on the user's memory, and it should help in minimizing the user's memory load. The important icons and objects should exist all the time in every screen. Nielsen (1995) raised a question, “What features often are missed and at what cost?” “Instructions for use of the system should be visible or easily retrievable whenever appropriate” (Accessed January, 2013).

H7: Flexibility and efficiency of use. Expert users should be considered. Accelerators and shortcuts, which are not used by novice users, should be provided to speed up the system dialogs. Nielsen (1995) suggests that the system should support “User tailor-ability to speed up frequent actions” and “User control: allow user to initiate/control actions” should be supported (Accessed January, 2013). The ability to customize the interface is an important aspect to provide users with preferable design, which would increase users' satisfaction. In addition to the shortcuts, keyboard main functions should be supported.

H8: Aesthetic and minimalist design. The interface dialogs should not provide un-needed information or parts that might mislead the users during performing tasks. Every extra element or information in the interface reduces the amount of system visibility and might lead to mistaken actions.

H9: Help users recognize, diagnose, and recover from errors. Good and clear error messages are important to help users to take correct decisions on the current status of their actions. These messages should precisely explain the error and suggest a solution that is easy to perform.

H10: Help and documentation. It is important to design the system that can be used without documentation but it is important to provide users with help documentation. The information in the help documents should be easy to read and focused on only what users usually perform on the interface. This can be done by providing step-by-step guide that should not be long and distractive.

5.4 PARTICIPANTS

As described in section 2.4.1.1 (regarding the preferred number of evaluators) to produce a reliable list of usability problems, having multiple evaluators is better than only one because different people uncover different problems from different perspectives. Moreover, Nielsen proposed that one evaluator would not be able find all the usability evaluators (Nielsen and Mack, 1994). In terms of the type of participants, I targeted graduate students of the Faculty of Computer Science in Dalhousie University who have at least completed one of the courses related to Human Factors Engineering (namely, CSCI 3160, CSCI6606, and CSCI 6903). Also, graduate students (both Master and PhD) in the Human Computer Interaction (HCI) field are considered. A total of 16 participants were recruited who include 9 regular experts and 7 novices (non-expert) as listed in the Table 5.

Participant ID	Graduate/ Undergraduate	Qualifications	Type of evaluator
ID: 1	Master student at the Faculty of Computer Science specialized in Human Computer Interaction.	Completed Human Factors in On-line Information Systems	Regular expert
ID: 2	Master student at the Faculty of Computer Science specialized in Human Computer Interaction.	Completed Human Factors in On-line Information Systems	Regular expert
ID: 3	PhD student at the Faculty of Computer Science specialized in	Completed a Human Factors in On-line Information Systems course and	Regular expert

	computer networks	User interface design course.	
ID: 4	Master student at the Faculty of Computer Science	Completed Human Computer Interaction course	Non-expert
ID: 5	Master student at the Faculty of Computer Science	Completed User Interface Design in his bachelor degree	Non-expert
ID: 6	Master student at the Faculty of Computer Science	Completed Human Computer Interaction course	Non-expert
ID: 7	Master student at the Faculty of Computer Science specialized in Human Computer Interaction	Completed Human Computer Interaction course	Regular expert
ID: 8	Master student at the Faculty of Computer Science specialized in Human Computer Interaction	Completed a Human Factors in On-line Information Systems and Completed Human Computer Interaction courses	Regular expert
ID: 9	Master student at the Faculty of Computer Science	Completed Human Computer Interaction	Non-expert
ID: 10	Master student at the Faculty of Computer Science	Completed Human Computer Interaction and User Interface Design	Regular expert
ID: 11	Master student at the Faculty of Computer Science specialized in Human Computer Interaction	Completed Human Computer Interaction course	Regular expert
ID: 12	Master student at the Faculty of Computer Science specialized in Human Computer Interaction	Completed Human Factors in On-line Information Systems	Regular expert

ID: 13	PhD student at the Faculty of Computer Science specialized in Human Computer Interaction and familiar with DalSpace interface	A master thesis in human computer interaction and area of research	Regular expert
ID: 14	Master student at the Faculty of Computer Science specialized in Human Computer Interaction	Completed Human Factors in On-line Information Systems. A master thesis in human computer interaction and area of research	Regular expert
ID: 15	Master of E-commerce	No previous experience with human computer interaction filed	Non-expert
ID: 16	Master of E-commerce	No previous experience with human computer interaction filed	Non-expert

Table 5. Participants' qualifications.

Even novices (non-experts) have a certain level of experience with user interface design and human factors after completing the graduate courses. All participants were recruited by e-mail announcements through Notice Digest (notice.digest@dal.ca) and through the Computer Science mailing list (csall@dal.ca), which is also a monitored mailing list. Additionally, all participants involved in this study signed an informed consent form with the right to withdraw at any time without consequence.

5.5 List of Tasks

I designed some tasks that focus on the most important elements that were derived from the “User Profiles” study. The results from the first study “User Profiles” have revealed some potential users groups such as undergraduate, graduate (master and doctoral) students and librarians. There are some of the public who might be considered as potential end users but we began start with of Dalhousie University students and staff members to be able to build on this study and figure out who is also using DalSpace. These tasks are given to evaluators in the training session in order to help evaluators who prefer to inspect the interface according to a set of tasks scenarios. Each table contains full description of each task. Performing these tasks is not mandatory. They have the freedom to choose the method they would like to proceed with in order to be familiar with the interface. I have designed the table of each task to describe:

- The goal of the task;
- The type of the task, is it regular, important, critical task;

- The actual steps that a typical user would follow to perform the task;
- The possible problems that users might face during performing the task;
- Time for expert to reach the goal;
- And the scenario.

The table task is designed to provide evaluators with a good background about each task. They have the freedom to follow their own path in evaluating the interface. However, these tasks would draw their attention to the main elements that they might want to focus on depending on the results from the “User Profiles” study. In addition, this helps evaluators to understand what DalSpace offers and provides a general sense of the layout of the interface, and help them carrying out the evaluation smoothly. The tasks are classified into the following three categories.

- *Regular tasks*: tasks that users would carry every time they log in into the system
- *Important tasks*: major tasks that users would perform *such as submitting a content*
- *Unusual but critical tasks*: tasks that have less frequency to perform, such as registering and browsing a restricted content

Note: the summary of all tasks is shown in Table 5 in section 5.3.4. Table 6 shows the task #1 as an example of the tasks provide to the evaluators. All tasks are attached in Appendix C.

Task #1, < find the DalSpace home page>

Goal	This task helps users to know exactly where to go to find the DalSpace website.
Type	Regular Task
Assumptions	The user needs to know that DalSpace is part of The Dalhousie library collections
Steps (use case)	<ol style="list-style-type: none"> 1- The user has to open the library website < http://libraries.dal.ca/>and click on collections. 2- The user has to scroll down to find DalSpace link 3- The user has to click on the DalSpace link 4- The system will take the user to a new interface that has general information about what DalSpace is and how to access the collections. 5- The user has to click on “Access DalSpace Collections here” to go to the home page of Dalhousie repository website.
Possible Problems	The user might expect to have a direct link at the community website.
Scenario	You want to use Dalhousie repository website (DalSpace) for the first time to

	search and browse the university collections.
Notes	N/A

Table 6. Find the DalSpace home page task

Task # 2 < Search for a keyword/thesis Title >

Goal	The goal is to walk the user through the basic steps of searching using the main interface before logging into the system
Type	Regular Task
Assumptions	<ul style="list-style-type: none"> • Users should decide which search bar to use since there are two; one in the top right and the other one between the text in the middle of the home page. • The system might return with no search results.
Steps (use case)	<ol style="list-style-type: none"> 1. The user types the keyword/thesis that he/she wants to search about in one of the search bars in the main menu. And hits GO button. 2. The system automatically displays the search results interface. 3. The user has to scroll down to see the search results because the system offers some search filters and scopes. 4. The list of documents is presented. 5. The user has to click on one of the documents. 6. The user clicks on the desired document. 7. The system automatically displays the document information (title, author, date posted, URL, name, description, size and type of the file). 8. The user scans the abstract.
Possible Problems	<p>Alternative Cases:</p> <p>6.1 If the user is not interested in any document, should search again or refine the search.</p> <p>8.1 after reading the abstract, if the user is interested, go to step 9.</p>
Scenario	You have opened the home page for the Dalhousie repository website and want to search for a keyword/thesis. You will take a quick look at the home interface and choose one of the search bars to type in the “NFC-Enabled Smartphone Application for Drug Interaction and Drug Allergy Detection”. Explore the results and try to read the abstract of the document.
Notes	<ul style="list-style-type: none"> • User might want to do more than one task at this point. Searching and refining or deciding a specific community. Therefore, all these three subtasks fall in the main task, which is searching a keyword/thesis. • Users are using the public interface. No need to log in at this point.

Table 7. The restricted access content task

Discussion: while designing the tasks, there were some quirks with the system that I noticed.

First of all, I could not design a task that deals with an advanced search inquiry because the system does not support it. However, there are some options to refine searches (such as filters) that users can apply to their search results, but these filters cannot be applied all at once. Filters

have to be applied only one at a time to author, issue data, or subject. I wanted to design a task where users can apply more than one search function at the same. For example, I wanted the task to focus on searching with three keywords, a year, an author and subject. The system does not support such an advanced search strategy. Instead, I designed tasks that they can perform by applying the filters to refine the search results using author, issue data, or subject filters such as task #3, 4 and 5 in Appendix C.

Designing these tasks did not only allow me to explore the interface and the features' powers, but also showed the aspects that should be inspected and assigned as a high priority task. The high priority tasks are: Task #1: find DalSpace, Task #2 search for a thesis, Task #6 and 7 browse a collection, Task #17 submissions, and Task #3 and #18 browsing a restricted content. The rest of the tasks summarize the features that are powered by the interface, but evaluators are allowed to focus on any task they would like to inspect either by following my plan of tasks or by developing their own tasks.

This priority was assigned due to the results from the “User Profiles” study when participants focused on main features that should be powered by DalSpace. In terms of the task “Find DalSpace”, this task was designed because most of the students did not know about DalSpace before they were asked to explore it to carry out the discussion with solid background. The students did not know how to get to DalSpace and they first searched for it using Google. DalSpace is placed under the library collections. Therefore, users have to search for a thesis title using Google or Google Scholar in order to lead to DalSpace, or users have to reach DalSpace through Dalhousie Online Library collections.

In terms of searching for a thesis (Task #2, 3, 4, 5), participants focused on the searching feature. They want to have precise results even when they are new to the system. For instance, when graduate students are preparing to write their theses, they want to know the structure or style of a particular community. There are some common guidelines within all communities at Dalhousie University but the structure differs from one discipline to another. Graduate students want to learn about thesis structure before they start writing.

Another important task is browsing a specific community's collection (Task # 7). All of the participants for the undergraduate, graduate (masters and doctorate) levels agreed that when they look for a supervisor in a university, they want to be able to browse the community collection which the particular supervisor belongs. Participant # 6 in the UP study explained that he/she

searched for a thesis in a specific topic under a specific subject of Dalhousie University to select a university to study in as a graduate student or choosing a supervisor for the graduate program which (Task # 11) covers this aspect.

Submitting a thesis or a document (Task #17) is the main task for graduate students as depositors. I assigned this task with high priority because every graduate student and honors undergraduate student will use DalSpace to submit a thesis or a research paper to the Faculty of Graduate Studies. Using DalSpace in this case is mandatory, so evaluators should focus on this task in order to be able to improve it. Regarding librarians as depositors, they use an administrative interface, which is out of the scope of my thesis. However, librarians use DalSpace as searchers and for reference purposes as discussed in the user profiles study. In terms of the restricted access (Task #18), if the user decides that a thesis should be restricted from public, the thesis will not be uploaded to DalSpace. That means the uploaded documents will be in the graduate studies collection but not in the online collection. In addition, the collection of the Board of Governors and Senate Minutes prior to 1986 is restricted. Some of the minutes included commentary and discussions that the university considered to be sensitive and should not be available for public, hence the “restricted” designation on minutes from that period.

It is important to know that in the communities' collections there is a collection that is assigned as restricted access: “School of Information Management Digital Image Library (Restricted Access)”. However, it is not clear from the system's responses, error messages or a description when selecting this link, which makes it difficult to understand what this content, is and why the collection is restricted. Therefore, evaluators have to explore this part of the interface in order to inspect the performance of the system.

To download or open a document from DalSpace (Task #6) is a feature that allows the users to open the document online or download it to have a digital copy of the document. The choice depends on users and the style that they prefer to read the document in which I assigned a low priority to this task. Evaluators do not have to perform the task they can just read the description of it.

In terms of logging into the system (Task #13 and 15), there are two ways; the first one is logging via the NetID as a Dalhousie member and the other way is to log in as a registered user who has to register first (Task #14) with valid e-mail account. These tasks are not considered as

everyday tasks, but they are critical because users need to know that they have the opportunity to explore the content of most of the collections via the public interface without the need of logging into the system. However, in order to be able to submit a document or a thesis to be uploaded in DalSpace, users have to be registered. The critical concept is derived from the need to login when users want to either submit a document or browse a restricted content.

5.6 HOW TO APPLY HEURISTICS ON A USER INTERFACE TUTORIAL

I started with conducting a tutorial lecture about the heuristics and how evaluators should apply them on the interface dialogs during the evaluation session. Examples usually are better than just lecturing. I explained each heuristic's main concept and gave examples. This was meant to help in carrying out the evaluations without having problems while referring to the heuristics.

Evaluators who have not performed a heuristic evaluation before were required to attend the lecture to increase their knowledge about heuristics and the overall method. Other evaluators, who have experience in heuristic evaluation, would not need to review the heuristics, but they would need to be trained in using the interface. Therefore, the objective of this lecture is to increase evaluators' knowledge about how to applying the heuristics.

I illustrated the heuristics through real examples applied on other interfaces because I did not want to influence the evaluators' opinions. The materials presented in this lecture in PowerPoint slides were sent to the evaluators at the end of the lecture. Unfortunately, most of the evaluators (13 out of 16) were busy and could not make it to the lecture. To deal with this situation, I had to send them the slides and a link to an online lecture presented by a usability specialist, so they would watch it in their own time. I notified them that I would be in the lab an hour prior to the actual study time in case any evaluator needs clarification.

5.7 STUDY PROCESS

The study lasted for 120 minutes. As the facilitator, I discussed the study and answer any questions. The participants performed the study by following the four sessions as described in sections 5.7.1 to 5.7.4. We started with the training session followed by the evaluation session. Then the severity rating was assigned for each uncovered usability problem. Finally, the solutions session was conducted to discuss problems and propose guidelines for the uncovered problems.

5.7.1 Training Session

Evaluators have to be familiar with the interface in order to increase their domain knowledge before they begin the evaluation session. This session lasted for fifteen minutes. Evaluators had the opportunity to decide on their own the way they wanted to explore the interface either by performing the given tasks or by developing their own tasks. In terms of how many times evaluators should inspect the interface, Nielsen recommends going over the interface at least twice. The first time they would explore the interface to have a general idea about the flow of the interaction between the user and the interface. The second time, they might start to perform some of the tasks to help them in the evaluation session and examine the most important elements in the interface or developing their own tasks. Nielsen suggests that following this two-round method would prepare evaluators for the next step, which is evaluating the interface (1992 & 1993).

The evaluators were provided with the list of tasks that they should focus on which covers main elements of the interface, but they can also develop their own tasks while going over the interface. The list of tasks and their full descriptions were given to evaluators at this session either to read them or perform some of them as shown in Appendix C. This aims to help evaluators understand what DalSpace offers and how it works in the real application. In addition, the session assisted evaluators to provide a general sense of the layout and helps them to carry out the evaluation smoothly. The different scenarios list all the possible steps to accomplish the tasks and the tasks are derived from the needs of users and what DalSpace offers at this stage of the design. The needs are the outcomes from the previous study (User Profiles). Thus, I derived the elements that I would like evaluators to inspect. The elements should cover regular (day-to-day) aspects, very important aspects, and unusual but critical aspects of the services powered by the interface as discussed in 5.3.2. The summary of all tasks is shown in Table 8.

No.	Task	Type of Task	Scenario
1	Find DalSpace Task	Important Task	You want to use Dalhousie repository website (DalSpace) for the first time to search and browse the university collections.

2	<p>Search Tasks:</p> <p>2.1 Search for a thesis title</p>	Regular Task	You have opened the home page for the Dalhousie repository website and want to search for a keyword/thesis. You will take a quick look at the home interface and choose one of the search bars to type in the “NFC-Enabled Smartphone Application for Drug Interaction and Drug Allergy Detection”. Explore the results and try to read the abstract of the document.
	2.2 Search within a scope	Regular Task	Now you know how to perform a simple search task. You want to refine your search results and focus on only a specific community (Faculty of Computer Science).
	2.3 Apply filters to the search results	Regular Task	After you performed the simple search task, now you need to refine the search to get more precise results. You want to use some filters and refine by the title/ date issued/subject/author of the document one at time.
	2.4 Apply sort options to the search results	Regular Task	After you performed the simple search task, you want to refine the search to get more precise results. You want to apply some sort options, such as by relevance, issue date, title, and order.
	2.4 Download/Open Task	Important Task: This can be considered as a subtask of all the subtasks.	Now you have reached the document that you think you are really interested in. You want to download it and save a copy in your PC/Laptop in order to read it later or use it in your work.
3	<p>Browse Tasks:</p> <p>3.1 Communities' collection from right side.</p>	Important Task	You want to explore/ browse specific community collections and have the chance to see the list of all communities and sub-communities.
	3.2 Browse by issue date	Important Task	You are now in the “browse” interface and you want to browse the repository collections by the issue date. To do so, you need to choose a month and a year from the drop menus. Or you can write the year in the text box if you only know the year.
	3.3 Browse by the author's name	Important Task	You are now in the “browse” interface and you want to browse the repository collections by the authors' names. You

			need some documents for a particular author and encouraged to enter first few letters of the author's name to have more precise results.
	3.4 Browse by the title of the document	Regular Task	You are now in the “browse” interface and you want to browse the repository collections by the document title. You are encouraged to enter first few letters of the document title to be more specific if you do not know the whole title.
	3.5 Browse by subject	Important Task	You are now in the “browse” interface and you want to browse the repository collections by the documents' subjects. You want to browse the document within the subject “Human Computer Interaction”.
	3.6 Browse the submit date of the document	Regular Task	You are now in the “browse” interface and you want to browse the repository collections by the document submit date.
4	Account Tasks: 4.1 Login via Net ID Authentication	Unusual but Critical Task	You want to log in to the system to create your own profile to start exploring the collections.
	4.2 Register as a new user	Unusual but Critical Task	You are not a Dalhousie member and do not have a Net ID. You need to register to log into the system.
	4.3 Login via Registered Users Password Authentication	Unusual but Critical Task	You are already registered user and you want to log in to the system.
	4.4 Password reset	Unusual but Critical Task	You forgot the password and want to reset it to be allowed to log in to the system.
5	Submission	Important Task	Submit a thesis to the Faculty of Graduate Studies Online Theses.
6	Restricted Content	Critical Task	Browse the Board of Governors Minutes that is was issued in 1984.

Table 8. Summary of the tasks scenarios.

The motivation behind providing a list of tasks (scenarios) and their descriptions is to try to simplify the complicated process of implementing/examining the features or dialogs of the full

system, which will help the developers to focus on specific parts of the system or interface (Nielsen, 1993). After finishing this session, evaluators would be trained and have enough knowledge on both the system interfaces and how to conduct the heuristic evaluation from the previous training lecture. Training evaluators is vital because it affects the results and the type of problems they uncover.

5.7.2 Evaluation Session

Evaluators inspected the interface by referring to the set of heuristics. The ten heuristics were adopted from two resources written by Elaine Weiss (1993) and Jakob Nielsen and Robert Mack (1994). These heuristics are important as they draw the evaluators' attention to the elements that are usually the source of usability problem. This session lasted for 70 minutes and each evaluator inspected the interface separately. Evaluators were not allowed to communicate with each other until the final session to aggregate the evaluations and come up with the final list of problems and propose solutions. Not allowing evaluators to communicate during the evaluation session is vital to avoid the bias and ensure independent evaluations.

In this session, evaluators did not have to perform the tasks from the given list in the previous session; they could develop their own tasks. Moreover, evaluators should have listed all the usability problems separately using the provided form even if the one element has more than one usability problem. This is important to help in explaining all the usability problems in the redesign process that might lead to completely replacing the element or to just fixing some of it. Evaluators are allowed to consider any new problems that might not belong to the ten heuristics (Nielsen, 1993). The result of the evaluation session was recorded in the form of written reports. Written reports are important because every comment is documented and available for further development. Each evaluator had to describe every problem in depth and then the investigator synthesized the description. The observers, (who are also the investigators) assisted evaluators when they had problems with the interface or the tasks while the responsibility of analyzing the interface was only assigned to the evaluator.

5.7.3 Severity Rating

In order to classify the problems, the severity rating has to be assigned to each usability problem found (Nielsen, 1993). The rating was accomplished after the evaluation session and separately

by evaluators who were asked to rate each usability problem in their list. The session lasted for 20 minutes. Evaluators were not allowed to communicate through the rating process to avoid bias and ensure that evaluators did not affect each other's evaluations. In most cases, evaluators will not have access to the interface while assigning the severity ratings. However, it was possible to give the evaluators the chance to revise and revisit some elements in the interface and not to have to rely on their memory or the written reports. A single severity rating is provided for each usability problem: The scale is from 0 to 4, quoted from Nielsen (1995) (p. 2).

0 = I don't agree that this is a usability problem at all

1 = Cosmetic problem only: need not be fixed unless extra time is available on project

2 = Minor usability problem: fixing this should be given low priority

3 = Major usability problem: important to fix, so should be given high priority

4 = Usability catastrophe: imperative to fix this before product can be released

Following this procedure will avoid having only minor problems, which is an important aspect of conducting a heuristic evaluation. This helps to assign the priority to the serious problems, which will increase the reliability of the heuristic evaluation to uncover the serious usability problems (Nielsen, 1994b).

5.7.4 Proposed Solutions Session

The purpose of this session was to propose some guidelines that could be adapted to improve the usability of DalSpace as it represents the open access of Dalhousie Repository. In this session, all evaluators were asked to get together in order to discuss each usability problem and propose solutions (Nielsen, 1995). Evaluators were provided with the Users' Profiles that address the users' needs, abilities and desires. The user profiles are the results from the previous study as discussed in Chapter 4. This will help evaluators to consider users needs throughout the session. The motivation behind having this session is not to list all the problems, but to provide guidelines and solutions that can help the developers' team to fix, improve the features and services powered by the interface. This serves one of the ultimate research objectives in order to develop and improve the Dalhousie Repository Interface (DalSpace).

CHAPTER 6 RESULTS AND DISCUSSION

To set the scene, this chapter focuses on describing the analysis method I followed to aggregate the evaluations. I transferred the row data from evaluators' reports into a list of problems according to their severity. Next, I applied a data analysis similar to what Nielsen and Molich followed in 1990, the details of which will be addressed in the results and discussion sections. Finally, I presented the final report of problems according to their severity, which will be provided to the development team to improve DalSpace service.

6.1 AGGREGATION PROCESS

Individual evaluations uncovered various problems of the DalSpace interface. A total of 16 evaluators participated in the evaluation study from different levels from novices with little experience to regular experts. Each evaluator had his/her evaluation report that contains the problem description, the violated heuristic, the problem screen, severity rating and the suggested solution. Figure 7 is an example of an evaluations report that was filled by participants. These reports could not be used directly and compared to each other. Because some evaluators describe the same problem from different perspectives, I outline the process phases that I have followed to transfer the data from raw to sold list of problems.

Phase 1: I transcribed all of the written reports into Word document and Excel sheets. Each individual report was organized by the participant ID. When some evaluators had more than one problem in one problem description column in the evaluation report, I tried to separate them into two problems. For example, Evaluator ID 14 stated that the homepage should provide more information to the user in terms logging to the system with a NetID or registering as a new user as well the faculty members should be organized according to their faculties or departments. The reasoning for these recommendations is because DalSpace is open access online repository that is accessible by the public not only Dalhousie members. I had to separate the statement into two problems: some information in the homepage about logging with the NetID as a Dalhousie member, and some information about registering as a new user from the public.

Phase 2: In order to group the problems, I classified all problems according to their severity ratings from the evaluators reports into four main categories: Catastrophic problems, Major problems, Minor problems, Cosmetic problems, “Not usability problems” group.

Phase 3: Some problems were found by more than one evaluator, but they share the same severity rating. In this case, I removed the duplicate and grouped them as one problem that was found by more than one evaluator. In addition, if two or more evaluators found the same problem and assigned different severity ratings I considered the problems as separate problems.

Phase 4: I started to discuss each category with more explanations using snapshots from DalSpace interface. The list of the problems in each category contains the problem ID, the heuristic(s) that was violated, the problem title, the severity rating, the evaluator's ID and expertise. Evaluators clearly indicated the location of the problem (in which interface), which helped me to discuss problem precisely. In addition, a full description of each problem and snapshots from the interface to indicate where exactly the problem exists and suggested solution(s) was added.

Phase 5: draw statistical conclusions from problem reports to investigate evaluators' performance, type of uncovered problems, violated heuristics, the difficulty to uncover problems, and duplicate problems.

#H	Problem Description	"Interface" Where is the problem	Severity Rating	Suggested solution	Comments	
1	8	Lot of whitespace on lists and underlined text	Community list (home)	0	Lists could be more attractive Multiple columns, less heavy typefaces	Remove redaction address
2	2	Different options before login form (netID/register)	Login	2	Put both login forms at the same page, like sign in/on at e-commerce sites	
3	2/3	Register page says nothing for those who have a NetID	/register	3	Inform users that they don't need to register if they have a NetID	
4	7	Why 2 similar search boxes at home?	Home	1	They are similar but with different text. It makes the home more cluttered and less useful.	Remove that search in the middle
5	7	Unable to search for title/author from sidebar	Sidebar	3	Add an advanced search box that would open if the user clicks a button	Useful for admin users/people looking for specific stuff
6	7	Using Enter to select from autocomplete only work not the search box	Search Filters	4	Fix the issue	
7	7	Hard to get to search box through keyboard	Any page	1	Should be one of the 1st items in the Tabindex	
8	7	Punctuation suggestions on autocomplete are weird	Search Filters	2	Should consider only words	
9	7	Better use an X to remove an existing filter than uncheck it	1)	1	Decide between an X or a check box.	
10	7	If the user is unmarking a filter, it should stay there not vanish	1)	2	If the checkbox is better, maintain it's behavior: unmark but not vanish	
11	7	Search for author name does not return anything	Browse by author	4	Fix this search option	

Figure 7. Example of problems report

6.2 RESULTS AND DISCUSSION

In this section, I discuss the results as a function of a number of factors (number of problems, evaluators' performance, and heuristics violated and, the difficulty to uncover problems, and

duplicate problems) as well as the final list of problems provided to the development team to improve DalSpace service classified according to their severity ratings.

6.2.1 Total Number of Problems before and after the Aggregation Process

The details of the aggregation process were described in section 6.1. Table 9 provides the number of problems before the aggregation process, the number of problems classified after the aggregation process and the final number of ‘Catastrophic problem’, ‘Major problem’, ‘Minor problem’, ‘Cosmetic problem’, and ‘Not a usability problem’. The original number of problems is the raw data from the evaluators' reports, and the final number is the sum of all problems discovered after I performed the aggregation process.

Original count	Final count	Catastrophic problems	Major problems	Minor problems	Cosmetic Problems	Not usability problems
123	66	17	17	21	11	3

Table 9. Problems' categories

From Table 9 and Figure 8, we can see that a large number of problems were uncovered by applying the Nielsen's 10 heuristics to the DalSpace interface. Applying the heuristic evaluation method helped evaluators to uncover over one hundred and twenty problems in total. However, after the aggregation process, the number of problems was reduced into 66 because I eliminated the supuplicate problems that share the same severity rating and the not usability problems group. Also, 7 of the 66 problems were documented by different evaluators but were assigned different severity ratings.

For the purpose of analyses, I considered duplicate problems with different levels of severity to be different problems. In addition, two evaluators (out of 16) noted 3 problems they considered as ‘not a usability problems’. This means that the heuristics helped the evaluators to be more focused on uncovering only usability problems.

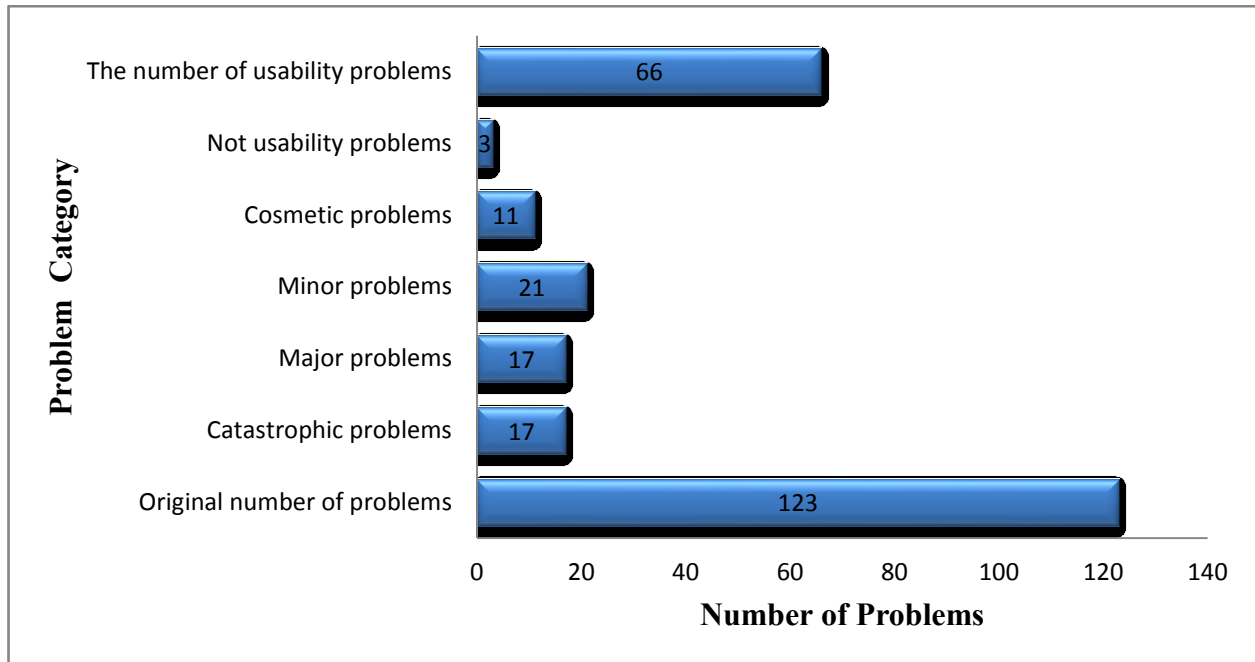


Figure 8. The number of problems in each category.

6.2.2 Evaluators' Performance

It is important to note that it is not possible to know the true number of problems in DalSpace. At best, I can only use the number uncovered as an estimate of the total number. That is, there may still be problems in DalSpace that have not been noted by anyone to date. Hence, it is not possible to compare the performance of each evaluator, or the entire team, to a standard of truth. However, I can compare the performance of evaluators against the total number of problems discovered by all evaluators. This analysis assumes that the team likely found all or almost all of the problems. This analysis was conducted within each category of problem and for experts and novice evaluators.

Table 10 summaries the number of problems and their severity ratings found by both experts and novices. Some problems were found by more than one evaluator.

Problem category	Number of problems
0	3
1	11
2	21
3	17
4	17

Table 10. 0 (not a usability problem) and 4 (a catastrophic problem).

To investigate evaluators' performance, I discussed the number of problems found by each evaluator, the severity of the uncovered problems and difficulty to uncover usability problems as follows.

6.2.2.1 Number of Problems

Table 11 shows that the average number of problems found by experts is 5.44 while the average number of problems found by novices is 4.57. There is no significant difference between the average number of problems found by experts and by novices

Evaluator type	Total number of problems	Best evaluator	Worst evaluator	Average number of problems	Standard deviation
9 Regular experts	66	9 (13%)	2 (3%)	5.44	2.24
7 Novices	66	14 (21%)	2 (3%)	4.57	4.43

Table 11. Evaluators' performance.

Somewhat surprisingly, the best evaluator is a novice (evaluator ID 5) with a total of 21% of the all problems (note, the total number of problems is the final number after applying the aggregation process). However, the best regular expert found only 13% of the total. In terms of worst, the worst expert and the worst novice found 3% of the total. Compared to Nielsen's findings, one evaluator can find 35% of the usability problems in the user interface while, from the study findings, 21% of the total number of problems was uncovered by the best evaluator. From this point, we can conclude that only one evaluator cannot find all the usability problems even if the evaluator is a regular expert. Using a simple two-group t-test (coding 1 for detected and 0 for not detected), for catastrophic problems (level 4), the number of problems detected by

experts was higher than the number of problems detected by novices with $t(32) = 2.626$ ($p < 0.013$; $t_{crit} = 2.037$). For major problems (level 3), the number of problems detected by experts was higher than the number of problems detected by novices with $t(32) = 2.626$ ($p < 0.013$; $t_{crit} = 2.037$). For minor problems (level 2), the number of problems detected by experts was *not* higher than the number of problems detected by novices with $t(40) = -0.412$ ($p < 0.683$; $t_{crit} = 2.021$). For cosmetic problems (level 1), the number of problems detected by experts was lower than the number of problems detected by novices with $t(12) = -2.948$ ($p < 0.008$; $t_{crit} = 2.086$). These findings contradict Nielsen's (1990) suggestion that the difference between the experts and novices will be statistically significant.

Implications: As can be seen in Table 9 and Figure 9, the number of minor problems is higher than the number of major problems. This was not expected because one would predict experts to find more severe problems and the current sample contained more experts than novices which contradicts one of the main hypotheses. This could be due to a number of reasons:

- The training session, which is the first session in the study process, was only for 10 minutes in duration. The main goal of the training session was to help evaluators become familiar with DalSpace. This time might not have been enough for them to explore every interface which had the negative effect on the general number of serious problems because the number of serious and minor problems was almost the same with 2 problems difference. Only two evaluators (both PhD students) had prior experience with DalSpace, but their experience was limited to submitting their masters' thesis to the graduate studies. The rest of evaluators had very limited or no experience prior to participating. Therefore, these two situations had negative effects on the number of problems.
- I provided evaluators with a one-hour tutorial lecture as a condition of their participation in the study. The lecture was intended to help them to apply the heuristics into any type of interface. However, only 3 evaluators attended the lecture. The rest preferred to watch the tutorial later on their own time and their self-study may not have been as effective. This might affected their performance by focusing on minor problems only. I informed evaluators that I will be with them during the evaluation session in case they needed further assessment. The video link and the PowerPoint slides were intended to help evaluators understand the heuristics

- It is possible that the designers of the DalSpace website were reasonably competent. That is, the site works, and has worked for some years. As such, it is possible that minor problems remain. However, fixing both severe and minor problems would increase the acceptability of the service.

Second, these findings contradict with what Nielsen suggests (1990) that the average number of problems between the two types of evaluators should be significantly different. The difference is small. Therefore, in order to produce more reliable results, more than one evaluator should examine the interface.

At this end, I got results that I would not expect, so I shifted my attention to investigate another dimension which is their performance according to the severity of the problems they uncovered as follows.

Another limitation is categorizing some these evaluators into the experts and non-experts groups. Two evaluators from each groups are discussed in terms of the number and type of problems they uncovered to investigate the differences. The comparison is between evaluators ID 3 and ID 13 as experts and evaluators ID 14 and ID 15 as non-experts.

The results show that evaluators ID 3 uncovered 6 problems and evaluators ID 13 uncovered 9 problems. Comparing the number to the number of problems uncovered by the two novices: evaluators ID 14 uncovered 4 problems while ID 15 uncovered 3. Therefore, experts found a total of 14 problems and non-experts uncovered 7 problems.

In terms of the type of problems, evaluator ID 3 found 4 catastrophic problems and 2 major problems. The types of problems uncovered by ID 3, who is an expert, are all serious problems and evaluator ID 13, who is an expert, uncovered 4 serious problems and 5 minor problems. On the other hand, evaluator ID 14 uncovered only serious problems while evaluator ID15 uncovered 1 serious problem and 2 minor problems.

To sum up, the number of problems uncovered by the two experts is more than the number of problems uncovered by non-experts. The severe problems were uncovered by both as evaluator ID 14 is a non-expert and assigned all 4 problems as serious problems. It is important to note that the severity of the problems is assigned according to the evaluators' opinions.

6.2.2.2 The Severity of Uncovered Problems

I am more concerned about the severity of the problems found by each group of evaluators. Therefore, I investigated evaluators' performance according to the type of the problem they

uncovered. In 1990, Nielsen suggested that usability specialists are better in uncovering problems than novices. To examine that, I compared the type of usability problems that were uncovered by both experts and novices. Figure 9 and Table 12 show that the majority of the problems found by experts were serious (catastrophic or major). On the other hand, novices tended to uncover cosmetic and minor problems. Both groups discovered about the same number, but differed in their focus. This is consistent with the notions of Nielsen (1990). The severity of problems uncovered by experts is higher than the severity of problems uncovered by the novices. Hence, one could conclude that a small set of expert evaluators is needed to find severe usability problems.

Category	Total	Novice	Expert
1	11	9	3
2	21	11	13
3	17	7	16
4	17	7	16

Table 12. Number of problems uncovered by evaluators in each category

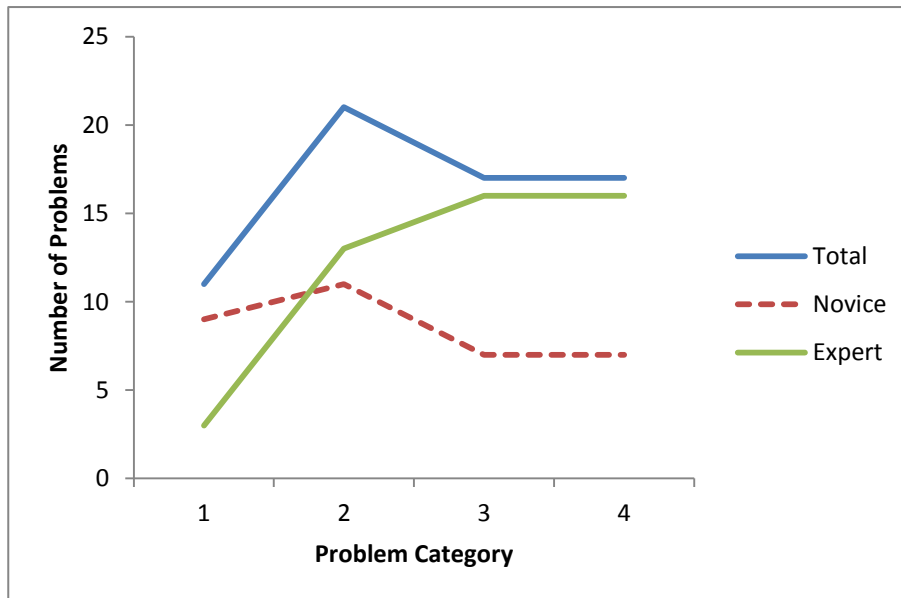


Figure 9. Evaluators' performance and type of problems.

Implications: one cannot rely on novices to uncover all types of problems: More novices will not necessarily find the severe problems. Before conducting the study, I had expectations that

recruiting as many evaluators as I possible might have more results since different people find different problems. However, if I focused on the severe problems I would agree that small number of regular experts would be enough to find a good number of serious problems. This does not contradict with the basic idea that uncovering some usability problems in an interface is better than having none. Also, the heuristic evaluation conducted on DalSpace interface is sufficient for uncovering both serious and minor problems. This result supports what Nielsen (1994) suggest in terms of the cost-effective method because we only used evaluators, the interface, and problem's report.

6.2.2.3 Difficulty of Uncovering Problems

The performance of evaluators can be rated according to the difficulty of uncovering problems in the DalSpace interface. Some problems are harder to uncover than others. I mean that an *Easy* problem is one that is found by many evaluators, whereas a *Hard* problem is one that is found by a few evaluators, or even just one evaluator. I also rated the ability of each evaluator to find usability problems as *Good* or *Poor* an evaluator who found many problems would have high ability whereas an evaluator who found few problems would have low ability. These two factors were investigated.

Some might think that difficult problems can only be uncovered by experts and easy problems can be uncovered by both experts and novices. This raises three questions: do experts, who are presumed to have a high ability to uncover problems, find only difficult problems? Do novices uncover only easy problems? Most importantly, can novices, who have presumed to have lower ability, find difficult problems? To address these questions, Figure 10 summarizes the ability of evaluators to uncover problems. The blue circles (O) represents non-experts while the red Xs represents experts. Each row represents one of the 66 problems, and the column represents one of the 16 evaluators.

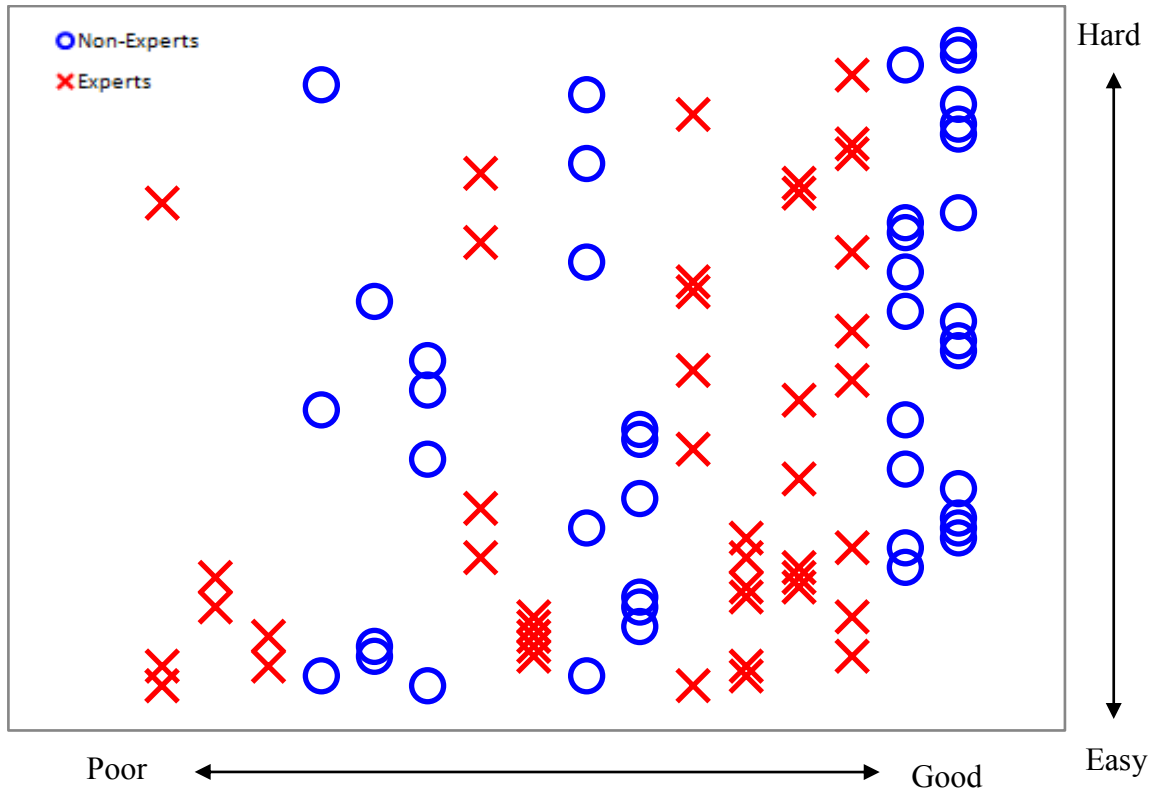


Figure 10. Problems found by both experts and novices.

We can see from Figure 10 that the two types of evaluators are fairly interspersed. In this, one must be mindful of the fact that there are ties (e.g., three evaluators found 2 problems, two found 3, 4 and 5, three found 6, and one found 7, 9, 10 and 16). However, in the right-top corner, both novices and experts found the hardest problems, but there are slightly more experts. The bottom of the figure show that both experts and novices are finding problems, but generally novices are more to the left (lower performance) and experts are more to the right (higher performance). Of course, there are exceptions. Furthermore, the ability of novices to find problems can be as high as that of the experts because the two types of evaluators appear in the right half of the Figure. Therefore, novices have the ability to uncover hard problems.

Implications: The results from this rating agree with what Nielsen and Molich (1990) suggest which is improving the overall results of the methodology by aggregating results from different evaluators. One cannot rely on one evaluator even if the evaluator is the best. Good evaluators do not have to find the difficult problems and poor evaluators do not find only easy problems. To deal with this situation, the aggregated results should be used to support having diversity of the

uncovered problems. Also, other types of usability testing would add to the reliability of the results.

6.2.3 The Violated Heuristics and Type of Problems

The heuristic evaluation method focuses on the application of a set of heuristics (usability principles) to the interface elements to find usability problems. Therefore, it was essential to investigate the number of times each heuristic was violated. Table 13 provides frequency of problems associated with each heuristic, categorized by the severity.

Figure 11 provides the same information graphically. It clearly shows that violations of Heuristic 4 (consistency and standards) and Heuristic 8 (aesthetic and minimalist design) were most often detected. The consistency and standards heuristic (H4) focuses on eliminating the confusion arises when different situations, actions and words are used to mean the same thing. Second, the aesthetic and minimalist design heuristic (H8) focuses on the extra elements or icons in the interface that should not exist as well as any other issues related to the screen design. The number of serious problems (catastrophic and major problems) that violate the H4 is 7 while the number of minor problems is 5. Interestingly, the number of serious problems that violate H8 is 8 while the number of minor problems is 4. Therefore, one could conclude that designers should attend to these heuristics, and that, in future work, this situation draws my attention to the fact that the system does not apply these two heuristics enough. In addition, the development team might focus on the most severe problems that violate these two heuristics.

On the other hand, Figure 11 shows that Heuristics 6 and 10 were the least violated. Heuristic 6 (recognition rather than recall) focuses on reducing the users' memory load by placing the interface elements in the same location throughout all the website screens, and recommends that the colors of previously visited sections of the site be changed already visited parts of the interface. This heuristic was only violated for four times, and all these problems as rated as either minor or cosmetic. These problems should be given low priority during the development process of DalSpace interface. Heuristic 10 (help and documentation) was also violated four times, but the type of problems were totally different. These four problems included three serious (catastrophic and major) and only one minor problem. Therefore, the problems that violate Heuristic 6 should be given lower priority during the development process while the problems that violate Heuristic 10 should be given higher priority.

Heuristic ID	Catastrophic problems	Major problems	Minor problems	Cosmetic problems
H1: Visibility of system status	3	1	2	0
H2: Match between system and the real world	2	2	2	3
H3: User control and freedom	2	5	0	0
H4: Consistency and standards	4	3	5	2
H5: Error prevention	3	2	2	2
H6: Recognition rather than recall	0	0	3	1
H7: Flexibility and efficiency of use	3	2	3	2
H8: Aesthetic and minimalist design	1	7	4	1
H9: Help users recognize, diagnose, and recover from errors	2	1	1	1
H10: Help and documentation	1	2	1	0
Sum	21	25	23	12

Table 13. Violated heuristics and problems categories.

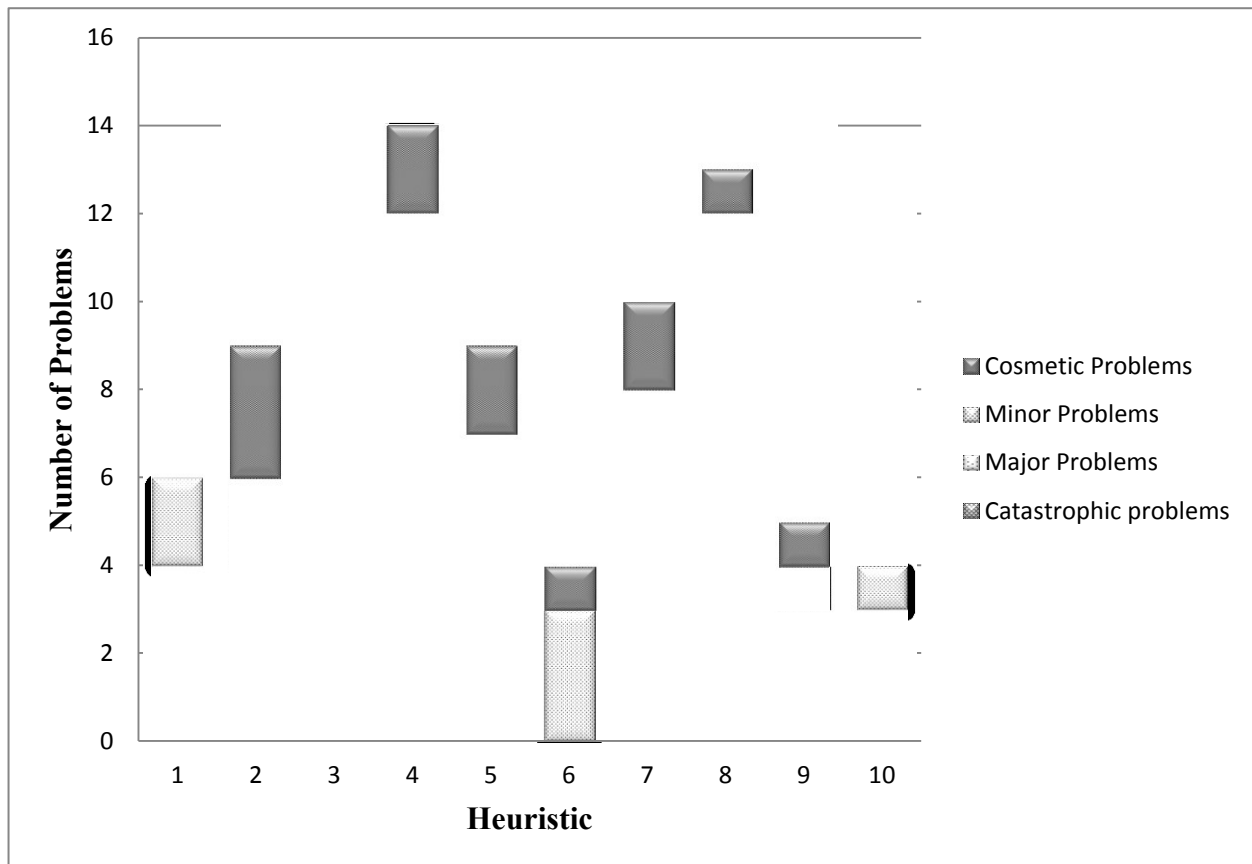


Figure 11. Heuristics violated and type of problems

Interestingly, Heuristic 3 (user control and freedom) was violated in seven problems, which is low proportion of the total. However, all of these seven problems were serious problems. In addition, Table 13 draws my attention to the fact that H3 only uncovered serious problems while H6 (recognition rather than recall) only uncovered minor problems. In addition, H1 (visibility of system status) did not uncover any cosmetic problems.

To sum up, Figure 12 shows the recommended priority levels for violated heuristics starting by problems associated with heuristic 4, 8, 3, 5, and 7 respectively.

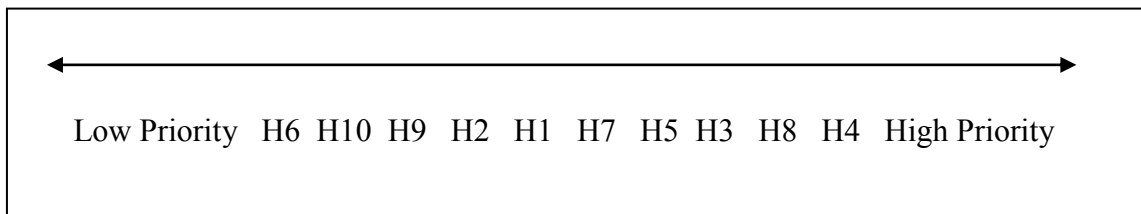


Figure 12. Suggested priority according to the violated heuristics and problems severity

Implications: one observation was that some participants had problems assigning heuristics for uncovered problems. For example, Problem 33 (crowded homepage) was listed as a major problem cited by two evaluators (one expert and one novice) but both did not assign a heuristic. This might have been due to time constraints during the evaluation, or because they were more focused on documenting the problems that they had uncovered. However, I tried to provide them with the list of heuristics and a short explanation in hand during the evaluation session to avoid leaving the heuristics' column empty. Even though they did not (or could not) use the heuristics, one can conclude that the reliability of the methodology is valid for uncovering usability problems in the DalSpace service even if they did not assign a violated heuristic.

On the other hand, some evaluators (both experts and novices) assigned more than one heuristic to one problem. For example, Problem 12 (Browse an empty collection) was cited as a catastrophic problem. However, the evaluator labeled the problem violates H8 and H9. It is possible that evaluators did understand the heuristics, but that sometimes two or more heuristics apply to the same problem. Therefore, this type of situation does not detract from the use of heuristics because the point of heuristics is to guide for uncovering, coding and then prioritizing problems. Also, the heuristic evaluation conducted on DalSpace interface is good for uncovering both serious and minor problems that I can draw conclusions by focusing on the violated

heuristics. This result supports what Nielsen (1994) suggests in terms of the cost-effective method because we only used evaluators, the interface, and problem's report.

6.2.4 Duplicate Problems with Different Severity Ratings

In some conditions, two or more evaluators found the same problems but assigned different severity ratings to those problems of this type were found. For the purpose of analysis, I considered the duplicates as new problems under each problem category with clear indication that these problems are duplicates. These seven problems are summarized in Table 14, along with the variations in the severity ratings. For example, problem number 60 (Browsing a restricted community/collection) is discussed in the catastrophic problems in the following section (6.5.1) and discussed again in the cosmetic problems due to variations in the assigned severity. Note that the variations are *not* small. That is, the different severities are not adjacent for most duplicates (i.e., they are *not* 1 and 2, or 3 and 4). For this reason, I could not group them to one problem and consider them as new ones.

Problem numbers	Problems title	Assigned severity ratings
60	Browsing a restricted community/collection	1 and 4
61	Two search boxes in homepage	1, 2, and 4
63	Search “This collection” option.	1 and 3
64	“Back” button while viewing an item	1 and 3
65	Symbols produced while browsing by author	1 and 3
66	RSS feeds	1 and 3
69	Crowded Home page	0 and 3

Table 14. Duplicates with different severity ratings

Implications: The results from the Table show that the difference between assigning the problem as severe problem and as a cosmetic problem is not small. Hence, I could not adjust these severity ratings. I have the hypothesis of one or more evaluators find the same problems but I did not have the hypothesis of assigning different severity ratings to those problems. If the deference was small, I could have grouped them to the more reasonable severity or I might recommend experts opinions.

6.2.5 Problems Categories

In this section, I classified the problems depending on the assigned severity ratings. The aggregation process produces five main problems categories including catastrophic, major, minor, and cosmetic and ‘not usability problems’. Each problem is fully described.

6.2.5.1 Catastrophic Problems

Problem number	Heuristic violated	Problem description	Severity rating	Which evaluator	Evaluator expertise
1	H1: Visibility of system status	Reaching DalSpace	4	ID1, ID14	Regular experts
2	H8: Aesthetic and minimalist design H4: consistency and standards	Two search boxes in the homepage	4	ID 3, ID 14	Regular experts
3	H3: User control and freedom H5: Error prevention	Random search results when clicking on GO button without typing a keyword	4	ID 6	Non-expert
4	H3: User control and freedom H9: help users recover from errors	When deleting a submission, the system does not provide an error message.	4	ID 13	Regular expert
5	H10: Help and documentation	Insufficient documentation	4	ID 3	Regular expert
6	H1: Visibility of system status H5: Error prevention	Introduction to logging and registering	4	ID 14 ID 16	Regular expert Non-expert
7	H2: Match between system and the real world	Contact information in the homepage	4	ID 3	Regular expert
8	H4: Consistency and standards	Browse by author name	4	ID 2, ID10, ID 11	ID 2 and 11 are Experts. ID 10 Non-expert

9	H4: Consistency and standards	Browse by subject	4	ID 11	Regular expert
10	H7: Flexibility and efficiency of use	More filters are required while browsing by date	4	ID 2	Regular expert
11	H5: Error prevention H9: Help users recognize, diagnose, and recover from errors	Browse restricted community	4	ID 13	Regular expert
12	H8: aesthetic and minimalist design H9: Help users recognize, diagnose, and recover from errors	Browse an empty collection by subject	4	ID 7	Regular expert
13	H4: Consistency and standards	“View more” link while discovering authors and subjects in homepage.	4	ID 10	Non-expert
14	H4: Consistency and standards	Search a keyword	4	ID 14 ID 15	Regular expert Non-expert
15	H2: Match between system and the real world	View abstract	4	ID 3	Regular expert
16	H7: Flexibility and efficiency of use	Search keyword removed automatically	4	ID 5	Non-expert
17	H7: Flexibility and efficiency of use	Using “Enter” key in the keyboard.	4	ID 10	Non-expert

Table 15. List of catastrophic problems

Some example of the uncovered problems in this category are presented as follows:

Problem 1: both experts found that reaching DalSpace was difficult and not direct which violates H1: visibility of system status. Evaluator ID 1 mentioned “DalSpace is not easy to

locate”. Evaluator ID 14 added “I did not know about DalSpace until I had to evaluate it”. Therefore, both evaluators rated this problem as catastrophic problem that has to be fixed. Evaluators have to reach DalSpace through Dalhousie online Libraries under library collections. This problem connects to what participants from the “User Profile” study (Chapter 4) stated that they cannot gain advantage from DalSpace services when they do not know that the service exists, and they have to upload their thesis to the graduate studies through DalSpace. The snapshot of the problem is shown in Figure 13.

Snapshot of problem 1:

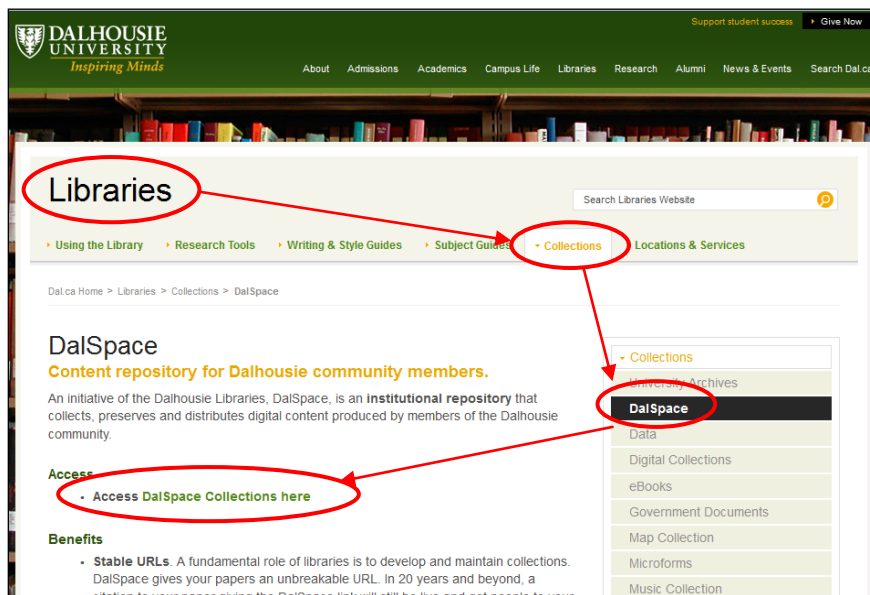


Figure 13. How to reach DalSpace through Dalhousie online libraries

Suggested solution (s): Evaluator ID 1 suggested the solution to the problem in which there is a need for having a link that is called “search DalSpace directory” in the library homepage. Moreover, this issue was discussed during the focus group meeting from the User Profiles study. Participants were wondering if they can have a link in each faculty homepage that leads directly to the repository. In addition to the results from the User Profiles study, Participant #3 suggested having a tutorial video about why and how to use DalSpace with a link on the web interface of each faculty would be helpful.

Problem 2: Two search boxes in DalSpace homepage. This problem was addressed by three evaluators (regular experts) who consider it as catastrophe problem. Moreover, two evaluators with some experience (ID 4 and ID 10) who considered it as a cosmetic problem are discussed

within the cosmetic problems group. DalSpace provides two search boxes in the homepage. One is in the right and one in the left-middle of the same homepage as shown in Figure D-14 in Appendix D. Evaluator ID 3 raised a question: “which search box I should use? I am confused”. Evaluator ID 14 agreed on the same point, “two different search boxes confuse users. Do they give different results?”, and evaluator ID 3 added “users might think that these two boxes search two different things”. This affects both the user experience with the system and the system performance because the interface has some extra elements that should not be there which violated the heuristic H8: Aesthetic and minimalist design. I think this situation violates also heuristic H4: consistency and standards because users should not wonder if some elements in the interface mean the same thing or not.

Snapshot of problem 2:

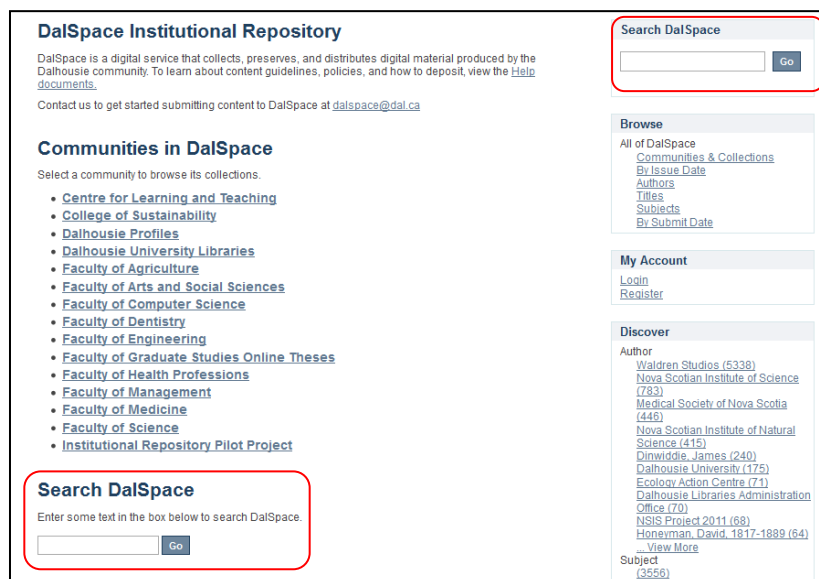


Figure 14. Two search boxes in DalSpace home.

Suggested solution(s): Evaluator ID 3 suggests focusing on only one search box and makes it clear to users. Focusing on only one search box would eliminate users' confusion, and save users' time thinking.

6.2.5.2 Major problems

Problem number	Heuristic violated	Problem description	Severity rating	Which evaluator	Evaluator expertise
18	H5: Error prevention H8: Aesthetic and minimalist design	Symbols produced while browsing by the author name	3	ID 13	Regular expert
19	H2: Match between system and the real world H3: User control and freedom	Register page and NetID	3	ID 10	Non-expert
20	H1: Visibility of system status	Irrelevant search results	3	ID 12 ID 16 ID 8	Regular expert
21	H4: Consistency and standards H8: Aesthetic and minimalist design	Scrolling down to view the search results	3	ID 7 ID 13	Regular experts
22	H7: Flexibility and efficiency of use H3: user control and freedom	“Previous” button in uploading a document for a submission	3	ID 1	Regular expert
23	H8: Aesthetic and minimalist design	Browsing by collection produces a long list of communities and sub-communities	3	ID 10	Non-expert
24	H3: user control and freedom H7: Flexibility and efficiency of use	Scope and filters while searching	3	ID 10	Non-expert
25	H3: user control and freedom	“Back” button while viewing an item	3	ID 7 ID 9	Regular expert Non-expert
26	H4: Consistency and standards	“Update” button in filters	3	ID 2	Regular expert

	H8: Aesthetic and minimalist design				
27	H4: Consistency and standards H8: Aesthetic and minimalist design	“Go” button in browsing by issue date	3	ID 7 ID 12	Regular experts
28	H5: Error prevention H9: Help users recognize, diagnose, and recover from errors	Browsing by issue date-wrong entry	3	ID 4 ID 6 ID 12	Both ID 4 and ID 6 are Non-experts; ID 12 is regular expert
29	H8: Aesthetic and minimalist design	View item-screen	3	ID 11	Regular expert
30	H10: Help and documentation	Help option	3	ID 1	Regular expert
31	H10: Help and documentation	Search “This collection” option	3	ID 2	Regular expert
32	H8: Aesthetic and minimalist design H2: Match between system and the real world	RSS feeds	3	ID 3 ID 12	Both Regular experts
33	N/Y	Crowded homepage	3	ID 9 ID 3	Non-expert Regular expert
34	H3: user control and freedom	Community item breadcrumb in the page header path	3	ID 7	Regular expert

Table 16. List of major problems

Table 16. List of major problems

Some example of the uncovered problems in this category are presented as follows:

Problem 18: Evaluator ID 10 described “Register page says nothing for those who have a NetID”. The problem violates both H2: match between system and the real world in which users would expect some explanation and H3: user control and freedom in which users are informed about what they are doing and why.

Snapshot of problem 18:

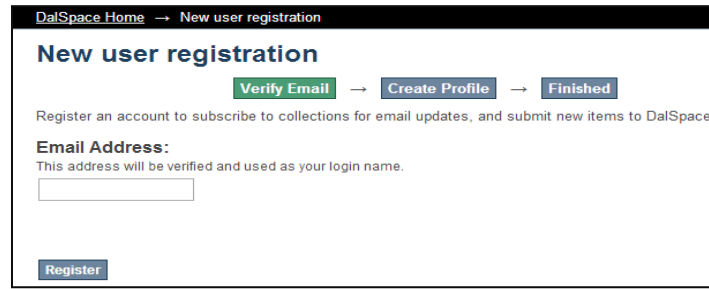


Figure 15. New user registration interface

Suggested solution(s): Evaluator ID 10 recommends that the system should “inform users that they do not need to register if they have NetID”. In addition, the system should provide a description for both situations either for registering as a new user or just logging into the system by the NetID.

Problems 19: Evaluator ID 13 found that browsing by author name produces symbols that he/she thinks it is not relevant. This might confuse users and raise some questions in regards to what do they mean. This problem violates H5: error prevention and H8: aesthetic and minimalist design. I found that clicking on those characters produce documents, which adds to the problem in which I could not find the connection between them and the documents.

Snapshot of problem 19:



Figure 16. Browsing by author name

Suggested solution(s): Evaluator ID 13 documented “Those characters in the results set should not be displayed”. These symbols should be replaced with authors' names instead.

6.2.5.3 Minor Problems

Problem number	Heuristic violated	Problem Description	Severity rating	Which evaluator	Evaluator expertise
35	H2: Match between system and real word	Sort the faculty profiles	2	ID 1	Regular expert
36	H1: Visibility of system status H5: Error prevention	Adding an extra reader field while submitting	2	ID 1	Regular expert
37	H6: Recognition rather than recall	Colors of visited links	2	ID 4	Non-expert
38	H1: Visibility of system status	User profile after logging with NetID	2	ID 5	Non-expert
39	H4: Consistency and standards	“Add” and “Apply” buttons under discover link	2	ID 7	Regular expert
40	H4: Consistency and standards	Users' path vs. the document path	2	ID 7	Regular expert
41	H8: Aesthetic and minimalist design	System suggests “enter first few letters” while browsing by title	2	ID 8	Regular expert
42	H7: Flexibility and efficiency of use H8: Aesthetic and minimalist design	Punctuation suggestions in search filters	2	ID 10	Non-expert
43	H4: Consistency and standards	Filters dropdown menus	2	ID 10 ID 12	Non-expert Regular expert
44	H4: Consistency and standards	“Show simple item record” link	2	ID 13	Regular expert
45	H6: Recognition rather than	Auto-fill on search	2	ID 13	Regular expert

	recall				
46	H6: Recognition rather than recall	The number of the documents while browsing by subject	2	ID 5	Non-expert
47	H2: Match between system and the real world H4: Consistency and standards H7: Flexibility and efficiency of use	Indirect link to download a document	2	ID 1 ID 13	Regular experts
48	H8: Aesthetic and minimalist design	Two search boxes	2	ID 1	Regular expert
49	H5: error prevention H9: Help users recognize, diagnose, and recover from errors	Browsing by issue date-wrong entry	2	ID 4	Non-expert
50	H10: Help and documentation	Help option	2	ID 1 ID 4 ID 15	Non-experts
51	H8: Aesthetic and minimalist design	Irrelevant search results	2	ID 5 ID 12	Non-expert Regular expert
52	H7: Flexibility and efficiency of use	“ Go” button	2	ID 13	Regular expert
53	N/Y	Using “Enter” key in the keyboard	2	ID 11	Regular expert
54	N/Y	Browse an empty collection	2	ID 11	Regular expert
55	N/Y	URL link in the view item page	2	ID 15	Non-expert

Table 17. List of minor problems

Some example of the uncovered problems in this category are presented as follows:

Problem 37: Colors of visited links. Evaluator ID 4 found that while exploring the system in all page, the color of visited links do not change to indicate that they have been visited. In DalSpace, the unvisited and visited links are in light blue while the dark blue for active links. This problem violates H6: Recognition rather than recall. Users will need to remember if they have already visited a link or not.

Snapshot of problem 37:

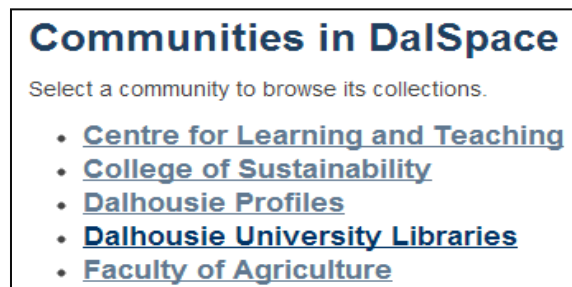


Figure 17. Light blue for both unvisited link and visited and dark blue for active link

Suggested solutions: Evaluator ID 4 recommends highlighting the links. Instead, I think the system should follow the general colors for all links which include; a blue for unvisited link, purple for links that have been visited, and a red for the active links that the mouse is on (Colors on text links, accessed in 2013, May). This would decrease the users' memory load trying to remember.

6.2.5.4 Cosmetic Problems

Problem number	Heuristic violated	Problem description	Severity rating	Which evaluator	Evaluator expertise
56	H7: Flexibility and efficiency of use	Reaching the search box through the keyboard	1	ID 10	Non-expert
57	H4: Consistency and standards H2: Match between system and the real world	“Discover” option	1	ID 10	Non-expert

58	H2: Match between system and the real world	“Files in this item” header	1	ID 13	Regular expert
59	H7: Flexibility and efficiency of use	Filter and sort at the same time	1	ID 1	Regular expert
60	H5: Error prevention	Browsing a restricted community/collection	1	ID 6	Non-expert
61	H4: Consistency and standards	Two search boxes in homepage	1	ID 4 ID 10	Both non-experts
62	H5: Error prevention H9: Help users recognize, diagnose, and recover from errors	Error messages are not separated from the text	1	ID 4	Non-expert
63	H6: Recognition rather than recall	Search “This collection” option.	1	ID 10	Non-expert
64	N/Y	“Back” button while viewing an item	1	ID 11	Regular expert
65	H2: : Match between system and the real world	Symbols produced while browsing by author	1	ID 10	Non-expert
66	H2: : Match between system and the real world	RSS feeds	1	ID 10	Non-expert

Table 18. List of cosmetic problems

Some example of the uncovered problems in this category are presented as follows:

Problem 57: “Discover” option. Evaluator ID 10 found that the title “discover” box in the homepage should be changed. The problem violates H4: consistency and standards while I think the problem violates H2: match between system and the real world because there is a browse option above it already. It would be more helpful to make it clearer that the system suggests some filters instead of the Discover option. Evaluator ID assigned 1 as a severity rating for the problem which is a cosmetic problem that can be fixed only if there is an extra time in the project

Snapshot of problem 57:

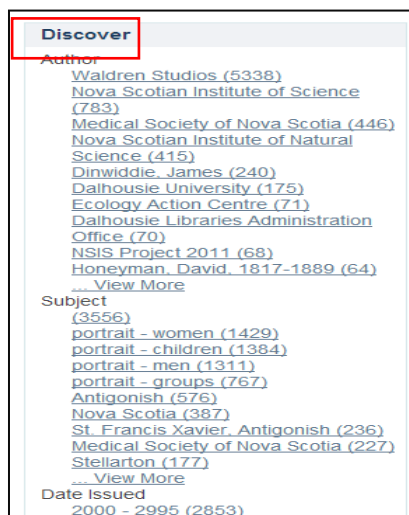


Figure 18. “Discover” option

Suggested solutions: Evaluator ID 10 recommends changing the title “discover” into “suggested filters”.

Problem 58: “Files in this item” header. Evaluator ID 13 raised a question for the header “files in this item” above the document. The question is “what is item? It could be number of files or just one!!” Evaluator ID 13 thinks that this problem is a cosmetic problem that can be fixed only if there is extra time in the project.

Suggested solutions: Evaluator ID 13 suggests “using another term may help” or “a plan listing of the document –“fulltextdoc”.

6.2.5.5 Not Usability Problems

Problem number	Heuristic violated	Problem description	Severity rating	Which evaluator	Evaluator expertise
67	Not a usability problem	File “icon” is generic	0	ID 10	Non-expert
68	Not a usability problem	Inconsistence date format displays	0	ID 13	Regular expert
69	Not a usability problem	Crowded Homepage	0	ID 10	Non-expert

Table 19. List of ‘not usability problems’

Some example of the uncovered problems in this category are presented as follows:

Problem 67: File “icon” is generic. Evaluator ID 10 found that the file icon in the view item interface is generic and not matching the type of the document. However, I noticed that some of the documents match the type of the document. For example, when the file is a picture, the file icon is JPEG image. Evaluator ID 10 thinks that this is not a usability problem with severity rating 0.

Snapshot of problem 67:



Figure 19. Generic file icon

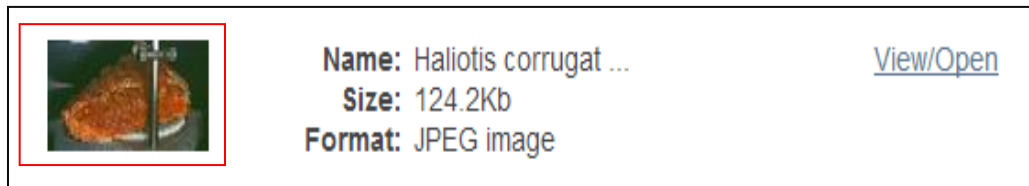


Figure 20. File's icon matching the document type

6.2.6 Summary of the Results

To summarize the results, I would address the initial hypotheses to compare with what I found. It was hypothesized that applying the heuristic evaluation to DalSpace user interface would provide

suggestions to improve the usability of the user interface and encourage users to use the library services. The suggestions are based on a list of usability problems that would be provided to the development team. The priority of fixing the problems can be assigned by investigating the frequency of each violated heuristic.

I found that applying the heuristic evaluation on DalSpace produced a large number of usability problems that will improve the service if fixed. The findings from the heuristic evaluations study suggest a list of usability problems classified depending on their severity ratings which start with catastrophic problems with severity rating 4; major problems and severity rating 3; minor problems with severity rating 2 and the cosmetic problems that have the least severity at 1. The last group is 'not usability problems' with a severity rating of 0. Section 6.6 contains a full description of the problems in all categories which will be provided to the development team to improve DalSpace. Applying the heuristic evaluation method is proved effective in uncovering the usability problems in IRs interfaces.

Further questions address the application of heuristics in this context. Two key aspects are investigated: Does the expertise and number of evaluators affect the reliability of the results from applying the heuristic evaluation to DalSpace user interface?

To answer the first of those general questions we consider the following hypotheses:

- Severe problems will be uncovered by experts, while the minor problems will be uncovered by novices.
- Difficult problems can only be uncovered by experts and easy problems can be uncovered by both experts and novices.
- The best evaluator will be an expert.
- As Nielsen and Molich (1994) reported for the traditional heuristic evaluation, experts will tend to produce better results than novices.
- The average of number of problems uncovered by experts and novices will differ (i.e. the mean number of problems found will differ significantly). Furthermore, experts are expected to find more problems than novices (i.e. the test for difference of means will be one-tailed).

To answer the second of those general questions, does the number of evaluators affect the reliability of the results, we consider the following hypotheses:

- A small set of evaluators (experts) can find about 75% of the problems in the user interface as Nielsen and Mack (1994) suggest.
- More serious problems will be uncovered by the group (experts or non-experts) with the most members.

To communicate the initial hypotheses with the findings, I examined the evaluators' performance according to three factors: the number of problems found by each evaluator and the severity of the uncovered problems. In terms of the number of problems, I found that following the heuristic evaluation method helped evaluators to uncover a large number of problems. However, the interface might have more problems that were not uncovered by the evaluators. I found that the average of problems found by experts is 5.44, while the average number of problems found by novices is 4.57. This contradicts Nielsen's (1990) prediction that the difference between the experts and novices should be statistically significant. Relating to the initial hypotheses that experts tend to produce better results than novices, the results suggest that the difference between the two types of evaluators is not statistically significant.

Moreover, the best evaluator among the group of evaluators (both experts and novices) is a novice who found 21% of the total number of problems. The best expert found 13%. This contradicts the initial hypothesis that the best evaluator will be an expert. From this point, I conclude that only one evaluator cannot find all the usability problems even if this evaluator is an expert which agrees with Nielsen suggestion (1994) that it is advisable to have more than one evaluator to inspect the interface. Compared to Nielsen's finding, one evaluator can find 35% of the usability problems in the user interface while, from the study findings, 21% of the total number of problems was uncovered by the best evaluator.

To this end, I shifted my attention to the type of problem uncovered by experts and novices. I found that experts uncovered serious problems (34 serious problems) more than novices (32 problems) who uncovered most of the minor problems. I conclude that the majority of the problems found by experts were serious (catastrophic and major). On the other hand, novices tended to uncover cosmetic and minor problems. Both groups discovered about the same number but the problems differed in their focus. This is consistent with Nielsen's (1990) suggestion and the initial hypothesis that hard problems uncovered by experts. That is, one cannot rely on novices to uncover all types of problems. The third aspect I examined is the ability to uncover difficult problems, which was hypothesized that they can only be uncovered

by experts, and easy problems can be uncovered by both experts and novices. I found that both experts and novices can uncover difficult problems. Therefore, I concluded that the ability of novices to find problems can be as high as that of the experts which contradicts the initial hypothesis.

Evaluators inspected DalSpace interface according to a set of heuristics (usability principles), I discussed how frequent each heuristic was violated. I found that Heuristic 4 (consistency and standards) and Heuristic 8 (aesthetic and minimalist design) were most often detected: Heuristic 4 was detected 14 times and Heuristic 8 was detected 13 times. The least frequent one is Heuristic 6 which was detected in only minor and cosmetic problems. I suggest starting with the most severe problems that violate certain heuristics. Precisely, the recommended priority levels for violated Heuristics starting by problems associated with heuristic 4, 8, 3, 5, and 7 respectively. This has helped us to assigned priority to the problems that the development team should start with besides the severity ratings of each usability problem.

Finally, I had a situation that two or more evaluators uncovered the same problems but assigned different severity ratings to the problems. I considered them as new problems and leave the decision to the development team. Therefore, these different severity ratings are not adjacent for most duplicates (i.e., they are *not* 1 and 2, or 3 and 4). However, I might recommend what regular experts have assigned for each problem.

6.2.7 Critique

In this section, I discuss the issues that are related to both the study's methodology and results. The most important problem after conducting the evaluation study is that no prior testing has been done on DalSpace interface. This heuristic evaluation is the first. Therefore, I could not compare the problems to already examined elements. To deal with this situation, I designed the study to have the evaluators freely evaluate the interface and document any problem they uncover as what anyone would do in the real world. In addition, I have used the results from the User Profiles study (Chapter 4) to create focused task scenarios.

In terms of having the evaluators inspect the interface freely, I tried to provide them with two choices; the first one is to evaluate the interface without guidance. The second choice is that I provided them with a list of tasks scenarios, but it was not mandatory to perform. However,

they are not considered as end users, so I provided them with full descriptions of each task and all the steps in order to achieve it, and they can just read it to have clear insights about the system reactions. Some evaluators might need guidance and some are not, so I tried to have plans to assist evaluators in both situations.

Another problem is that I evaluated DalSpace while it is already running the system under the libraries collections. Nielsen (1990) suggests evaluating any user interface while it is on paper prototype. Therefore, it would be better situation when evaluating DalSpace in early stages of the design; however, it is always better to perform the heuristics evaluation at any stage, and would help the services to improve.

6.2.8 My Own Experience

Reflecting on what Karat et al. (1992) found that experts did not need the heuristics in front of them during the evaluation. From my observations during the evaluation study, participants needed to review the heuristics and their explanations. I followed their advice for experts, but I provided them with a list of heuristics and their explanations in hand during the evaluation session. I followed other advice from Loitzl (2006) in providing "an assistant who can give advice during the evaluation." I clearly indicated that if any evaluator had a problem with either the DalSpace interface or the heuristics, he or she should ask for help during the study. Further advice that I have followed from Loitzl (2006) is that the training should not be implemented in the same interface that would be examined to ensure "fresh and unbiased perspective".

The User Profiles study helped me to address end users' needs. Based on the information I gathered and the final Users Profiles, I designed the tasks to cover the main parts that would satisfy their goals. In the problems report, (section 6.2.5) uncovered problems that match the users' needs are addressed. I discussed the situation when there is a link to the results from the 'User Profiles' study, such as Problem 1 when users have difficulties reaching DalSpace because it is listed under Dalhousie online libraries. The Users' profiles describe the demand of users to have direct links on the faculty online homepage. Also, the user profiles represent the typical usage of actual end users. Along with the list of the problems, all types of user profiles will be provided to the development team. What I have learned from that is before any testing regarding usability, end users should be studied because at the end products and services are designed for them.

In terms of evaluators' expertise, I have recruited regular experts, who were specialized in Human Computer Interaction (HCI) as their research area. Novices were recruited, as well. I was interested in the severity of problems that novices uncover. I asked all evaluators to read the heuristics, watch an online lecture with full examples and explanations before they participate. I have created the tutorial lecture, but most evaluator (graduate students) were busy to attend except for 3 evaluators out of 16 (2 novices and 1 expert). Moreover, I provide them with a list of heuristic and descriptions in hand during the whole session. All of these options were provided to the evaluators to help them referring to the right heuristic while they evaluate. From my point of view, this helped them to understand and refer correctly. From the results, I can see that only three problems that were not consider as usability problems, which may lead us to conclude that all the options I provided helped them to learn and apply them correctly. This situation helped me to always have backup plans and be prepared for such situations while conducting further research.

Novice evaluators have some experience with user interface design and Human Computer Interaction field since they have completed the courses. However, I cannot consider them as experts, but I have to address the level of experience they have because it reflected on their ability to find a large number of usability problems. Only two evaluators were completely new to the usability evaluations and DalSpace interface. In this situation, I learnt to decide before hand what type of evaluators to participate. In addition, Nielsen (1994) suggests that the number of evaluators depends on the cost of hiring an evaluator against the cost of uncovered problem. The situation would be totally different if the heuristic evaluation was conducted on different types of institutions.

Reflecting on some situations that I would have done differently is list as following:

- I wish I have designed a post questionnaire to reflect on their experience with the materials and methodology. This would help me to learn from their suggestions in future work.
- I would train evaluators to work at least a week before I conduct any the heuristic evaluation again which will clearly affect the results, from my point of view. This would increase the evaluators' knowledge regarding the tested system. As well, at least one double expert who has experience with DalSpace as a system and has an experience in performing heuristic evaluation.

- I wish I have recruited librarians and trained them on how to apply the heuristics which would increase the results value.
- If I had conducted the heuristic evaluation by myself and produced a report, then compare it to what participants found which add to the value of the results.
- I would increase the time assigned for the training session. The training session was only to help evaluators get familiar with the interface, and I think it was not enough.
- I wish I had interviewed some evaluators who did poorly during the heuristic evaluation session.
- I would use fewer novices and focus on regular experts and at least one double expert.
- Screen recorders should have been used to review evaluators' behavior during the evaluation method. This would help in investigate evaluators' actions or tasks and how the system reacted which would improve the overall results from applying the methodology.

6.2.9 Main Contributions

The main research questions from both research studies should be addressed to discuss the main contributions. The ultimate goal of my research is to investigate an area that has not been seriously studied before which is the usability of DalSpace interface. Two main contributions were derived from this thesis. One on the level of Dalhousie University and the second are to add to the literature review regarding conducting the heuristic evaluation on IRs systems.

First, I have created four main User Profiles that precisely describes potential users groups of DalSpace. This was accomplished by answering four main research questions;

- Who are the users of DalSpace?
- What do they want to achieve using DalSpace?
- What are the problems that users face?
- What should DalSpace provide them with?

The four main Users Profiles would be the start point to investigate the potential end users.

Moreover, a heuristic evaluation was conducted to examine the usability of DalSpace, which is the first study that has been conducted regarding the usability of DalSpace. The heuristic evaluation study was intended to meet the following research objectives;

- To determine the usability problems of Dalhousie Repository Interface “DalSpace”.
- To provide a solutions and guidelines regarding the uncovered problems.

- To provide the development team in Dalhousie University with solid list of problems to be used in the iterative design process for development purposes.

To this end, the main contribution on the level of Dalhousie University is providing the development team with information about the potential users groups and the list of usability problems that would increase the acceptance of DalSpace.

Second, the contribution that adds to the literature review in Chapter Two is that I have used the User Profiles to designed focused task scenarios to guide evaluators who prefer to have a list of tasks scenarios. In addition, I asked evaluators to suggest solutions, which add to the efficiency of the method, and describe precisely where does the problem exists. This has helped me to discuss and have screen shots of the problem which produces more precise problems' report. Moreover, the original method is to have the evaluators perform the evaluation in one session. Instead, I have divided the study into four main sessions, training session, evaluations session, severity rating session, and the suggested solution session. I have done the study in this way in order to help evaluators get familiar with the interface, assign accurate violated heuristics, appropriate level of severity and suggest some solutions, respectively.

By reflecting back on the usability methods summarized in Chapter Two: The literature review, there are differences and similarities that I have found by comparing to their results to the findings. First of all, Qing and Ruhua (2008) point out the benefits from conducting usability evaluation on the Discipline Repositories include understanding the target users' needs. The 'User Profiles' study has helped the research to creating profiles that precisely describe users needs, goals, tasks, and problems. Adding to the benefit of having a list of problems that users suffer from, we have clear insights on the potential end users which would help in future user research.

Second, Calvi (2008) reports that results from the usability evaluation to a DSpace (IR) are concerned about the lack of feedback. This is exactly what we have found as described in Problem 28 and Problem 49 as the system lacks providing feedback, especially in typing wrong entries. Moreover, Calvi in her report (2008) suggests that some of the system actions should be automated which would help users to avoid making errors. Compared to our results, evaluators found that s filters buttons should be automated to speed up the the search results. For example, in Problem 26 users have to click on the "Update" button to refine the search results and apply changes. Another suggestions that we share is that early involvement of the users in

the design process would laminate some problems, which agrees on some of the difficulties that we have found because it is already running system.

Additionally, Caccialupi et al. (2009) focused on only two interfaces in the B@bele archive which include the discovery and submission interfaces. The reason behind focusing on only these two interfaces is the result of many usability evaluations and users testing that have been conducted on the interface. Compared to our finding, I found that some heuristics were violated more often than others which will help us gain focus on the further research as the case in Caccialupi et al. research. Finally, our finding aligned with Hovator et al. (2002) findings to reveal that evaluators found difficulties regarding the search function which did not reach their expectations. For example, Problem 14 uncovers difficulties in searching for a keyword while Problem 4 focuses on the random search results. Therefore, users are familiar with search engines that provide them with accurate search results which are what they expect to have.

CHAPTER 7 CONCLUSIONS AND FUTURE WORK

Users Profiles study has been conducted to create user profiles that describe some potential user groups. Four main Users' Profiles describe undergraduate and graduate students (both master and PhD) and librarians. These profiles helped in creating the tasks scenarios to focus on some elements in order to address their needs. The results from this study will be provided to the development team along with the list of problems produced from the heuristic evaluation study. The list of problems is divided into categories depending on their severity ratings. One of the limitations of the user profiles study is the sample population. The focus group meeting was conducted by students at the Faculty of Computer Science. The sample population should have included students from different departments to represent these user groups. Our methodology suggests using the user profiles along with the heuristic evaluation approach which adds to the literature. In addition, the studies conducted on DalSpace are the first of kind because there is not much testing has been conducted regarding either the DalSpace usability or users.

Heuristic evaluation should be the first step to test the usability of the user interface in order to build on the results for further research. The results from the heuristic evaluation should be supported with user testing, and the expertise of evaluators should be reassessed according to their qualifications. Another major limitation in conducting the heuristic evaluation approach is the lack of analysis on monitoring how many times each task was used, by which evaluator, and if performing these tasks have an effect on the results. As mentioned in the online article “Heuristic Evaluation vs. Laboratory Testing” (accessed 2013) is that if the heuristic evaluation has not been done first, ten participants in a laboratory test might spend most of the session time having difficulties with some obvious usability problems. More importantly, the heuristics that were violated the most as a result from the evaluation study should be used to design some specific tasks that can be tested by conducting user testing.

The development team in the Dalhousie library should perform the heuristic evaluation and have a list of problems that can be considered as known usability problems. This list can be used as the base to support further usability research on DalSpace. The benefit is to have more usability testing could be derived and compared to the list of known usability problems in DalSpace interface. Moreover, after having the information needed and the experience gained from the study, new heuristics that are specially designed for the DalSpace interface should be tested. Heuristics about the most important aspects in the interface should be created to be

examined more such as the depositing process and searching tasks. In addition, a second heuristic evaluation should be performed after creating new heuristics that are focused on only DalSpace elements.

Examining the admin interface in DalSpace was out of my thesis scope because it targets different users groups that I have not investigated in the User Profiles study. I will continue to examine the admin interface, but I would first gather some information to form the User Profiles about potential user groups who would use the admin interface such as, graduate studies, archive, and the administrative departments.

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APPENDIX A The List of Attributes Discussed in the Focus Group Meeting-User Profiles, derived from (Kuniavsky, 2003)

Demographic information	<ul style="list-style-type: none"> • Concerning the particular user group. Age, gender, culture, what's their mother tongue primary language? • Does their culture affect the way that they would use the website?
Technological	<ul style="list-style-type: none"> • Is the users' technological background important? Why?
Web Use	<ul style="list-style-type: none"> • Their <u>experience</u> with browsing websites and interfaces. <ul style="list-style-type: none"> ○ How long have they been doing this? ○ How often do they do this? • <u>Typical tasks</u>: <ul style="list-style-type: none"> ○ What do they do on the web? How often?
The environment	<ul style="list-style-type: none"> • <u>Use location</u>: <ul style="list-style-type: none"> ○ Is the service is going to be used from home? from the office? • <u>Use time</u>: <ul style="list-style-type: none"> ○ When are they going to use the service? For long, short time or even once? ○ Can they have some copies from the material? Or borrow them? • <u>Competition</u>: <ul style="list-style-type: none"> ○ What are other repositories that offer the same services?
Goals	<ul style="list-style-type: none"> • There is a reason why people use the repository website. They are trying to accomplish something. Short and long term goals help in understanding users' behavior and attitude toward the services. • <u>Short Term</u>: <ul style="list-style-type: none"> ○ What problems are your users trying to solve? ○ Does this service meet users' expectations in finding what they are looking for? • <u>Long Term</u>: <ul style="list-style-type: none"> ○ Is offering this kind of service a benefit for Dalhousie as a whole?
Motivation	<ul style="list-style-type: none"> • Why are users using the repository website? • Is using the website mandatory or optional in reaching the content they want?
Pain	<ul style="list-style-type: none"> • Are they still using the website even with having some problem? • Are these problems sever or minor? • Do they have to use the website to get the content even with severe problems? • Are there any movements toward improving the services? • What do you think is the most serious problem that they face during performing the tasks?
Needs	<ul style="list-style-type: none"> • <u>Functional</u>: <ul style="list-style-type: none"> ○ What are the features that the repository website offers? ○ Do they meet users' needs? • <u>Reasons</u>: <ul style="list-style-type: none"> ○ Why are they using the service? ○ What do you think is making them stick with it?
Knowledge	<ul style="list-style-type: none"> • <u>Domain and product knowledge</u>: <ul style="list-style-type: none"> ○ How much do the users know about the repository website and its services? ○ Are they professionals or amateurs? ○ Do they know about their options if they have any? • <u>Competitive awareness</u> <ul style="list-style-type: none"> ○ Are they aware of other repositories? ○ Are Dalhousie students allowed to use other universities repositories and what are they?
Usage	<ul style="list-style-type: none"> • Will users need to do some research before they use it? • Do they need tutorials? • Do they need to do that every time they want to use a feature or only once before using it in general?

**APPENDIX B Interview Questions Manipulated to Cover the Same Attributes Discussed
in the Focus Group Meeting**

1. Have you ever used DalSpace?
2. Who else do think would use the DalSpace?
3. How long have they been using the repository website? How often?
4. When you use DalSpace what do you want to perform? What type of tasks?
5. What do they do on the web “typical tasks”? How often?
6. Do you face some problems? What are they?
7. What is your primary language? Does it affect the way that you surf the website?
8. How are you aware of other repositories? Are Dalhousie students allowed to use other universities repositories? What are they?
9. What are other repositories that offer the same services?
10. Why do you think other users are using the repository website?
11. Is using the website mandatory or optional in your case (.....) reaching the content they want?
12. What are the features that the repository website offers?
13. Do you think that using the DalSpace from home or from an office has deference?
14. Do they need tutorials?
15. Do they need to do that every time they want to use a feature or only once before using it in general?
16. Is offering this kind of service benefit Dalhousie as a whole?
17. Are you still using the website even with having some problem? Are these problems sever or miner?
18. How much do the users know about the repository website and its services?
19. Do you remember any stories of situations that happened to you or to other users?
20. Are Dalhousie students allowed to use other universities repositories what are they?
21. Any other comments that you would like to add?

APPENDIX C List of Task Scenarios

Search refinements (scope, filters, sort options)

Task # 3 < Search-Scope>

Goal	The goal of this task is to refine the search by choosing the desired scope from the drop menu to choose community or collection.
Type	Regular Task
Assumptions	Some of the search results do not appear automatically. Users must click on the some buttons to perform the task, such as GO button.
Steps (use case)	<ol style="list-style-type: none"> 1- Type in a key word to search about and hit GO button. (Task #1) 2- The system automatically displays the search results interface. 3- The interface contains some search refinement options. 4- The user will choose a search scope from the drop menu. 5- The user has to click on GO button to get the results after refinement. 6- The system does the changes and displays the search results. 7- The user needs to scroll down to see the results because there are some other refinement options in the top of the page.
Possible Problems	The user might think that as soon as they choose the refinement option the new search results would appear.
Scenario	Now you know how to perform a simple search task. You want to refine your search results and focus on only specific community which is “Faculty of Computer Science”.
Notes	<ul style="list-style-type: none"> • This task can be performed with task 1. It is up to the user if he or she wants to refine the search from the start point (all at once). • Users are using the public interface. No need to log in at this point.

Task # 4 < Search-Filters >

Goal	The goal is to add some filters to the search results either before exploring search results or after.
Type	Regular Task
Assumptions	The user has to click GO button to show the updated results. The system will not automatically perform the changes after selecting a particular filter.
Steps (use case)	<ol style="list-style-type: none"> 1- Type in a key word to search about and hit GO button. 2- The system automatically displays the search results interface. 3- The interface contains some search refinement options. 4- The user will choose a search filter from the drop menu which contains author, date issued, title and subject. 5- The user has to click on GO button to get the results after refinement. 6- The system does the changes and displays the search results. <p>The user needs to scroll down to see the results because there are some other refinement options in the top of the page.</p>
Possible Problems	<ul style="list-style-type: none"> • The user might think that as soon as they choose the refinement option the new search results would appear.

	<ul style="list-style-type: none"> The filters cannot be applied all of them at once because the user can apply one at a time from the drop menu not text box.
Scenario	After you performed the simple search task, now you need to refine the search to get more precise results. You want to use some filters and refine by the title/date issued/subject/author of the document one at time.
Notes	<ul style="list-style-type: none"> This task can be performed with task 1. It is up to the user if he or she wants to refine the search from the start point (all at once). Users are using the public interface. No need to log in at this point.

Task #5 < Search-Sort options >

Goal	The goal of this task is to sort the search results.
Type	Regular Task
Assumptions	The user has to click APPLY button to show the updated results. The system will not automatically perform the changes after selecting a particular filter.
Steps (use case)	<ol style="list-style-type: none"> Type in a key word to search about and hit GO button. The system automatically displays the search results interface. The interface contains some search refinement options. The user will choose a sort option from the box which contains Results per page, Sort items by relevance, title or date issued, and the ascending and descending order The user has to click on APPLY button to get the results after refinement. The system does the changes and displays the search results. <p>The user needs to scroll down to see the results because there are some other refinement options in the top of the page.</p>
Possible Problems	The user might think that as soon as they choose the refinement option the new search results would appear.
Scenario	After you performed the simple search task. You want to refine the search to get more precise results. You want to apply some options, such as sort by relevance, issue date, title, and order.
Notes	<ul style="list-style-type: none"> This task can be performed with task 1. It is up to the user if he or she wants to refine the search from the start point (all at once). Users are using the public interface. No need to log in at this point.

Download/Open Task:

Task # 6 < Download a file/document>

Goal	To download a file from the repository website.
Type	This is a subtask of all the subtasks 1.1, 1.2, 1.3 that belongs to task #1.
Assumptions	User needs to perform one of these tasks 1.1, 1.2, 1.3 to be able to perform this task.
Steps (use case)	<ol style="list-style-type: none"> The user clicks on the link that he or she is interested in. The system automatically views the document information. The user has to scroll down and click on View/Open link. A pop up window appears asking the user if he or she wants to view the document online or download it.

Possible Problems	N/A
Scenario	Now that you have reached the document that you think you are really interested in, you want to download it and save a copy in your PC/ Laptop in order to read it later or use it in your work.
Notes	The user has the ability to view the document online or download it. At this point user does not have to log in if the document is open to the public and there are no restrictions on it.

Browse Tasks:

Task #7 < Browse communities' collection By Browse Menu “right side of the home page”>

Goal	The goal of this task is to browse and search within a specific community collection using the browse menu.
Type	Important task
Assumptions	<ul style="list-style-type: none"> • User has two options to start browsing any community's collection. • There are no rules to follow. • This task is similar to the search task except the system offers browsing the collections in general.
Steps (use case)	<ol style="list-style-type: none"> 1- The user has to select the first option “communities and collections” from the browse menu in the right side of the Dalhousie repository home page. 2- The system will take the user to a new interface called “Community List” which contains a list of all communities and their sub-communities. 3- The user selects one of these communities. 4- The system offers to browse by the Issue date, author, titles and subjects. The system also displays the community's recent submissions, and search bar.
Possible Problems	The user might get confused when to use the browse menu and when to use the search bars to explore and search within one community because using the search bar offers searching in a specific community.
Scenario	You want to explore/browse specific community collections and have the chance to see the list of all communities and sub-communities.
Notes	<ul style="list-style-type: none"> • This feature helps the user when they know exactly which community he/she wants to search. • I did not focus on how to refine the search or the browse because detailed steps were done in task 1.1.2 in refining the search results. • If the user is interested in a particular document in a specific community, he/she can download it by performing task 1.1.4

Task # 8 < Browse communities' collections by selecting a community from the list in the “left side of the home page” >

Goal	The goal of this task is to browse and search within a specific community collection using community list.
Type	Important Task
Assumptions	<ul style="list-style-type: none"> • User has two options to start browsing any community's collection. • There are no rules to follow. <p>This task is similar to the search task except the system offers browsing the collections in general.</p>
Steps(use case)	<ol style="list-style-type: none"> 1- The user has to select one community from the “Community List” in the left side of Dalhousie Repository home page, which contains a list of all communities and their sub-communities. 2- The system will take the user to a new interface that offers to browse by the Issue date, author, titles and subjects. The system also displays the community recent submissions, and search bar.
Possible Problems	The user might get confused and ask the question why there are two options “Browse Menu and Community List” to perform the same task which is browsing and searching within one community.
Scenario	You want to explore/browse specific community collections and have the chance to refine the search within that community using the community list.
Notes	<ul style="list-style-type: none"> • This feature helps the user when the user knows exactly which community he/she wants to search. • I did not focus on how to refine the search or the browse because detailed steps were done in task 1.1.2 in refining the search results. • If the user is interested in a particular document in a specific community, he/she can download it by performing task 1.1.4

Task #8 < Browsing the repository collection by the issue date>

Goal	The goal is to browse the repository collections by the issue date.
Type	Important Task
Assumptions	The user has to click GO and UPDATE buttons to show the updated results. The system will not automatically perform the changes after selecting a particular filter.
Steps (use case)	<ol style="list-style-type: none"> 1- The user has to select the second option “By Issue Date” from the browse menu on the right side of the Dalhousie repository home page. 2- The system will move to a new interface that contains the documents arranged in ascending order and two drop menus to choose the exact month and year. 3- The user has to select a specific month and year. 4- The user has to click on GO button to update the list of documents. 5- If the user is interested in changing the order from ascending to descending they can from the sort option. 6- The user has to click on UPDATE button to display the changes.

	7- The user has to scroll down to explore the documents.
Possible Problems	The user might think that as soon as they choose the date (a month and a year) the new search results would appear automatically.
Scenario	You want to browse the repository collections by the issue date. To do so, you need to choose a month and a year from the drop menus. Or you can write the year in the text box if you know the only the year.
Notes	N/A

Task #9 < Browsing the repository collection by the author's name>

Goal	The goal is to browse the repository collections by the issue date.
Type	Important Task
Assumptions	The user has to click GO and UPDATE buttons to show the updated results. The system will not automatically perform the changes after selecting a particular filter.
Steps (use case)	<ol style="list-style-type: none"> 1- The user has to select the third option “By Authors” from the browse menu in the right side of the Dalhousie repository home page. 2- The system will move to a new interface that contains the documents arranged in alphabetical order and a drop menu to choose the preferred order (descending or ascending). 3- The user has to enter first few letters of the author's name. 4- The user has to click on GO button to update the list of documents. 5- If the user is interested in changing the order from ascending to descending they can from the sort option. 6- The user has to click on UPDATE button to display the changes. 7- The user has to scroll down to explore the documents.
Possible Problems	The user might think that as soon as they type the first letters the new search results would appear automatically.
Time for expert	1 minute and 30 seconds.
Scenario	You want to browse the repository collections by the authors' names. You need some documents for a particular author and are encouraged to enter first few letters of the author's name to have more precise results.
Notes	There are “letters' links” in the top of the page which allow the user to browse the documents with the author's name that start with these letters.

Task #10 < Browsing the repository collection by the title of the document>

Goal	The goal is to browse the repository collections by the title of the document.
Type	Important Task
Assumptions	The user has to click GO and UPDATE buttons to show the updated results. The system will not automatically perform the changes after selecting a particular filter.
Steps(use case)	<ol style="list-style-type: none"> 1- The user has to select the fourth option “By Titles” from the browse menu in the right side of the Dalhousie repository home page. 2- The system will move to a new interface that contains the documents arranged in alphabetical order and a drop menu to choose the preferred order descending or ascending. 3- The user has to enter first few letters of the document title. 4- The user has to click on GO button to update the list of documents. 5- If the user is interested in changing the order from ascending to descending they can from the sort option. 6- The user has to click on UPDATE button to display the changes. 7- The user has to scroll down to explore the documents.
Possible Problems	The user might think that as soon as they type the first letters the new search results would appear automatically.
Scenario	You are now in the “browse” interface and you want to browse the repository collections by the document title. You are encouraged to enter first few letters of the document title to be more specific if you do not know the whole title.
Notes	There are letters' links in the top of the page which allow the user to browse the documents that the title starts with these letters.

Task #11 <Browsing the repository collection by the subjects>

Goal	The goal is to browse the repository collections by the subject of the document.
Type	Important Task
Assumptions	The user has to click GO and UPDATE buttons to show the updated results. The system will not automatically perform the changes after selecting a particular filter.
Steps(use case)	<ol style="list-style-type: none"> 1- The user has to select the fifth option “By Subjects” from the browse menu in the right side of the Dalhousie repository home page. 2- The system will move to a new interface that contains the documents arranged in alphabetical order and a drop menu to choose the preferred order descending or ascending. 3- The user has to enter first few letters of the document subject. 4- The user has to click on GO button to update the list of documents. 5- If the user is interested in changing the order from ascending to descending they can from the sort option. 6- The user has to click on UPDATE button to display the changes. 7- The user has to scroll down to explore the documents.
Possible	The user might think that as soon as they type the first letters the new search

Problems	results would appear automatically, which is not true.
Scenario	You are now in the “browse” interface and you want to browse the repository collections by the documents' subjects. You want to browse the document within the subject “Human Computer Interaction”.
Notes	There are letters' links in the top of the page which allow the user to browse the documents that the subject starts with these letters.

Task # 12 < Browsing the repository collection by the submit date of the document >

Goal	The goal is to browse the repository collections by the submit date of the document.
Type	Regular Task
Assumptions	The user has to click GO and UPDATE buttons to show the updated results. The system will not automatically perform the changes after selecting a particular filter.
Steps(use case)	<ol style="list-style-type: none"> 1- The user has to select the sixth option “submit date” from the browse menu in the right side of the Dalhousie repository home page. 2- The system will move to a new interface that contains the documents arranged in alphabetical order and a drop menu to choose the preferred order descending or ascending. 3- The user has to enter the month and the year of the submission date. 4- The user has to click on GO button to update the list of documents. 5- If the user is interested in changing the order from ascending to descending they can from the sort option. 6- The user has to click on UPDATE button to display the changes. 7- The user has to scroll down to explore the documents.
Possible Problems	The user might think that as soon as they type the first letters the new search results would appear automatically, which is not true.
Scenario	You are now in the “browse” interface and you want to browse the repository collections by the document submit date.
Notes	There are letters' links in the top of the page which allow the user to browse the documents that the subject starts with these letters.

Account Tasks

Task # 13 <Log In via Net Id Authentication>

Goal	Logging into the system to see the restricted content.
Type	Unusual but Critical Task
Assumptions	To use this option of the log in method, the user has to be a Dalhousie students/member with valid Net Id.
Steps (use case)	<ol style="list-style-type: none"> 1- The user clicks on the login link in the right top of DalSpace main interface. 2- The system automatically moves to a new interface that consists two logs in options. Net Id Authentication and Registered Users Password Authentication.

	<ol style="list-style-type: none"> 3- The user clicks on Net Id Authentication. 4- The system automatically moves to a new interface that asks the user to enter the username and the password. 5- The user has to click on sign in button to log in. 6- The system displays the DalSpace main interface.
Possible Problems	It is important step if the user is interested in submitting a thesis. In terms of the search results.
Scenario	You want to log in to the system to create your own profile to start exploring the collections.
Notes	There is not a clear difference between logging in and exploring the system from the public interface.

Task # 14 <Register as a new user >

Goal	Register as a new user
Type	Unusual but Critical Task
Assumptions	Any user can register to access the collections. The user does not have to be Dalhousie member or student.
Steps(use case)	<ol style="list-style-type: none"> 1- The user clicks on register link in the right of the DalSpace main interface. 2- The system automatically moves the user to “New user registration” interface. 3- The user has to follow a three steps procedure. The first step is to type in the e-mail address that will be used as a username. 4- The second step is to fill the information for the user profile. 5- The user will receive an email that confirms registration.
Possible Problems	N/A
Scenario	You are not a Dalhousie member and do not have a Net ID. You need to register to log into the system.
Notes	End users from around the world can register to explore the content but they can explore most of it from the public interface which draws the attention to the reason behind asking end user from around the world to register.

Task #15 < Log In via Registered Users Password Authentication>

Goal	The goal of this task is log in as a already registered user
Type	Unusual but Critical Task
Assumptions	In order to perform this task, users have to be registered in the system.
Steps(use case)	<ol style="list-style-type: none"> 1- The user clicks on the “Log In “in the right menu at the DalSpace main interface. 2- The system will automatically move the user to a new interface that contains two options: Net Id Authentication and Registered Users Password Authentication.

	<ul style="list-style-type: none"> 3- The user clicks on Registered Users Password Authentication. 4- The user enters a valid e-mail address and a password. 5- If the user forgot the password: go to task 1.3.4 to reset the password. 6- The user has to click on sign in to log in the system
Possible Problems	Users might forget the password. When they do so, they need to click on the link to
Scenario	You are already a registered user and you want to log in to the system.
Notes	Registration is important to allow users to subscribe to collections for email updates, and submit new items to DalSpace.

Task #16 <Password reset>

Goal	To reset the password in case it has been forgotten
Type	Unusual but Critical Task
Assumptions	N/A
Steps(use case)	<ul style="list-style-type: none"> 1- If the user forgot the password, he/she should click on the link “Forgot your password” to go through three main steps to reset the password. 2- First the user has to type in the same address used when registering and click send info button. 3- An email will be sent to the e-mail containing a special URL and further instructions. 4- The user will receive an email “Change Password Request” 5- The user has to click on the link in the received e-mail to follow the instruction 6- The link will move the user to “Reset password” interface that contains the e-mail and two text boxes to fill in with the new password and confirmation (password should be at least six characters long). 7- The user has to click on reset password button to confirm changes.
Possible Problems	They need to have a verified email account to be able to receive the email notice for resetting the
Scenario	The user forgot the password and wants to reset it to be allowed to log in to the system.
Notes	N/A

Submit task

Task # 17< Submission >

Goal	To submit a document and upload it to DalSpace
Type	Not Usual but critical
Assumptions	Graduate students have to use DalSpace to submit their graduate thesis to the Graduate Studies.
Steps(use case)	<ol style="list-style-type: none"> 1- The user has to log into the system. 2- A new link will appear under Account menu called “ submissions” 3- The user has to click on “submissions” 4- The system automatically moves the user to the “Submissions & workflow tasks” 5- The user has to click on start a new submission to start the process. 6- The user has to choose which collection to submit an item to. However, the system does not provide other choices rather than “Faculty of Graduate Students Online Theses” and click NEXT. 7- The system shows the “Describe Item” that user should fill in the information. 8- The system shows two buttons: “Save and Exit” & “ Next” <ol style="list-style-type: none"> 8.1 If the user clicks on Save and Exit, the system moves to a new interface that asks the users to answer this question “Save or cancel your submission?” and provide three buttons: <div style="display: flex; justify-content: center; gap: 10px; margin: 5px 0;"> Oops, continue submission Save it, I'll work on it later Remove the submission </div> 8.2 Oops, continue submission moves back to the submission & work flow to continue. 8.3 Save it, I'll work on it later moves the user to a new interface with statement written “Unfinished submissions” and a box that contains the title, collection, and submitter. 8.4 Remove the submission moves the user to a new interface with the message “Your submission has been cancelled, and the incomplete item removed from the system”. 9- If user chooses “Next”, the system moves to a new interface “Describe Item” that asks the user to enter the title of the theses and abstract, readers, graduate coordinator, the external examiner, and the supervisor(s). 10- The system allows the user to choose between the following : <div style="display: flex; justify-content: center; gap: 10px; margin: 5px 0;"> < Previous Save & Exit Next > </div> 11- If the users decide to continue and clicks “Next” 12- The system move to a new interface while the system shows the progress <div style="display: flex; justify-content: center; gap: 10px; margin: 5px 0;"> Describe → Describe → Upload → Review → License → Complete </div> 13- The system asks the user to upload the files and assign a type of the document.

	<p>14- Then, the system allows the user to add more than one file.</p> <p>15- By clicking on “Next”, the systems moves to a new window that allows the user to review the entered information and confirm it.</p> <p>16- Then, the user will wait for the approval from the graduate studies.</p> <p>17- By getting the approval, the process will reach the last step in it informs the user that the submission is completed.</p>
Possible Problems	The submission link would not appear unless the user is logged in the system.
Scenario	Submit a thesis to the Faculty of Graduate Studies Online Theses.
Notes	If the user has to submit a paper rather than a thesis and does not choose a collection then clicks NEXT, the system does not leave the page and no error message appears.

Restricted Content Task

Task # 18 < Browse a Restricted Content >

Goal	Examine if the user is allowed to browse the restricted content or not and examine the system response.
Type	Critical Task
Assumptions	Users know that the content under this heading is considered as restricted content because it is written in the link of the
Steps(use case)	<ol style="list-style-type: none"> 1. In order to browse a restricted content, the user has to click on “browse communities & collections” 2. Scroll down to the down end of the screen to find a heading “School of Information Management Digital Image Library (Restricted Access)” 3. User has to click on it 4. The systems shows a search interface that offers a text box to type in a keyword and a list of browse options that includes: By issue date, author, title, subject, and by submit date. 5. The user types in a keyword “management”. 6. The system responses with a message written in search results area “Search produced no results.”
Possible Problems	The system does not provide the user with an error message from the point of clicking on the link to browse the content.
Scenario	Browse restricted content and search for the key word “ management”
Notes	The user can follow the same steps to accomplish the tasks wither before logging in the system and after. There is not a different in the system response.

Task # 18 < Browse a Restricted Content within the “Board of Governors Minutes” >

Goal	Examine if the user is allowed to browse the restricted content or not and examine what the system response is.
Type	Critical Task
Assumptions	Users will not be notified about the restricted content until they try to access it.
Steps(use case)	<ol style="list-style-type: none"> 1. The user clicks on Browse communities & collections from the right menu in the home interface. 2. The system displays a list of all communities and sub communities. 3. The user has to scroll down to find “Board of Governors Minutes” link. 4. The user has to click on the link. 5. The system displays a list of the Governors Minutes classified by the year. 6. The user has to scroll down to choose 1984. 7. The system shows an interface with message that says it is a restricted content and the user has to log in the system to be allowed to access the document.
Possible Problems	Users will not know that this is considered as restricted content until they try to access the document.
Scenario	Browse the Board of Governors Minutes that is was issued in 1984.
Notes	Users will be asked to register or log in to have the opportunity to access the document.

APPENDIX D Snapshots of Uncovered Problems

Catastrophic Problems:

Problem 3: Random search results when clicking on GO button without typing a keyword.

Evaluator ID 6 suggests that this problem violates heuristic H3: user control and freedom. The evaluator accidentally clicked on GO button without typing a keyword. The system responded and produced random search results. I think this problem violates H5: Error prevention because the system has to notify the user that he or she would not get any results without typing a keyword. Both GO buttons in the two search boxes in the homepage produce random search results.

Snapshot of problem 3:

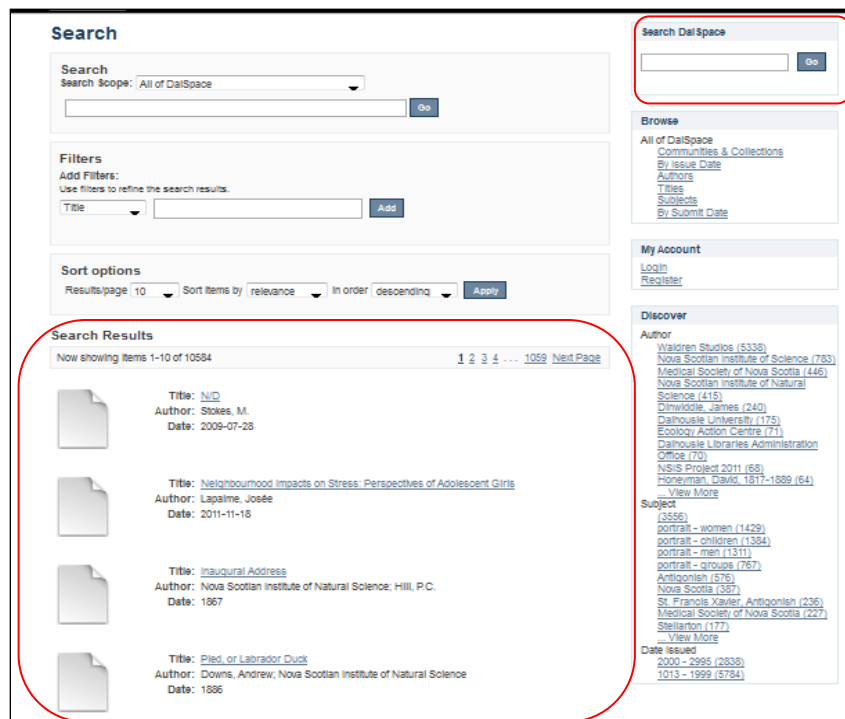


Figure 21. Search results from clicking on GO button without typing a key word

Suggested solution(s): Evaluator ID 6 suggested either an error message that says “enter a keyword” or the system does not move to a new screen with random results. The second suggestion was to freeze the system. From my point of view, suggesting the system to freeze without responding might violate another heuristic, which is H1: visibility of system status

because the system has to keep users informed about the system status by providing appropriate feedback within a reasonable time.

Problem 4: When deleting a submission, the system does not provide an error message.

Evaluator ID 13 created a submission request. When decided to remove the submission request from the list and clicked remove, the system did not warn the user that he or she is about to delete a submission. This reaction violates H3: user control and freedom (from Evaluator ID 6 point of view) while I think it violates H9: help users recover from errors. This is because the system should address the reaction of the system, in my case deleting the submission, and help the user to recover by asking users again to confirm the request or reject it.

Snapshot of problem 4:

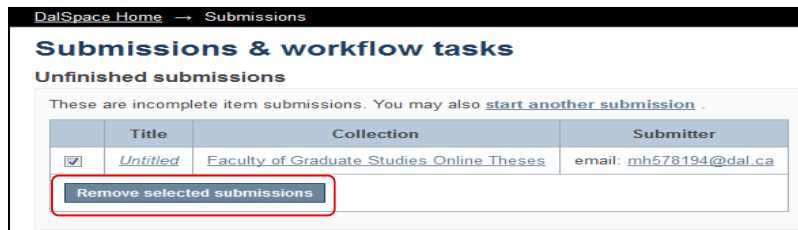


Figure 22. Deleting a submission

Suggested solution(s): Evaluator ID 13 suggests simply provide an error message that help the user to confirm the action. Even though the system asks the user to select the document in the check box, it is not enough to inform users that they are about to delete a submission.

Problem 5: Documentation is not enough. Evaluator ID 3 thinks that having only few introductory lines in the homepage and a link to only one page description of DalSpace is not enough. In addition to what Evaluator ID 3 documented, users should be provided with full description of what DalSpace offers, how they can benefit from the service and when they should search the collections. This problem violates the heuristic H10: help and documentation which would users with their tasks and complete description of all the steps that the user should follow.

Snapshot of problem 5:



Figure 23. Introduction to DalSpace and the help documentation link

Suggested solution(s): Evaluator ID 3 suggests “having video tutorial would be helpful”. This suggestion adds to the results from the User Profiles study. Students both graduate and undergraduate wanted to have tutorial videos about the benefits of using DalSpace and why they should use it.

Problem 6: Introduction to logging and registering. Evaluator ID 14 was confused between logging to the system with a NetID as a Dalhousie member or register as a new member. The system does not introduce the users to these two options with a good description. The evaluator did not know about the opportunity to log in without registering. This problem violates, from Evaluator ID 14 point of view, the H1: visibility of system status in which the system should provide the user with feedback before selecting a choice. Besides heuristic 1, from my point of view, H5: error prevention is also been violated because users might register and wait for the approval while they can log into the system with their NetIDs. Evaluator ID 16 found the same problem and commented “logging is not clear”. The Evaluator, who is non-expert, did not assign a heuristic that would be violated by the problem.

Snapshot of problem 6:

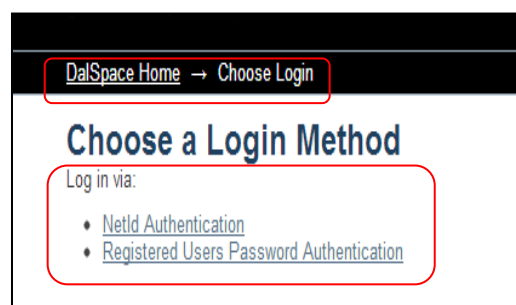


Figure 24. Logging options

Suggested solution(s): Evaluator ID 14 suggests “DalSpace should provide more information in the homepage”. From my point of view, the system should provide a description when the user

select register that they have the opportunity to log in without registering if they are members of Dalhousie University.

Snapshot of problem 7:

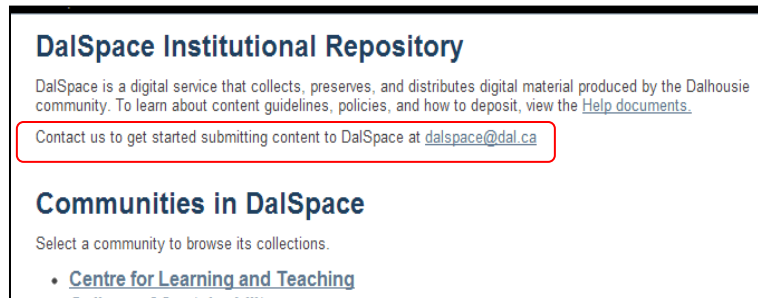


Figure 25. Contact information in DalSpace homepage

Problem 7: Contact information in the homepage. Evaluator ID 3 found that it is unusual to place the contact information “within the text of the homepage”. The evaluator thinks that the contact information should be under “contact us” option. This problem violates H2: match between system and the real world in that the interface provides elements that are not familiar to users.

Suggested solution(s): Evaluator ID 3 thinks that the location of the contact information should be under a tab.

Problem 8: Browse by author name. Evaluator ID 2 noticed that when browsing by author name and typing a name such as James, the system produced a list of publications for other names such as Jami, Janet, “which is not precise because I am only interested in James”. Evaluator ID 10 wrote about the same problem from another point of view-returning with no results. Evaluator ID 11 addressed this problem in which the system produced a list of authors' names, and when clicking on one name, the evaluator noticed that the document does not belong to the author. Therefore, browsing by an author name return no results, not precise results or the document's author does not match the author name link produced by the browsing results. Evaluator ID 2 suggests that this problem violates the heuristic H4: consistency and standards in which the system should follow the “platform convention”.

Snapshot of problem 8.1:



Figure 26. Browse by an author name

Snapshot of problem 8.2:

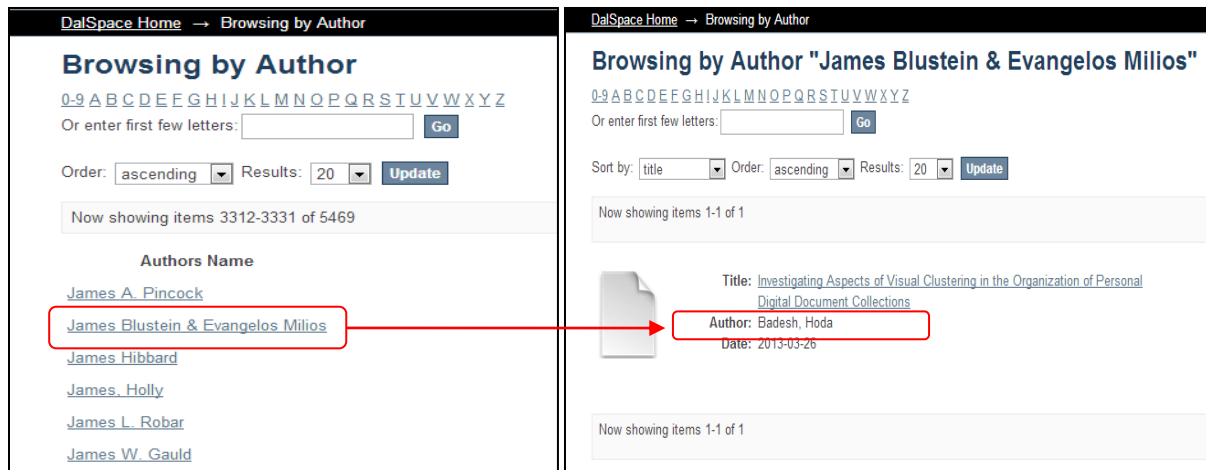


Figure 27. Browse author's name not matching

Suggested solution(s): Evaluators ID 2 and 7 think that this is a technical issue that has to be fixed. This problem would affect the level DalSpace efficiency. From my point of view, the system shows the supervisors of a thesis as authors without indicating that clearly. This is what confused evaluators. The system should provide the user with an explanation that the supervisor of a thesis is considered as an author in the browsing results.

Problem 9: Browse by subject. Evaluator ID 11 noticed that browsing by subject produces results that differ from search the same keyword. Evaluator ID 11 wrote, “when I selected browse subject “Nova Scotia” on the right column of DalSpace home, I can see there are 382 items to be found. However, when I entered the same keyword “Nova Scotia” in the filter, it

displays 924 items. Confusing !!” The evaluator was confused by the two different results. This problem violates the H4: consistency and standards.

Snapshot of problem 9:

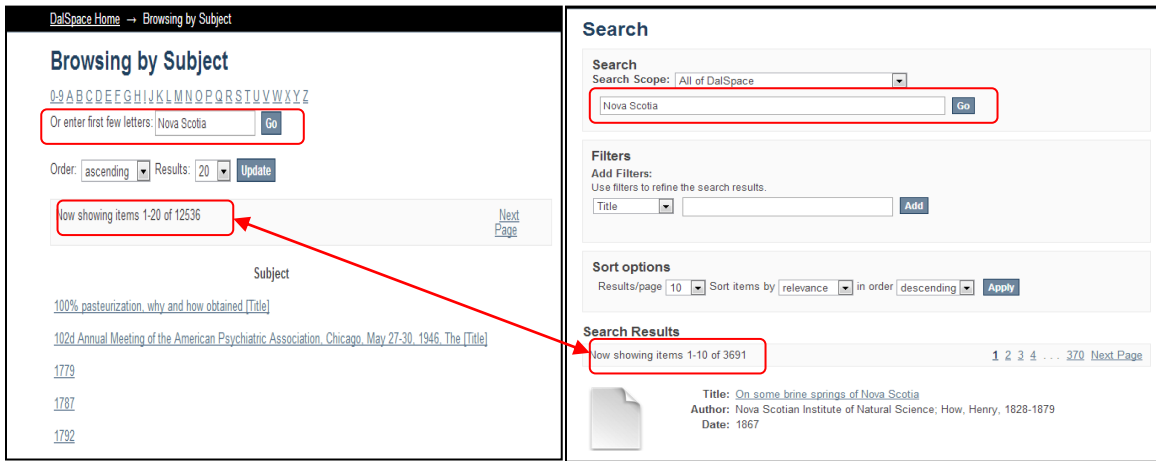


Figure 28. Variation in the results by browsing a subject and searching the same subject.

Suggested solution(s): Evaluator ID 11 suggests that it is a technical problem that should be fixed. From my point of view, this affects the level of DalSpace efficiency regarding browse and search results.

Problem 10: More filters are required while browsing by date. Evaluator ID 2 noticed that the filters are not enough while browsing by date. “For example, if I am only ‘interested’ in theses while browsing by date so there should be some filters” Evaluator ID 2 documented. Users can only refine the browsing results applying a sorting features and typing the year, which evaluator ID 2 noticed are not enough. This problem violates the heuristic H7: flexibility and efficiency of use.

Snapshot of problem 10:

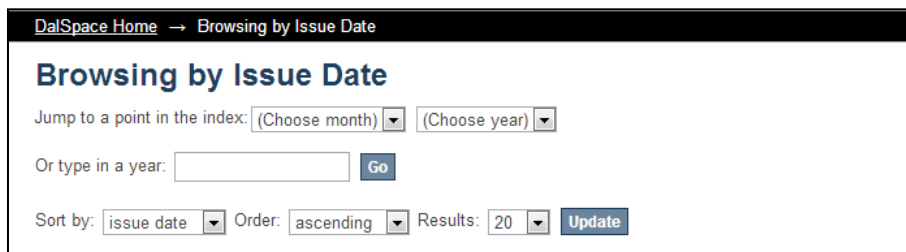


Figure 29. Browsing by issue date sort options

Suggested solution(s): Evaluator ID 2 documented that this problem is a technical problem and more filters should be added.

Problem 11: Browse a restricted community. Evaluator ID 13 tried to access the collection “Atlantic Centre of Excellence for Women's Health” and the system showed an error message written twice in the webpage. This error message says “You do not have the credentials to access the restricted community “Atlantic Centre of Excellence for Women's Health”. This problem violates the heuristic H5: Error prevention in which the system should provide a better design instead of preventing errors occurrence from the begging. From my point of view, this problem violates H9: Help users recognize, diagnose, and recover from errors in which the error message should explain why the collection is restricted, and for whom would this collection be restricted. It is important to note that the system provides a link to log into the system in order to view the restricted content. This creates a new problem because after logging to the system. The system again shows the same error message which makes no sense for asking the user to log in to see the content.

Snapshot of problem 11:

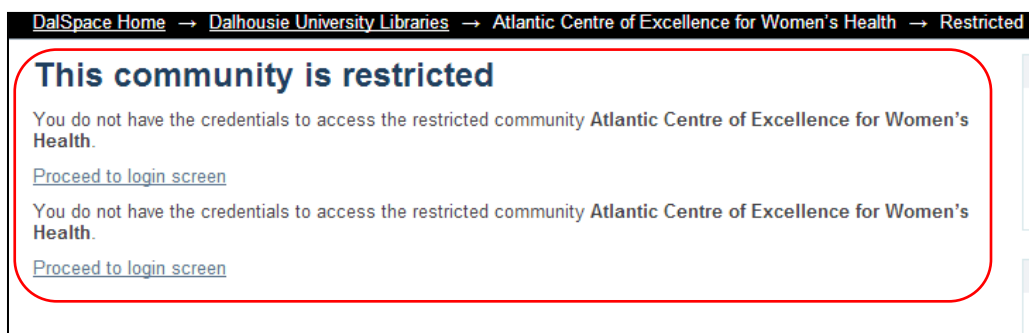


Figure 30. Browsing a restricted collection/community

Suggested solution(s): Evaluator ID 13 suggests two solutions to the problem. First, the system should “disable/gray out the links to the restricted content, so users cannot click and land on restricted page”. Second, “the error message should appear only once”.

Problem 12: Browse an empty collection. Evaluator ID 7 found that when the collection or community is empty “does not include any documents”, the system “still shows filters at the top” and the error message “Sorry, there are no results for this browse” is “easily lost as it is in plain text and visually dominated by the filters above”. This problem violates H8: aesthetic and minimalist design in which the system includes some irrelevant parts in the design. Moreover,

the problem violates H9: help users recognize, diagnose, and recover from errors for the plain text error message.

Snapshot of problem 12:

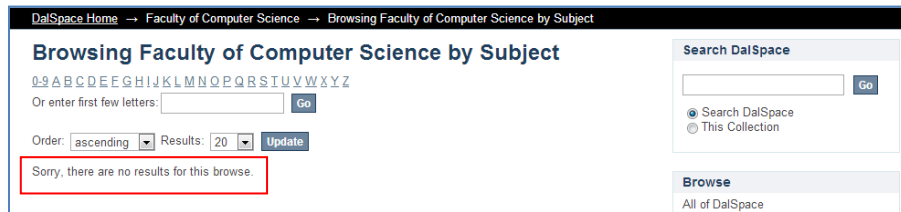


Figure 31. Browsing an empty collection by subject filter

Suggested solution(s): Evaluator ID 7 suggests removing the filters when the collection does not have documents. In addition, provide an error message that shows “this collection is empty” written in bold.

Problem 13: “View more” link while discovering authors and subjects in the homepage.

Evaluator ID 10 found that following the link “view more” in the homepage is leading to a page that does not apply any search features or filters. In other words, the system “hides search results and the other options”. The problem violates H4: consistency and standards in which the system should not surprise users with actions that they do not expect and follow the “platform conventions”.

Snapshot of problem 13:

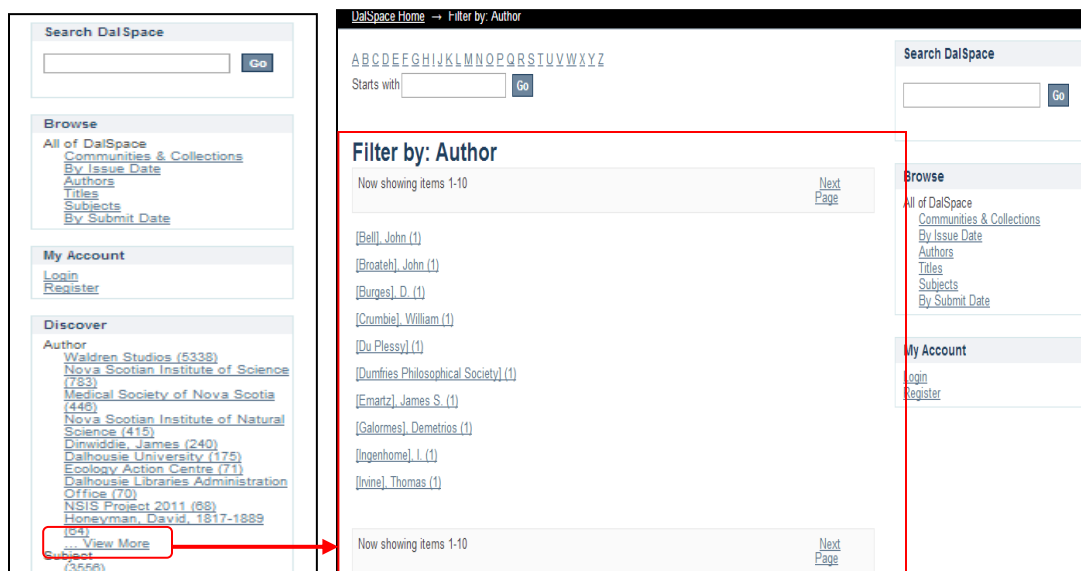


Figure 32. View more option

Suggested solution(s): Evaluator ID 10 recommends providing all the other options when the user follows the link.

Problem 14: Search a keyword. Evaluator ID 14 noticed that searching with a keyword “mobile navigation” the system provides search results that are not relevant. This affects the efficiency of searching for a key word using DalSpace which participants from the first study “the User Profiles” both graduate students master and PhD students want to have precise search results. The first document in the search results list has a “mobile” as a key word, and the second document has “navigation”. This problem violates H1: visibility of the system status in which the system should provide more precise results. In addition, Evaluator ID 15 documented the same problem while searching for “web design”, he/she did not find a document that has the two words together.

Snapshot of problem 14:

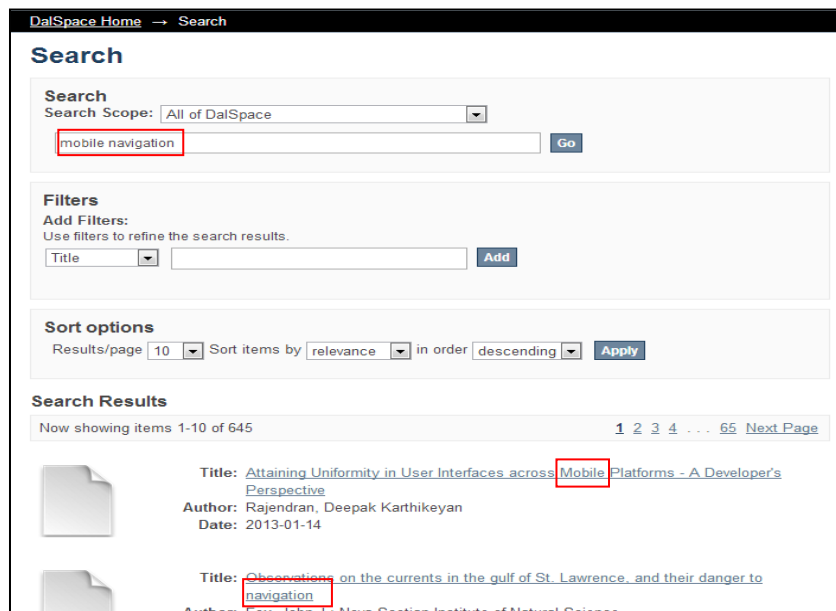


Figure 33. Search results

Suggested solution(s): Evaluator ID 14 considers the problem as a functional problem that has to be fixed. However, I think it might be useful to highlight or bold the key words in the title of documents produced by the search. In addition, the search results list should start with the most relevant document by matching the keywords entered with the key words of the title or tags associated with the document.

Problem 15: View abstracts. Evaluator ID 3 noticed that in order to read the abstract, the user has to click on the document title that leads to the abstract. The evaluator was wondering if users can just read few lines from the abstracts as the case in “IEEE database” from the search results page. This problem violates the heuristic H2: match between system and the real world in which users should be familiar with having abstracts for publications without following the document link. The search results “documents” have only the title, author's name, and data.

Snapshot of problem 15:

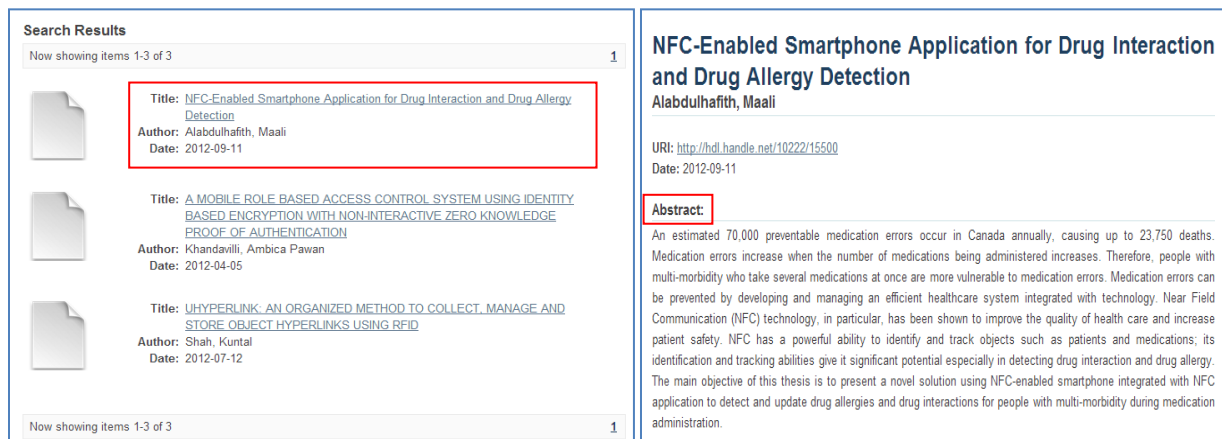


Figure 34. View abstract from search results documents

Suggested solution(s): Evaluator ID 3 recommends “abstracts should be under the suggested titles without clicking on the title link to see the abstract.” From my point of view, this would help graduate students as discussed in the “User Profiles” study in enhancing the graduate students' experience while using DalSpace for their academic work.

Problem 16: Search keyword removed automatically from the search bar. Evaluator ID 5 noticed that when typing a keyword in the search bar and clicking on the GO button, the system automatically removes the keyword from the search bar. This problem violates the heuristic H7: flexibility and efficiency of use in which users have to retype every time they want to perform a search task.

Snapshot of problem 16:

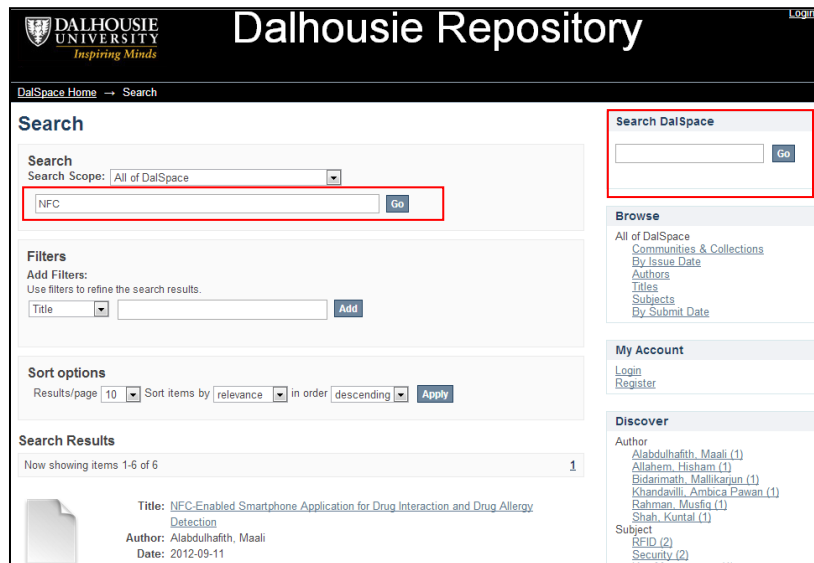


Figure 35. Keyword is removed automatically after producing results

Suggested solution(s): Evaluator ID 7 recommends following what other search bars do. This would save users' time in retyping the same search keywords if users want to apply some change on the keyword.

2. Major Problems

Problem 20: Irrelevant search results. Evaluator ID 12 mentioned that he/she “Could not decide whether the search consisted of desired item”. This affects the efficiency of searching for a key word using DalSpace which participants from the first study “the User Profiles” both graduate students master and PhD students want to have precise search results. The first document in the search results list has a “mobile” as a key word, and the second document has “navigation”. This problem violates H1: visibility of the system status in which the system should provide more precise results. Evaluator ID 16 found the same problem and documented the results are not relevant and contains some professors' profiles” and “some of the articles are not related to the keywords at all”. Evaluator ID 16, who is a non-expert, did not assign a heuristic to the problem.

Suggested solution(s): Evaluator 12 did not provide any suggestions. However, I think it might be useful to highlight or bold the key words in the title of documents produced by the search. In addition, the search results list should start with the most relevant document by matching the keywords entered with the key words of the title or tags associated with the document.

Problem 21: Scrolling down to view the search results. Evaluator ID 7 documented that the amount of search results view is affected by the filters above. Evaluator added that users have “to scroll down to see more than 2 or 3 items”. The search refinements take half of the page from the top. Evaluator ID 13 documented the same problem in which filters take half of the screen and users needs to scroll down to view the list of results. This problem violates H4: consistency and standards in which the system should follow the usual style of producing results. Another heuristic is violated which is H8: aesthetic and minimalist design in which extra elements in the design affect the visibility of more important parts in the web page design.

Snapshot of problem 21:

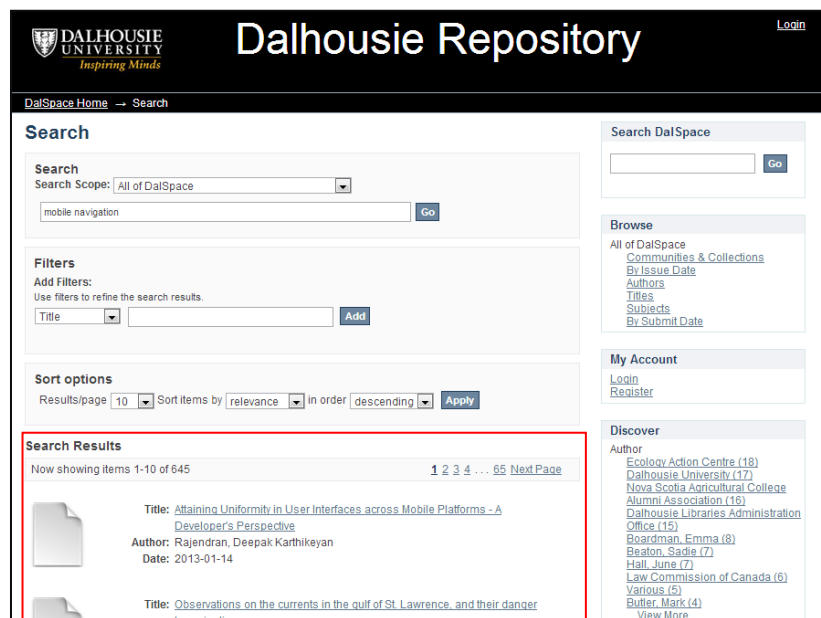


Figure 36. Search results placement

Suggested solution(s): Evaluator ID 7 recommends moving the filters to the side bar in order to allow results fill extra space. Moreover, Evaluator ID 13 suggests that making the search results is the main part of the results page is important. In addition, moving the search refinement into the right would be helpful to add more space for results.

Problem 22: “Previous” button in uploading a document for a submission. Evaluator ID 1 had a problem in the item submission process. In the upload file step, he/she could not use the previous button. Clicking on the “previous” button was not moving the evaluator to the previous step. The system kept refreshing the page. This problem violates, from the evaluator point of view, H7: flexibility and efficiency of use. From my point of view, I think the problem has

violated the H3: user control and freedom in which the system should support the undo/redo action while performing an important task such as item submission. This problem connects to what I found from the previous study “User Profiles” when the PhD student had some problems while submitting which should be given high priority. Fixing this problem is essential because the only way to submit a thesis to the graduate studies is through DalSpace.

Snapshot of problem 22:

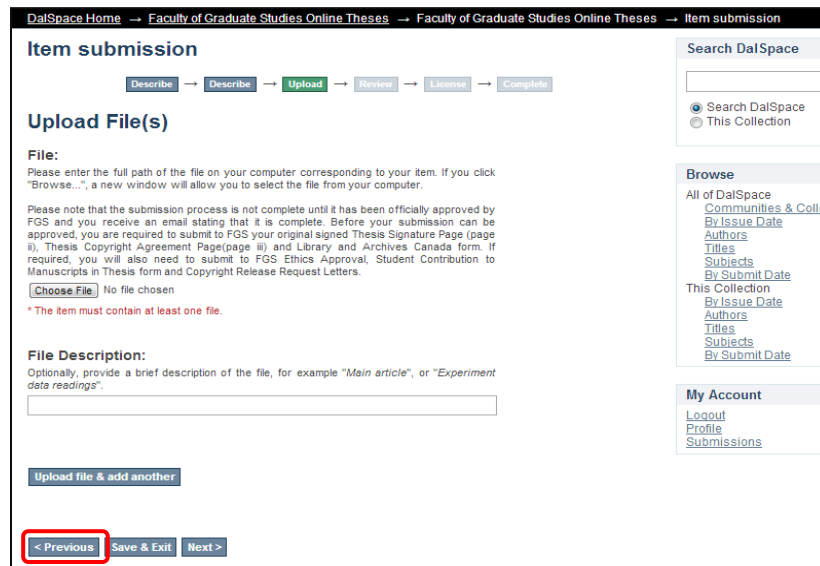


Figure 37. “Previous” button in item submission

Suggested solution(s): Evaluator ID 1 suggests that this is a functional problem that has to be fixed.

Problem 23: Browsing by collection produces a long list of communities and sub-communities. Evaluator ID 10 commented on the design of the web page that users can browse collections. Evaluator added “lots of bold and underlines”. When users click browse by “Communities & Collections”, the system lists all the links to communities and sub-communities. Users have to scroll down to browse all communities and collections. The problem violates H8: Aesthetic and minimalist design.

Snapshot of problem 23:

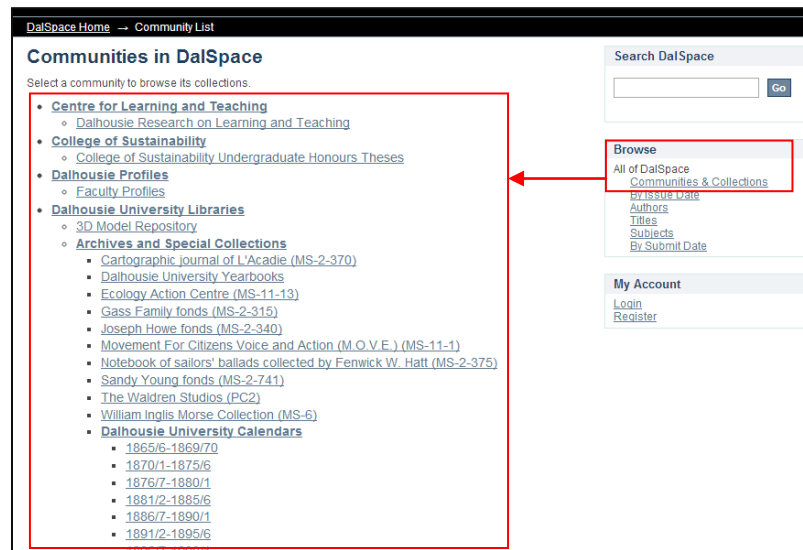


Figure 38. Browsing by collection produces a long list of communities and sub-communities

Suggested solution(s): Evaluator ID 10 suggests having only titles of communities and collections and providing local filters to explore the sub-communities/collections. In addition, removing the bold links and make them lighter.

Problem 24: Scope and filters while searching. Evaluator 10 noticed that applying the scope and filters at the same time requires a lot of interactions. This problem violates two heuristic from the evaluator point of view, H3: user control and freedom and H7: flexibility and efficiency of use.

Suggested solution(s): Evaluator ID 10 recommends having a global button that says “apply changes” would help the users speed up the searching process.

Problem 25: “Back” button while viewing an item. Evaluator ID 7 noticed that the system does not support a “back” button to go back to the search results except the back button in the browser. Evaluator ID 9 documented the same problem “the only way I can go to previous results is the “back” button”. The problem violates H3: user control and freedom, from the Evaluator ID 7 point of view. The system should support the undo button not only by the browser but also by the system design. However, the user might try to click on the path “breadcrumb”, but the system will replace the results by Recent Submissions..

Snapshot of problem 25.1:



Figure 39. No “back” button to return to the search results

Snapshot of problem 25.2:

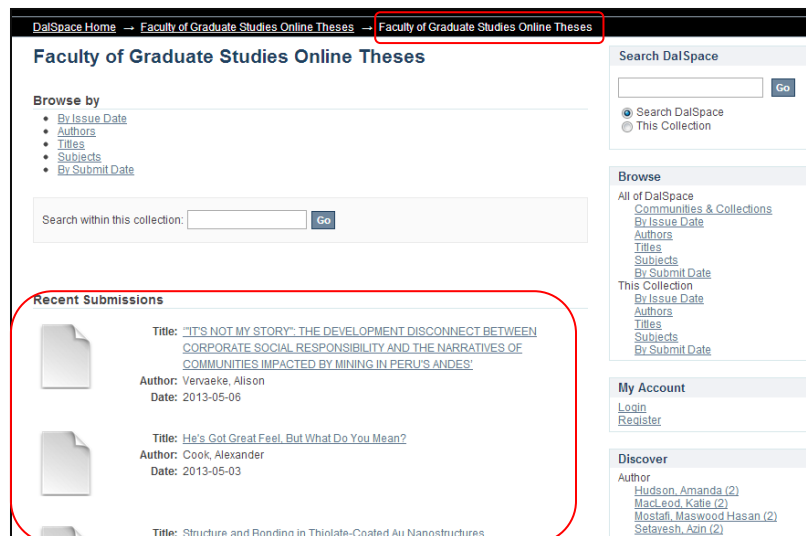


Figure 40. Clicking on the directory of the item does not return to the search results

Suggested solution(s): Evaluator ID 7 recommends having a “return to search results” link either in the item page or the breadcrumbs display while Evaluator ID 9 documented that the system should allow users to go to the search results by adding a “back” button in the item page.

Problems 26: “Update” button in filters. Evaluator ID 2 found that when applying a filter and uncheck it, when need to click on UPDATE button. This problem violates the H4: consistency and standards in which the system should follow “platform conventions”. From my point of view, the problem violates H8: Aesthetic and minimalist design in which the webpage design should be clear and easy to use while applying the filters. Applying filters while browsing is an

important feature because any searcher would need fast, clear, precise browse tools that help them reach their goals.

Snapshot of problem 26:

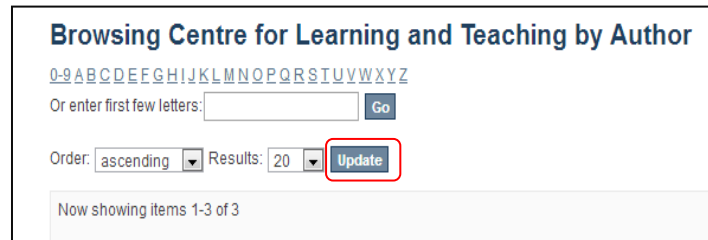


Figure 41. "Update" button in filters.

Suggested solution(s): Evaluator ID 2 suggests "when user check or uncheck a filter, it should be reflected on the results". The system should apply the changes automatically. In addition, applying one global button that says "apply changes" as Evaluator ID 10 suggested in Problem 24.

Problem 27: "Go" button in browsing by issue date. Evaluator ID 7 was confused while browsing by issue date. The Go button on placed in the second line when the systems request, as a second choice, to type in a year. The first choice is to choose a month and a year from the drop down menu. The placement of Go button in the second line confused the evaluator whether the Go button apply the first choice or not. This problem violates the H4: consistency and standards in which the system should follow "platform conventions". I believe that the problem violates H8: aesthetic and minimalist design in which the webpage design should be clear and easy to use while applying the filters.

Snapshot of problem 27:

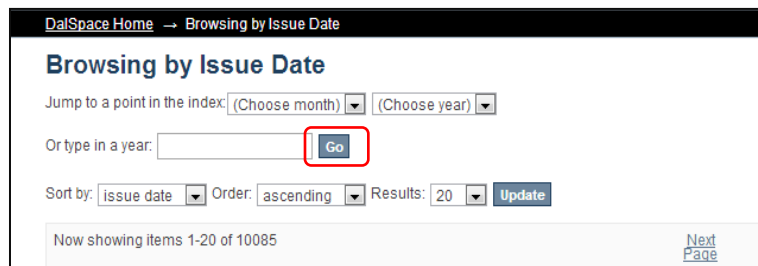


Figure 42. "Go" button in browsing by issue date

Suggested solution(s): Evaluator ID 7 recommends having the “Go” button beside the month and year drop down menus. In addition, the system should apply the changes automatically. In addition, applying one global button that says “apply changes” as Evaluator ID 10 suggested in Problem 24.

Problem 28: Browsing by issue date-wrong entry. Evaluator ID 6 noticed that “selecting a future date such as December 2013 does not alert the user about their non-existence”. The system produces random results with removing the future entry when clicking on Go button as shown in Figure. This problem violates H5: error prevention in which the system should prevent the user from entering wrong or future date. From my point of view, H9: "help users recognize, diagnose, and recover from errors" is violated as well because the system should provide an error message.

Snapshot of problem 28:



Figure 43. Browse by issue date-wrong entry

Suggested solution(s): Evaluator ID 6 recommends that selecting the year first and then a month might eliminate this problem. In addition, providing a calendar instead of the drop menus might eliminate the problem as other websites do when selecting a date.

Problem 29: View item-screen. Evaluator ID 11 found that after producing a search results and the user clicks on a document to view, the system stay at the same page. The system does not open a new tab or page which leads to difficulties in going back to the results. This problem is strongly associated with the Problem 25. Evaluator ID 11 thinks that the problem does not belong to the list of heuristics. However, I think if there is a back button as what has been suggested to “problem 25” this problem may not be considered as a usability problem.

Problem 30: Help option. Evaluator ID 1 found that clicking on the help option at the bottom of the homepage “takes you ‘out’ of DalSpace”. However, the system moves to the help webpage that the library provides when any user wants to access DalSpace through the library's collections. Moving the user to a new page that has a different style and not associated with DalSpace pages adds to the problem. The heuristic H10: help and documentation have been

violated in which the documentation is not enough. This problem is associated to Problem 5 in the catastrophe problems group when the system is introduced just in two lines.

Snapshot of problem 30:

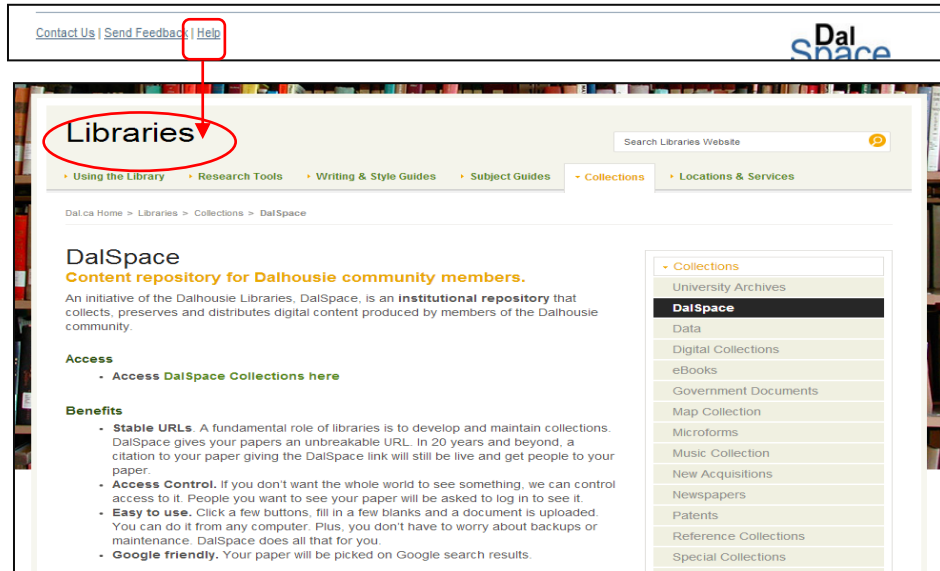


Figure 44. Help option

Suggested solution(s): Evaluator ID 1 suggests “a detailed documentation on how to use DalSpace, what features work should be displayed probably in a separate window”. This problem should be fixed because the results from the first study “User Profiles” show that the students' user groups would need tutorials and proper documentation for the system. This would help them know about the system and how to deal with it for their academic purposes.

Problem 31: Search “This collection” option. Evaluator ID noticed having two options while searching for keyword; search DalSpace and This collection options as shown in Figure 39. The evaluator was confused about the second option. He/she did not know what the system means by this collection. This problem, from the evaluator point of view, violates H10: help and documentation.

Snapshot of problem 31:



Figure 45. Search “This collection” option

Suggested solution(s): Evaluator ID 2 suggests “Small help icon placed next to *Search in DalSpace* can be helpful”.

Problems 32: RSS feeds. Evaluator ID 3 documented “What is “RSS Feeds”? Cannot understand!”. In DalSpace homepage, there are a section called RSS feeds that has three options; RSS 1.0, RSS 2.0, and Atom. In addition, evaluator ID 12 found the same problem and documented that clicking on the RSS opens and information about medicine. Evaluator ID 3 documented that H8: aesthetic and minimalist design was violated because the system should not have extra elements that are not necessary. On the other hand, Evaluator ID 12 thinks that H2: match between the system and the real world was violated. The system should not have phrases and words that users are unfamiliar.

Snapshot of problem 32:

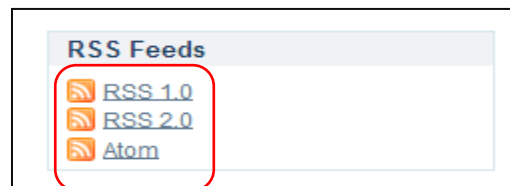


Figure 46. RSS feeds in the homepage

Suggested solution(s): Evaluator ID 3 recommends “give a better explanation on what is RSS, and give examples on how to use it and why it is important”. Evaluator 12 did not provide any suggests for the problem. However, I think removing them from the webpage would eliminate the confusion.

Problems 33: Crowded homepage. Evaluator ID 9 did not like how the homepage is designed. Evaluator documented “Lot of options and links in the main screen make it difficult to browse”. This problem might not violate any heuristic, but it decreases the level of satisfaction which is an important part of any user interface.

Snapshot of problem 33:

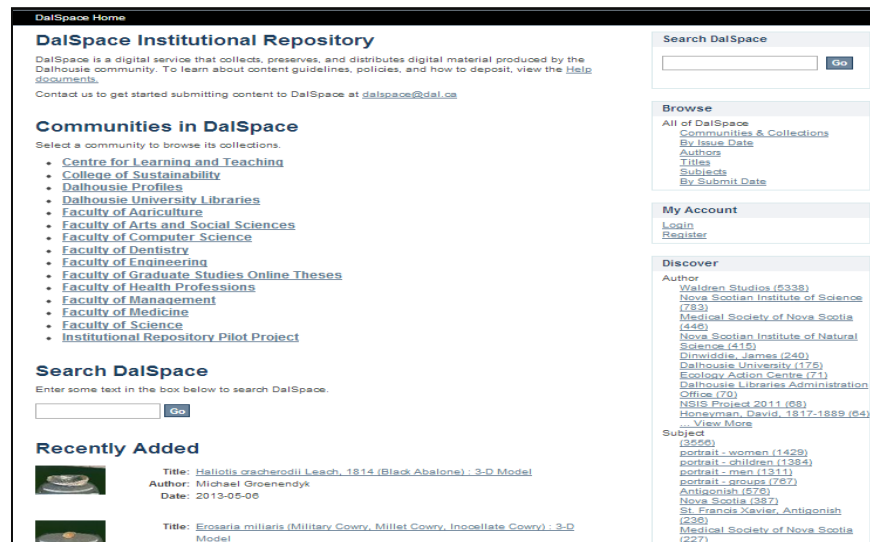


Figure 47. DalSpace home

Suggested solution(s): Evaluator ID 9 recommends changing the colors and backgrounds. Moreover, Evaluator ID 3 made a note that the home interface should have more colors and backgrounds because they are very basic. This problem is somewhat similar to what Evaluator ID 10 felt about the boldness and number of links in one page in Problem 23.

Problem 34: Community item breadcrumb in the page header path. Evaluator ID 7 documented that he/she could not click on the item breadcrumb. The link is not activated which creates a difficulty for going back to the search results. The heuristic H3: user control and freedom was violated in which the system should make it easy for the user to navigate and support the undo and redo options. This problem is strongly connected with the back button problem 25 and the view-item screen in Problem 29.

Snapshot of problem 34:



Figure 48. Community item breadcrumb

Suggested solution(s): Evaluator ID 7 suggests making “these breadcrumbs clickable.” Solving this problem adds to the solutions of having “back” button to the search results or the previous page.

3. Minor Problems

Problem 35: Sort the faculty profiles. Evaluator ID 1 documented that there is a need to sort by faculties that they belong to faculty number of publications. Evaluator ID 1 added that there is no link to sort the faculty profiles. In browsing faculty profiles, there is no need for having the issue date, authors and others. The problem violates the H2: match between the system and the real word because users want to sort the faculty profile depending on the faculties or publication into which they belong.

Snapshot of problem 35:



Figure 49. Sort faculty profiles

Suggested solutions: Evaluator ID 1 suggests removing the browse by list and replacing it with faculties or publications sort filters. This is agreed on from the results in the “User Profile” study when graduate students want to explore faculty profiles to browse the completed theses under

their supervisor. Fixing this problem might add to the efficiency of the system for graduate students and their interests in certain professors.

Problem 36: Adding an extra reader filed while submitting. Evaluator ID 1 documented that “while design a submission, I tried to add a new reader without inserting any text. The system did not do anything and not even a response to incorrect action”. The evaluator wanted to examine adding extra fields without filling them with information and the system reaction. The user has to be notified when some fields have to be filled. This problem violates two heuristics from the evaluator point of view which include; H1: visibility of system status and H5: error prevention.

Snapshot of problem 36:

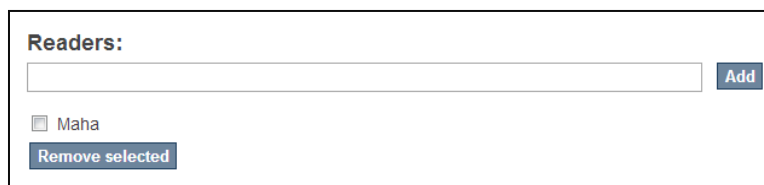


Figure 50. Adding an extra reader without entering text returns no error messages

Suggested solutions: Evaluator ID 1 suggests having an error message that the system should provide when a user add a new filed for an extra reader without entering text. From my point of view, the system should highlight the fields that have to be filled before moving to the next step while submitting a document.

Problem 38: User profile after logging with NetID. Evaluator ID 5 documented after logging into the system with his/her NetID, “my name does not appear anywhere in the system”. The system allows Dalhousie members to log into the system with their NetID which save their time from registering. The user was wondering why his/her name or his/her information does not appear that he is logged into the system. The system only shows two links “Profile and Logout” as shown in Figure D-46 in Appendix D. This problem violates the H1: visibility of system status.

Snapshot of problem 38:



Figure 51. User profile after logging with the NetID

Suggested solutions: Evaluator ID 5 suggests “the user name should be written everywhere”. In addition, the system should display the user name at the top beside the link “Profile”.

Problem 39: “Add” and “Apply” buttons under discover link. Evaluator ID 7 found “Clicking on a subject, author, or a date under ‘discover’ applies the filter immediately but the option require the use to press ‘Apply’ or ‘Add’ to force the update”. Therefore, the problem is about an extra clink on “Add” to refine the search and on “Apply” to sort the results. This problem violates H4: Consistency and standards.

Snapshot of problem 39:

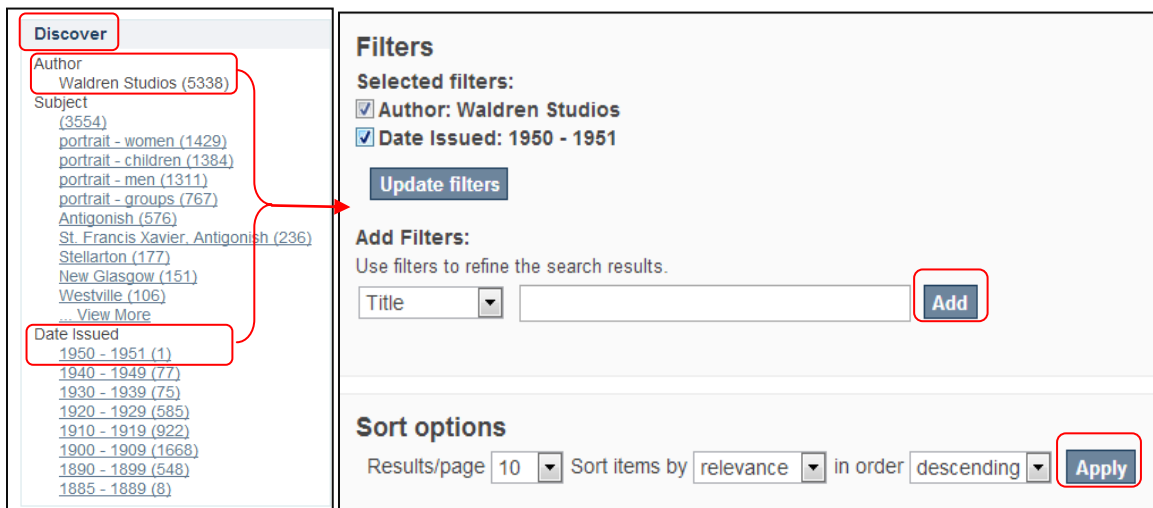


Figure 52. “Add” and “Apply” buttons under discover link

Suggested solutions: Evaluator ID 7 recommends either adding “checkboxes beside authors, subjects, etc. and “apply” button” or make the changes apply immediately without having to click on any button.

Problem 40: Users' path vs. the document path. Evaluator ID 7 noticed “viewing a document record changes the breadcrumb path to show document category, not users' path document”. This problem violates the H4: consistency and standards because users are familiar with having the path that they took to get in the document they want which help them navigate easily. The user reached the document by searching the author's name. However, the system displays the document path rather than the path that they user took to reach the document.

Snapshot of problem 40:



Figure 53. The document breadcrumb path

Suggested solutions: Evaluator ID 7 suggests “breadcrumbs should show the users' path, add a separate line at top”. This might help in solving other problem documented by evaluators, especially problems 25 and 29. In addition, this problem is connected to the problem 25 when there is no way to go back to the previous page expect by the “back button”.

Problem 41: System suggests “enter first few letters” while browsing by title. Evaluator ID 8 documented that there are “too many options for searching by titles”. This might complicate the interface, and it should be easy to use. In browsing by title, the system suggests two options either choosing a starting letter or “enter first few letters”. The problem violates the H8: aesthetic and minimalist design in which she/he thinks that these two options are unnecessary.

Snapshot of problem 41:

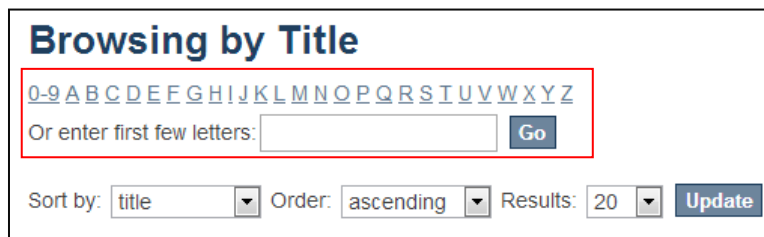


Figure 54. “Enter first few letters” option while browsing by title

Suggested solutions: Evaluator ID 8 recommends that “If you have an option of search by date and author's name than remove the other option of searching by staring few letters”. The evaluator agrees that the other options are unnecessary.

Problem 42: Punctuation suggestions in search filters. Evaluator I D10 found it unusual to have punctuation suggestions (0-9) while applying filters on the search results as shown the Figure from the previous problem 41. The evaluator believes that the problem violates H7: flexibility and efficiency of use while I believe that the problem violates H8: aesthetic and

minimalist design in which there are extra and should not be included in the interface design. However, if the numbers are connected to the type of document, the system should notify the user.

Suggested solutions: Evaluator ID 10 recommends having only letters and words and excluding the numbers. If they are connected to the type of documents, the system should provide a small help icon beside them so users can know why there are numbers in the suggestions.

Problem 43: Filters dropdown menus. Evaluator ID 10 noticed that after selecting any option from the drop down menus while refining, the selection disappear from the menu. Evaluator ID 10 commented “If the user is unmarking of filter, it should stay there not vanish”. This problem violates H4: consistency and standards in which the user should still see what selection he/she just made. For example, if the user selects authors from the dropdown menu that starts with title and clicks on Add button, the system produces results but the selection “authors” disappear and is replaced by title. The system returns to the first order.

Snapshot of problem 43:

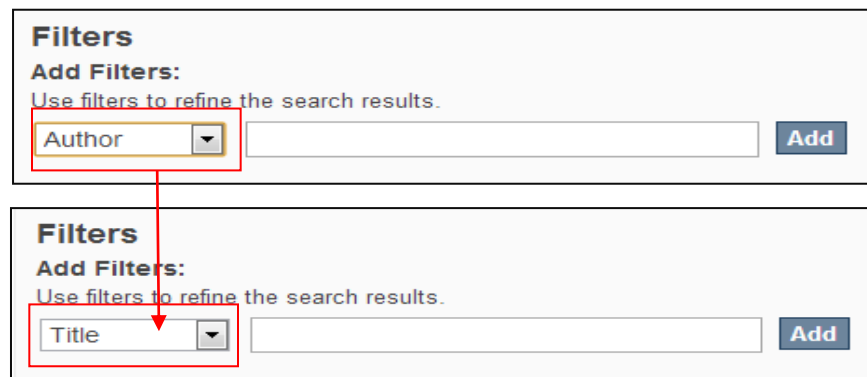


Figure 55. Filters dropdown menus

Suggested solutions: Evaluator ID 10 suggests “check box is better” instead of dropdowns. This helps in marking and remarking the choices.

Problem 44: “Show simple item record” link. Evaluator ID 13 noticed that there is a link called “Show simple item record” in view item interface after following the link “Show full item” link. The first link leads to the document information. The evaluator commented on the placement of the link at the top of the page which she/her considered it as “inconsistence”. This is because the second link “Show full item” is in the middle of the page while the first one is in the top of the page.

Snapshot of problem 44:

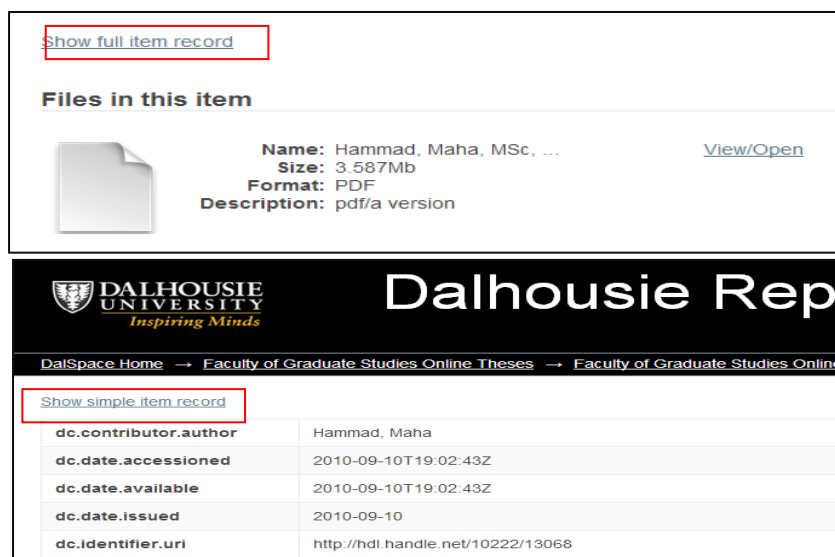


Figure 56. Show item full/simple record links

Suggested solutions: Evaluator ID 13 having a space or placing the link at the middle would be helpful. In addition, “perhaps using another name would help”.

Problem 45: Auto fills on search. Evaluator ID 13 noticed that the auto fill of suggestions is not possible. The evaluator was expecting from DalSpace search bar to provide auto fill suggestions and commented “doesn't auto filling on screen like Google”. This problem violates the H6: recognition rather than recall which helps users to choose from the existing documented and reach the document they want quickly.

Suggested solutions: Evaluator ID 13 suggests that “This should be a nice feature to have similar to Google”

Problem 46: The number of the documents while browsing by subject. Evaluator ID 5 noticed that while browsing by subject, the system shows the number of the items found as “99-103 from 12098”. The evaluator was wondering why the system represents the number in such way while the number should “(1-4)” instead of “(99-103)”. The evaluator mentioned that the problem violates H6: recognition rather than recall.

Suggested solutions: This is functional problem that could be fixed easily. The Evaluator commented “It should tell the number of items found (1-4) not (99-103)”.

Problem 47: Indirect link to download a document. Evaluator ID 1 documented that having to download a document, “you have to open and then save. There is no link given to download directly”. In addition, Evaluator ID 13 found the same problem and commented “ability to download is not visible and indirect”. Evaluator ID 13 thinks that the problem violates H4:

consistency and standards and H7: flexibility and efficiency of use while evaluator ID 1 documented H2: match between system and the real world.

Snapshot of problem 47:



Figure 57. View/Open option

Suggested solutions: both evaluators suggest having a link to download directly. Evaluator ID 13 commented “people know how to do this but it would be helpful to have download link option”.

Problem 48: Two search boxes. Evaluator ID 1 found that having two search boxes which was found by Evaluator ID 3 and 14 with different severity rating as shown in Table 20. All evaluators are considered expert..

Evaluator ID	Severity rating	Problem number	Heuristics violated
ID 1	2	48	H8
ID 3 and ID 14	4	2	H8

Table 20. Two search boxes severity rating variation

Suggested solutions: Evaluator ID 1 suggests the same problem as Evaluator ID 3 and 14 recommend which removing one and focusing on one and make it visible to users.

Problem 49: Browsing by issue date-wrong entry. Evaluator ID 4 found that “user can enter any value without feedback from the system”. Evaluator ID 4 did not assign a heuristic that is violated by the problem. From my point of view, this problem violates H5: error prevention in which the system should prevent the user from entering wrong or future date. In addition, H9: Help users recognize, diagnose, and recover from errors is violated as well because the system should provide an error message if there is a tradeoff between those two heuristics.

Suggested solutions: Evaluator ID 4 agreed with Evaluator ID 6 on the same suggestion which is having “appropriate error message should be displayed”.

Problem 50: Help option. Evaluator ID 4 found that the help page is “not in sync with the main site”. This problem is associated with problem number 30 in the major problems group when Evaluator ID 1 documented that the system takes him/her to outside of the system. Moving the

user to a new page that has different style and not associates with DalSpace pages adds to the problem. Evaluator ID 15, who is non-expert, found the same problem and added that “cannot type in what kind of help I need”. All evaluators assigned H10: help and documentation that has been violated by these two problems.

Suggested solutions: Evaluator ID 4 commented help page should have the same user interface design.

Problem 51: Irrelevant search results. Evaluator ID 5 found that searching a keyword produces many irrelevant documents that are listed in the first page. Evaluator ID 5 documented “when I search for one, I get many unrelated documents”.

Suggested solutions: Evaluator ID 5 documented that this problem is a functional problem. However, I think it might be useful to highlight or bold the key words in the title of documents produced by the search. In addition, the search results list should start with the most relevant document by matching the keywords entered with the key words of the title or tags associated with the document.

Problem 52: “Go” button. Evaluator ID 13 found that while refining search results the systems require an extra click on “Go” button to apply the changes. Evaluator thinks that the extra click is not necessary and results should be refined directly. Evaluator ID 13 found that the problem violates the H7: flexibility and efficiency of use.

Snapshot of problem 52:

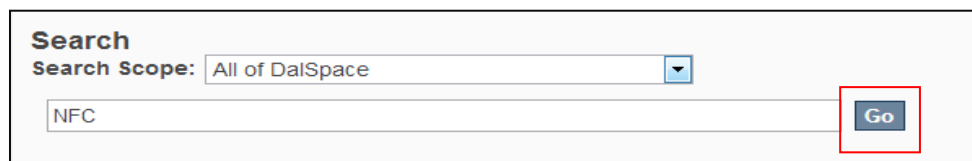


Figure 58 “Go” button while refining the search results.

Suggested solutions: Evaluator ID 13 suggests “eliminating the need to click on “Go” by default when the user finishes it”. Moreover, it would be more helpful to produce the results directly after choosing the desired refinements.

Problem 53: Using keyboard functions. Evaluator ID 11 found that using “enter” key in the keyboard is important and it is hard to get to the button using the keyboard. Evaluator ID 11 did not assign a heuristic that he/she thinks it is violated by the problem. However, I think H7: flexibility and efficiency of use was violated because the system does not support all users' levels. The problem decreases the speed of using the system

Suggested solutions: Evaluator ID 11 recommends that the system should support it from the first hit for all pages.

Problem 54: Browse an empty collection by subject. Evaluator ID 11, who is a regular expert, found that while browsing some communities, some of them were empty. Evaluator ID 11 did not assign a heuristic for the uncovered problem.

Suggested solutions: Evaluator ID 11 did not suggest any solution to the problem.

Problem 55: URL link in the view item page. Evaluator ID 15 found that there is a URL link in the top of the view item page and commented “it does not name an explanation of what it does” as shown in Figure 54. The evaluator did not know that the URL link is the link to the documented if used as resource. The evaluator did not assign a heuristic or a solution to the problem.

Snapshot of problem 55:

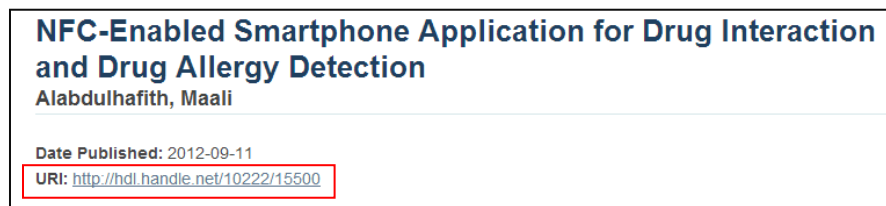


Figure 59. URL link in the view item page

4. Cosmetic Problems

Problem 56: Reaching the search box through the keyboard. Evaluator ID 10 found that it is hard to get the search box by using the keyboard which violates the H7: flexibility and efficiency of use. Expert users want to apply some accelerators. Evaluator ID thinks that this problem is a cosmetic problem that can be fixed only if there is an extra time in the project.

Problem 59: Filter and sort at the same time. Evaluator ID 1 found that it is not possible to apply filters and sort at the same time while browsing by submit date. Users have to click on “Go” after typing the year and then to sort the results they have to click on “Update” button. Evaluator ID 1 thinks it is a cosmetic problem that can be fixed only if there is extra time in the project.

Snapshot of problem 59:

Figure 60. Filters and sort options while browsing by issue date

Suggested solutions: Evaluator ID 1 recommends “Draw a line between the two to indicate that sorting has to be alone as a next step, or make sorting inactive while filtering is being done.”

Problem 60: Browsing a restricted community/collection. Evaluator ID 6 found that the system does not indicate that the community/collection is restricted until the action is taken, especially senate minutes collection. In addition, the evaluator thinks that the problem violates H5: error prevention. It is important to note that Evaluator ID 13 found the same problem “problem 11 in the catastrophe problems group” as shown in Table 21.

Evaluator ID	Severity rating	Problem number	Heuristics violated
ID 6	1	60	H5
ID 13	4	11	H5/H9

Table 21. Browsing a restricted community problem severity rating variation

Suggested solutions: Evaluator ID 6 documented “Do not categorize a restricted data just make it invisible. Or inform the user that is restricted and for more information they have to click on something or a link.”

Problem 61: Two search boxes. This problem has been found by many evaluators who assigned different severity ratings as shown in Table 22. First, Evaluator ID 3 and 14 have assigned the problem as a catastrophe problem that has to be fixed first. Second, Evaluator ID 1 has assigned the problem as a minor problem that should be given low priority. Third, Evaluator ID 10 and 4 have assigned the problem as a cosmetic problem that should be fixed unless there is extra time for the project.

Evaluator ID	Severity rating	Problem number	Heuristics violated
ID 10/ ID 4	1	61	H4
ID 1	2	48	H8
ID 3/ ID 14	4	2	H8

Table 22. Two search boxes problem severity rating variation

Suggested solutions: by adding to other evaluator comments on the problem, Evaluator ID 10 commented “They are similar but with different text. It makes the home more polluted and less successful.” Moreover, the evaluator suggests “removing that search in the middle.” Evaluator ID 4 commented “the purpose of the two boxes should be defined”.

Problem 62: Error messages are not separated from the text. Evaluator ID 4 found that the error messages throughout most of the situations are not separated from the original text in the page design. The problem violates the H5: error prevention while I think the problem violates H9: Help users recognize, diagnose, and recover from errors in which the system should provide error messages that are very precise and noticeable.

Suggested solutions: Evaluator ID 4 recommends providing the error messages in red.

Problem 63: Search “This collection” option. Evaluator Id 10 found that “is meaningless if the user gets there through a thesis title search”. Evaluator ID 10 thinks that the problem violates H6: Recognition rather than recall in which the system should help users know the collection that they are searching within. Evaluator ID 10 with Evaluator ID 2 found the same problem but they assigned different severity ratings as shown in Table 23.

Evaluator ID	Severity rating	Problem number	Heuristics violated
ID 10	1	63	H6
ID 2	3	31	H10

Table 23. Search “This collection” option problem's severity rating variation.

Suggested solutions: Evaluator ID 10 suggests changing the term from “this collection” into “CS collection” as an example.

Problem 64: “Back” button while viewing an item. Evaluator ID 11 noticed that “there is no ‘go back’ link except the undo button in the browser.” The evaluator did not assign a heuristic that is violated and considered the problem as a cosmetic problem. It is important to note that

Evaluator ID 7 and 9 found the same problem and considered it as a major problem as shown in Table 24.

Evaluator ID	Severity rating	Problem number	Heuristics violated
ID 11	1	64	N/Y
ID 7 and 9	3	25	H3

Table 24. “Back” button while viewing an item problem severity rating variation

Problem 65: Symbols produced while browsing by author. Evaluator ID 10 found that the “List of authors have symbols”. Evaluator ID 13 found the same problem and assigned the problem as a major problem that has to be given high priority while Evaluator ID 10 thinks it is a cosmetic problem as shown in Table 25. Evaluator ID 10 thinks that the problem violates H2: Match between system and the real world.

Evaluator ID	Severity rating	Problem number	Heuristics violated
ID 10	1	65	H2
ID 13	3	18	H5/8

Table 25. Symbols produced while browsing by author severity rating variation

Suggested solutions: Evaluator ID 10 commented that “Remove meaningless author values from the listing. If those symbols mean “no authors” show that instead.”

Problem 66: RSS feeds. Evaluator ID 10 raised a question about the RSS and Atom feeds in the homepage as other evaluator did (Evaluator ID 3 and 12). Evaluator ID 10 thinks that this problem is cosmetic problem while the other two consider it as major problem as shown in Table 26. Evaluator ID 10 thinks that the problem violates H2: match between system and the real world.

Evaluator ID	Severity rating	Problem number	Heuristics violated
ID 10	1	66	H2
ID 3 and 12	3	32	H2/8

Table 26. RSS feeds problem severity rating variation

Suggested solutions: Evaluator ID 10 commented “Show only one link instead, Do people bother about the RSS type nowadays?”.

5. Not Usability Problems:

Problem 68: Inconsistence date format displays. Evaluator ID 13 found that while browsing by date, the format is inconsistence. Evaluator ID 13 thinks that this is not a usability problem. “I think this is a date integrity issue & it should be consistence”, Evaluator ID 13 documented.

Snapshot of problem 68:

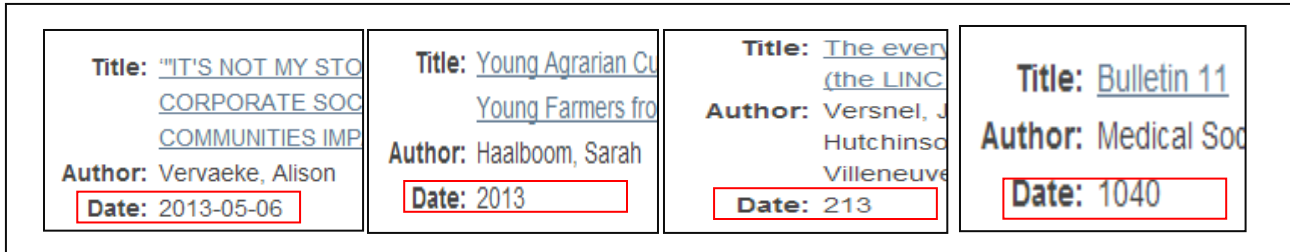


Figure 61. Inconsistence date format displays

Problem 69: Crowded homepage. Evaluator ID 10 along with other evaluators who found the same problem thinks that the homepage is full of links and bold texts. Evaluator ID 10 thinks that the problem is not a usability problem while Evaluator ID 7 thinks this is a major problem as shown in Table 28.

Evaluator ID	Severity rating	Problem number	Heuristics violated
ID 10	0	69	N/Y
ID 7	3	34	H3

Table 27. Crowded homepage problem severity rating variation

Suggested solutions: Evaluator ID 10 recommends that “Lists should be more attractive, less heavy and multiple columns and remove underline and boldness”.

APPENDIX E 1 Letter of Approval-User Profile Study



Social Sciences & Humanities Research Ethics Board Letter of Approval

November 08, 2012

Maha Al-johani
Computer Science\Computer Science

Dear Maha,

REB #: 2012-2824

Project Title: Heuristic Evaluation of Dalhousie Repository Interface

Effective Date: November 08, 2012

Expiry Date: November 08, 2013

The Social Sciences & Humanities Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans*. This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Sincerely,

Dr. Sophie Jacques, Chair

APPENDIX E 2 Letter of Approval- Heuristic Evaluation Study



Social Sciences & Humanities Research Ethics Board Letter of Approval

March 25, 2013

Maha Al-johani
Computer Science\Computer Science

Dear Maha,

REB #: 2013-2940

Project Title: Heuristic Evaluation of Dalhousie Repository Interface

Effective Date: March 25, 2013

Expiry Date: March 25, 2014

The Social Sciences & Humanities Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans*. This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Sincerely,

Dr. Sophie Jacques, Chair