Evaluating the usability of the information architecture of academic library websites

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Abstract

Purpose: The purpose of this paper is to provide an integrated list of heuristics and an information architecture (IA) framework for the heuristic evaluation of the IA of academic library websites as well as an evaluation framework with practical steps on how to conduct the evaluation.

Design/methodology/approach: A set of 14 heuristics resulted from an integration of existing usability principles from authorities in the field of usability. A review of IA literature resulted in a framework for dividing academic library websites into six dialogue elements. The resulting heuristics were made applicable to academic library websites through the addition of recommendations based on a review of 20 related studies.

Findings: This study provides heuristics, a framework and workflow guidelines that can be used by the various evaluators of academic library websites, i.e. library staff, web developers and usability experts, to provide recommendations for improving its usability.

Research limitations/implications: The focus of the usability principles is the evaluation of the IA aspects of websites and therefore does not provide insights into accessibility or visual design aspects.

Originality/value: The main problem that is addressed by this study is that there are no clear guidelines on how to apply existing usability principles for the evaluation of the IA of academic library websites.

Keywords: Website usability, Information architecture, Academic library websites, Heuristic evaluation, Usability inspection, User-centred design

1. Introduction

Academic institutions need to be aware of the usability problems on their websites, which can be improved to gain the "advantages of usable educational websites" (Hasan, 2013, p. 231). A usability problem is something that is confusing, misleading, or sub-optimal in an interface (Lazar et al., 2010, p. 252). The aim of a usability inspection is to find usability problems in an existing user interface design and to make recommendations for fixing the problems and improve the usability of the design (Nielsen and Mack, 1994, p. 3). According to Sherwin (2016) "universities that prioritize a good user experience leverage the website to contribute to larger institutional goals and see a clear return on investment".

This paper provides an integrated list of heuristics and an information architecture (IA) framework for the usability evaluation of academic library websites as well as an evaluation workflow with practical steps on how to conduct an evaluation using these resources.

1.1 History of academic library website usability

The evaluation of library websites has attracted a large amount of attention from researchers in the field of library and information sciences (Chase et al., 2016; Pant, 2015; Silvis, 2017; Wu and Brown, 2016).

A library website is an important gateway to a university's library services, including electronic resource access, online catalogues, and online referencing services. Library websites were initially developed to meet the needs of the people who work in the library (Dominguez et al., 2015, p. 100) and were designed and maintained by library employees, rather than web developers (King and Jannik, 2005, p. 236). This resulted in academic library websites that were "filled with too much library jargon, including endless acronyms for names of databases and tools, too much text, and confusing navigation options" (Dougan and Fulton, 2009, p. 218). According to Tidal (2012, p. 94), the confusion with terminology is one of the biggest obstacles in library websites.

A large amount of research have been done on usability and IA in the 1980s and 1990s (Nielsen and Mack, 1994; Rosenfeld and Morville, 1998; Shneiderman, 1986). Early research in the field of usability and user-centred design (UCD) demonstrates how principles of cognitive psychology apply to the design of almost anything (Norman, 1988). Norman (1988) covers topics such as discoverability, feedback, and affordance (of everyday things). These principles are now widely used in website usability (Krug, 2014, p. 190). However, according to the findings of early studies on academic library websites, some of these websites may have been developed without consideration for the vast amount of research that already existed in the field at the time. This may have been as a result of the rapid growth of resources on these websites according to Duncan and Holliday (2008, p. 301).

Library websites have evolved dramatically "from simple pages with a few links to complex sites that provide direct access to hundreds of different resources" (Duncan and Holliday, 2008, p. 301). Library resources that were made available on library websites were growing at a rapid rate and at that time the focus was more on quantity rather than quality (Duncan and Holliday, 2008, p. 301; King and Jannik, 2005, p. 236). This resulted in websites that were "cluttered and crowded with information" (Dominguez et al., 2015, p. 100).

The rapid growth of library websites resulted in the existence of certain websites that were not robust enough to support a large number of resources, according to Duncan and Holliday (2008, p. 301). One of the major problems with early academic library websites was that they may have been designed and redesigned without much consideration for the website IA – the organisation and underlying structure of the website (Duncan and Holliday, 2008, p. 302). Therefore, Duncan and Holliday (2008, p. 301) concluded that some early academic library websites may not have been designed with the users in mind or with a consideration for how it would affect the findability of information.

Academic library websites are large, information-rich systems, which are only useful if the available resources are findable. Therefore, IA is essential for the success of an academic library website (Gullikson et al., 1999, p. 293). One of the main focuses in the field of IA is supporting the findability of information (Wodtke and Govella, 2009, p. xvii) and it is regarded by Rosenfeld, Morville and Arango (2015, p. 5) as a "critical success factor" for the overall usability of a website.

1.2 The value of heuristic evaluation as a usability evaluation method

Usability evaluation is a term that is used to describe a "process or activity that aims to improve the ease of use of an interface" (Lazar et al., 2010, p. 256). There are three broad categories under usability evaluation that define how usability problems are identified – expert-based evaluation (by expert evaluators), automated testing (with tools), and user-based testing (with end-users) (Zahran et al., 2014, p. 26).

Expert-based evaluations, as opposed to user-based tests, are ideal for the evaluation of IA because users are good at performing tasks within an interface, but they are not interface experts (Lazar et al., 2010, p. 256). Although user testing is a valuable method for getting users' opinions on the usability of a product, users might not necessarily be able to comment on the usability of its IA. The IA of a website can effectively be evaluated using the expert-based method called heuristic evaluation. Heuristic evaluation is also classified as a usability inspection method (Nielsen and Mack, 1994, p. 2).

According to Nielsen & Mack (1994, p. 2), "Several studies of usability inspection methods have discovered that many usability problems are overlooked by user testing, but that user testing also finds problems that are overlooked by inspection". Therefore, the best results can be achieved by combining user-based and expert-based methods. It is not uncommon for expert evaluators to be able to identify many of the usability problems that users are able to identify during usability testing, as heuristic evaluators are encouraged to put themselves in the typical users' shoes. Ideally, a usability inspection method should be used first to "clean up" the interface and to uncover obvious interface flaws. Improvements should be suggested even before user-based testing starts so that user testing can be applied to the revised design (Lazar et al., 2010, p. 256; Nielsen and Mack, 1994, p. 19). This way, experts can find the interface flaws, and users can focus on finding task-related flaws, without being distracted by interface flaws (Lazar et al., 2010, p. 256).

More evaluators will result in a greater variety of problems discovered; however, according to Nielsen (1995a), three to five evaluators is optimal. It could also be beneficial to include evaluators with different roles in the website redevelopment team, for example, librarians, web developers, and usability experts, which could also result in a greater variety of problems identified.

There are various heuristics that apply to generic problems that can exist in large websites. However, library websites, a subset of these large websites, have elements that are unique to them. This study aims to provide a simplified way of applying existing usability principles to the elements in academic library websites.

The gap that has been outlined in the above discussion is outlined in the following problem statement.

1.3 Problem statement

There is a lack of guidance on performing heuristic evaluation of the IA of academic library websites. Therefore, a set of integrated heuristics, a framework, and evaluation workflow for using the set of heuristics were developed. The steps that were taken include:

- Integrating sets of existing usability principles from Nielsen (1995b), Shneiderman et al. (2016), and ISO 9241-110 (2006);
- Supplementing the set of usability principles with sub-criteria applicable specifically to IA elements;

- Determining what usability problems are commonly found on academic library websites by evaluating related studies and making the integrated set of heuristics applicable to these problems;
- Devising an IA framework that can be used to divide a library website into smaller parts that can be evaluated separately, hereafter referred to as dialogue elements.
- Devising an evaluation workflow for using the heuristics and framework to perform a heuristic evaluation of academic library websites.

The following section describes the methods that were used to address the steps listed in the problem statement above.

2. Methods

This study consists of a literature review of the following topics.

- Usability
  o Usability measures
  o Usability evaluation
  o Usability evaluation principles
- Information architecture
- Academic library website usability (related studies)
  o Usability problems that are commonly found on academic library websites

The literature review method has multiple purposes. The resources that were used to find literature on the topics varied depending on the topic and the purpose of the literature review on that topic.

The literature reviews of usability and IA had two purposes. Firstly, to provide the context and the background of the current knowledge of the topic by evaluating and summarising the key concepts used in the study, i.e., usability and IA. Secondly, to find established lists of usability principles that apply to these two topics in order to create an integrated set of heuristics. Therefore, the sources were gathered based on the credibility of the authors and the impact of the contribution they made to the field, and consisted mainly of published books.

The purpose of the literature review on the topic of academic library websites was to find out how other related studies on the topic were conducted, and what the results were in the context of this study. Therefore, the sources that were consulted consisted of published articles only. The scope was limited to articles from 2006 – 2016, starting with the newer articles. Older articles were excluded based on the history of academic library website usability and the drastic evolution of websites as discussed Section 1.1.

As the study progressed, articles were added that were found in the reference lists of the newer articles, which resulted in the inclusion of widely cited articles from 2005 as well (since these studies, regardless of their old dates, had a significant influence on the current work).

Based on the different purposes of the subtopics, the literature review was divided into the following two parts.

- Part 1: Background to the study
  o Usability and usability evaluation
  o Information architecture
- Part 2: Analysis of established usability principles and related studies
  o Established usability principles
  o Related studies

2.1 Usability and usability evaluation

The literature review of usability presents various perspectives of usability, i.e., definitions, usability goals, usability measures, and human factors. These perspectives are then integrated to formulate a definition composed of usability measures that encompass each of the perspectives. This establishes the characteristics that can be used to describe a usable product and how it can be achieved using the UCD (user-centred design) process.

The next aspect of usability that is explored is the evaluation phase of the UCD process and various ways in which usability can be evaluated.

2.2 Information architecture

The literature review of IA is used to explain what IA is and describes its relationship to usability. The purpose of this section is to identify the IA components that large websites consist of, as well as how the scope of usability heuristics can be narrowed to only focus on the usability of IA (as opposed to other aspects such as visual design and accessibility). The identification of IA components is used to determine how the library websites can be divided into dialogue elements for the purpose of heuristic evaluation.

2.3 Established usability principles

Three lists of established usability principles that are applicable for the heuristic evaluation of websites were identified and analysed to create an integrated set of heuristics for this study.

These lists of principles were selected as the top three due to their credibility, the fact that they are widely cited, and their applicability to this study and heuristic evaluation in general.

They are credible because the first two lists were created by authorities in the field of usability engineering (Macefield, 2014, p. 2) and the third one is a published ISO standard. Standards are defined as "formal documents that are developed through some form of consensus and formal voting process and published by standard making bodies" (Stewart and Travis, 2003, p. 992).

In the analysis of different lists of principles, Nielsen's heuristics (Nielsen, 1995b) and Shneiderman's golden rules (Shneiderman et al., 2016) were the most commonly listed, therefore, it can be inferred that these are the two most commonly used lists of principles.

Other lists of principles that were found were not applicable to the scope of this study and were therefore eliminated. For example, Tognazzini's first principles of interaction design (Tognazzini, 2014) has a strong focus on the evaluation of the usability of the visual design aspects of an interface, and this study does not focus on visual design. Lists of principles that have a strong focus on accessibility, for example, the Web Content Accessibility Guidelines (WCAG) (Henry, 2012) were also not considered because the accessibility aspects of websites are beyond the scope of this study.

Heuristic evaluations are usually conducted by using a small set of general usability principles (Nielsen, 1994, p. 28). These principles can then be adapted to apply to any interface such as websites (Preece et al., 2015, p. 405). The three lists that were chosen are general enough so that they can be adapted and applied to any user interface. According to Nielsen (1994, p. 28), his heuristics are "general rules that seem to describe common properties of usable interfaces" and the evaluator can add any additional principles that apply to specific dialogue elements. Shneiderman (2016) states that his principles are widely applicable and must, therefore, be adapted based on the environment, but that "they provide a good starting point for web designers" (Shneiderman et al., 2016). ISO 9241 Part 110: 7 dialogue principles are designed to be general and are "presented

without reference to situations of use, application, environment or technology" (ISO 9241-110, 2006, p. 1). They are applicable in the analysis, design, and evaluation of interactive systems (ISO 9241-110, 2006, p. 1).

These general heuristics were therefore integrated and adapted to apply specifically to usability problems related to website IA.

2.4 Related studies

Twenty related studies were identified and summarised. The usability problems that were identified in each of the related studies were discussed in the context of the integrated set of heuristics. This helped identify the applicability of each of the heuristics to academic library websites.

The result of part two was a set of heuristics and sub-criteria that are applicable for heuristic evaluations of academic library websites.

3. Background to the study

The core concepts used in this study, usability and IA, are described in this section, as well how the usability of IA can be evaluated.

3.1 What is usability?

According to Nielsen (2012), usability is a quality attribute that determines whether a product is easy to use. Nielsen (2012), together with other prolific authorities in the field, uses various overlapping collections of descriptive usability terms to define usability. Such terms can be used to describe or measure the usability of a system (Preece et al., 2015, p. 19). These various collections of terms are consolidated in this study to create an integrated definition of usability.

Each of the authorities refer to their collections of terms using different titles, i.e.: quality components (Nielsen, 2012), usability measures (ISO 9241-11, 1998), usability goals (Preece et al., 2015, p. 19), and human factors (Shneiderman et al., 2016). Shneiderman et al. (2016) also refer to these human factors as "usability goals and measures". These terms are referred to as usability measures hereafter.

These various factors of usability were consolidated to encapsulate all usability measures from the various experts to create a single definition of usability. The following table shows what terms the various authorities in the field use to define their lists of usability measures. (Table 1)

Table 1: Usability measures used in various usability definitions and goals of usability

Term	Nielsen (2012) Quality components	Preece, Rogers and Sharp (2015) Usability goals	Shneiderman et al. (2016) Human factors	ISO (1998) Usability measures
Effectiveness	-	Effectiveness	-	Effectiveness
Efficiency	Efficiency	Efficiency	Speed of performance	Efficiency
Learnability	Learnability	Learnability	Time to learn	-
Memorability	Memorability	Memorability	Retention over time	-
Safety	Errors	Safety	Rate of errors by users	-
Satisfaction	Satisfaction	-	Subjective satisfaction	Satisfaction
Utility	-	Utility	-	-

Therefore, through consolidating these usability measures, usability can be defined as the degree to which an interface can be considered usable with regards to the seven usability measures — effectiveness, efficiency, learnability, memorability, safety, satisfaction, and utility.

Usability can be achieved through the user-centred design process (Burmester and Machate, 2003, p. 45). The process consist of iterative cycles, phases or activities involving design, prototyping, and evaluation of the user interface (Burmester and Machate, 2003, p. 45; Dix et al., 2004; Petrie and Bevan, 2009, p. 7). Preece, Rogers, and Sharp (2015, p. 15) refer to it as the process of interaction design and state that these activities should inform one another and should be performed repeatedly in order to design a successful product (Preece et al., 2015, p. 15).

According to Petrie and Bevan (2009, p. 7) and Preece, Rogers and Sharp (2015, p. 15) the evaluation phase is at the heart of the process.

3.2 How to conduct a heuristic evaluation

There are no specific guidelines on how to conduct a heuristic evaluation. Evaluators are allowed to decide how they want to perform the evaluation of the interface and they are not required to perform tasks. A general recommendation is to go through the interface twice (Nielsen, 1994, p. 29; Pickard, 2013, p. 133). The first pass is when evaluators move through the system once to familiarise themselves with the navigation structure and the general scope of the website. The second pass is when the evaluator focuses on the specific elements of the system related to the heuristics identified. These specific elements are referred to as dialogue elements and is clarified in Section 5.2.

If more than one evaluator is involved in the process, they should perform the evaluations independently and be de-briefed after performing the evaluations so that they can share their experiences and suggest solutions (Nielsen, 1995a; Pickard, 2013, p. 133). The evaluator should present some form of report after the evaluation (Nielsen, 1995a). The findings can then be presented, and system revisions can be recommended.

The outcome of the heuristic evaluation method is a list of an interface's usability problems with references to the heuristics that were violated by the design according to the opinion of the evaluator (Nielsen, 1995a). The results of a heuristic evaluation typically include a list of features that cause usability problems that should be improved, features that do not cause problems and do not need to be changed, and features that should be tested with actual users (TecEd, 2016).

3.3 What is IA?

Website IA is concerned with the arrangement (Information Architecture Institute, 2013), organising (Krug, 2014, p. 183), structuring (Brinck et al., 2001, p. 120; Garrett, 2011, p. 30), or planning (Lynch and Horton, 2009, p. 71) of website content.

One of the main focuses in the field of IA is supporting the findability of information (Wodtke and Govella, 2009, p. xvii). Educational websites are mainly concerned with two major questions: can the information that the user is looking for be found easily on the website and can the information be found in a timely manner? (Mustafa and Al-Zoua'bi, 2008, p. 2). Rosenfeld, Morville and Arango (2015, p. 5) regard findability as a "critical success factor" for the overall usability of a website: "if users can't find what they need through some combination of browsing, searching, and asking, then the site fails". Findability is referred to as the sister of usability because one cannot *use* something if one cannot *find* it first (Wodtke and Govella, 2009, p. xvii).

Overall website IA comprises the following four systems – organisation, labelling, search, and navigation — characteristics that are shared by most interactive information environments (Rosenfeld et al., 2015, p. 39).

The remainder of this section focusses on identifying the IA components in the context of large, information-rich websites, such as academic library websites.

3.3.1 Organisation systems

"*How we categorize information*" (Rosenfeld et al., 2015, p. 49).

There are various ways to organise a website's information. A successful organisation system is one that supports a user's tasks (Brinck et al., 2001, p. 120; Nielsen, 1999, p. 198).The organisation system of a website focuses specifically on the *classification* and *logical grouping* of information (Rosenfeld et al., 2015, p. 58).

3.3.2 Labelling systems

"*How we represent information*" (Rosenfeld et al., 2015, p. 49).

Labels are used to represent larger pieces of information in websites. Examples of textual labels on websites include page titles (the text that is displayed in the browser tab), the names of the links (to other pages or locations on the same page), and the headings on a webpage (Rosenfeld et al., 2015, p. 82; Toub, 2000, p. 23). Examples of visual labels include icons or buttons. Labels should be descriptive of the content they represent and should use language that is meaningful to the target users of the website (Rosenfeld et al., 2015, p. 82).

3.3.3 Navigation systems

"*How we browse or move through information"* (Rosenfeld et al., 2015, p. 49).

Navigation systems are closely related to search systems since they both help users to move through the website (Rosenfeld et al., 2015, p. 43). In this context, the focus is on systems that support browsing.

From an information architect's perspective, navigation systems refer to giving users context and allowing users to navigate laterally and vertically between branches in a hierarchical navigation system so that they can get to anywhere from anywhere (Rosenfeld et al., 2015, p. 177).

Generally, large websites include the following three embedded navigation systems: global, local, and contextual navigation (Rosenfeld et al., 2015, p. 122). The global navigation system refers to the hyperlinks that should consistently be present on all webpages in the form of a navigation bar to allow direct access to important pieces of information (Rosenfeld et al., 2015, p. 122; Wodtke and Govella, 2009, p. 5). This is also referred to as the primary navigation (Duckett, 2011, p. 472). It is convention to put the main (global) navigation bar at the top of the page (Rosenfeld et al., 2015, p. 129). Additionally, local navigation menus should be provided that allow users to explore pages within each of the sections (Duckett, 2011, p. 472). Local navigation systems allow users to explore links that are relevant to the information being displayed on the current page and can typically be found on the side of a page in the form of a sidebar. This is also referred to as the secondary navigation (Duckett, 2011, p. 472). Contextual navigation links are links that are specific to a particular page, document, or object (Rosenfeld et al., 2015, p. 122) and can typically be found within bodies of text, for example, within paragraphs.

3.3.4 Search systems

"*How we search information*" (Rosenfeld et al., 2015, p. 49).

Search systems help the user find information when there is too much information to browse. In large websites, search systems are the only efficient means to find specific content pages or all the pages that mention a specific keyword or phrase (Lynch and Horton, 2009).

According to Nielsen (1999, p. 224, 2013), the majority of users are still search-dominant, which means that they will immediately start using the search box when they land on a website, instead of following links in order to navigate through the website. These users know what they want and want to find specific information as quickly as possible.

3.4 Usability evaluation of IA systems

During a heuristic evaluation, the evaluator(s) needs to go through the interface several times to inspect various dialogue elements (Pickard, 2013, p. 113). A dialogue element, as defined by Danino (2001) is an element of a website that contributes to a dialogue with a website's visitors and can be different elements on different websites, depending on the structure of the website. The dialogue elements that are to be evaluated would be identified by the researcher before the heuristic evaluation, and pointed out to the evaluator(s) so they can be investigated, with the purpose of ensuring that each evaluator follows the same process. Each dialogue element must be evaluated against the list of heuristics and the evaluator judges whether each dialogue element complies with the heuristics (Nielsen, 1995a).

Based on Rosenfeld et al.'s (2015) definitions of the four IA component categories, the IA systems that users use to move through a website, i.e., the navigation and search systems can easily be identified as separate evaluable components, i.e., global, local, and contextual navigation (see Section 3.3.3), and search systems (Section 3.3.4), whereas the labelling and organisation systems are more applicable to the website as a whole or any component of a website. Therefore, labelling and organisation systems are difficult to define as evaluable components that can be identified across different websites.

Based on this observation, the navigation and search systems were used as the basis for identifying dialogue elements that can be identified and evaluated across various academic library websites and is presented as an IA framework in Section 5.2.

The organisation and labelling were identified as aspects that can be evaluated within the identified components and was further identified as the first two heuristics in Section 5.1.

4. Analysis of established usability principles and related studies

This section presents the integration of existing lists of usability principles as well as recommendations for each of the heuristics based on results from related studies.

4.1 Integration of existing lists of usability principles

There are various existing sets of principles that can be used for heuristic evaluations. However, a set of principles that applies specifically to the evaluation of the IA of academic library websites could not be found; therefore, a set of principles was compiled for this purpose. The set of heuristics was compiled from an integration of existing lists of principles.

There are three general lists of principles from authorities in the field of usability that can be adapted and used for heuristic evaluations. The three lists that were used are:

- 10 Usability heuristics for user interface design (Nielsen, 1995b)
- Eight golden rules of interface design (Shneiderman et al., 2016)
- ISO 9241 Part 110: 7 dialogue principles (ISO 9241-110, 2006)

The integration was done by comparing the heuristics from each of the lists with each other starting with Nielsen's (1995b) ten heuristics and determining which of Shneiderman's (2016) golden rules and ISO's (2006) dialogue principles correspond with the heuristics and contributes to their explanations and which can stand alone as new heuristics in addition to the ten heuristics. The resulting list consists of fourteen heuristics.

Nielsen (1994, p. 153) states that the labels that were chosen to describe his heuristics are his subjective attempt to abstract the main usability issue, but that it is possible to use other labels instead. For each heuristic that is derived from the existing lists of principles, a descriptive label is identified based on the description of the existing principles and the researcher's subjective interpretation. These identified labels are used in Table 2 as a guide to show what existing principles the new heuristic terms are derived from.

It is to be noted that some principles were split into two or more principles (if it made sense as separate principles). For example, Nielsen's "Heuristic 2: Match between system and the real world" comprises concepts of labelling and organisation systems, therefore it was split into two heuristics with these names.

The table summarises the integration of the heuristics by indicating what principles from the different existing lists correspond to each other and which principles are unique. The terms in the left column are the terms that were identified as the labels that are used in this study to refer to each of the heuristics. They are presented in the table in the order that they were devised, i.e., based on the order of Nielsen's (1995b) heuristics.

The set of heuristics and sub-criteria that resulted from the above integration is presented in Section 5.1. The sub-criteria that resulted from the above integration were revised and expanded to focus on the usability of IA specifically, based on IA literature. For example, usability principles related to visual design aspects were excluded. Visual design refers to aesthetic aspects of the website, including colours, font choices, the overall look and feel, the images, and other elements (Usability.gov, 2013). The visual design of a website is more visible to a user when they first interact with a system, however, if the organisation of the website and its content does not have a good underlying structure, then the visual design will not fix the usability problems (Lynch and Horton, 2009, p. 71). It is further important to note that accessibility is an important aspect of usability. Accessibility refers to how user-friendly the interface is for disabled persons. For example, people who are visually impaired need colour blindness support or larger font sizes. These aspects are dependent on the usability of the visual design aspects of an interface and therefore it is excluded from this study, since the focus of the study is only on the IA.

The list of integrated heuristics were further modified to make them applicable to academic library websites. This was done by evaluating problems that were found in related studies with reference to the integrated set of heuristics. The problems that were found were used to supplement the sub-criteria with recommendations specifically applicable to academic library websites.

Table 2: Integrated heuristics with identified labels

Labels	**Heuristics** (Nielsen, 1995a)	**Golden rules** (Shneiderman et al., 2016)	**Dialogue principles and recommendations** (ISO 9241-110, 2006)
Feedback	Heuristic 1: Visibility of system status	Golden rule 3: Offer informative feedback	Recommendations from dialogue principles 3: Conformity with user expectations, and 4: Suitability for learning.
Labelling	Heuristic 2: Match between system and the real world		Recommendations from dialogue principles 2: Self-descriptiveness and 3: Conformity with user expectations
Organisation	Heuristic 2: Match between system and the real world		
Controllability	Heuristic 3: User control and freedom	Golden rule 6: Permit easy reversal of actions	Dialogue principle 5: Controllability
Consistency	Heuristic 4: Consistency and standards	Golden rule 1: Strive for consistency	Recommendation from dialogue principle 3: Conformity with user expectations.
Error prevention	Heuristic 5: Error prevention	Golden rule 5: Prevent errors	
Task completion support	Heuristic 6: Recognition rather than recall	Golden rule 8: Reduce short-term memory load	Dialogue principle 1: Suitability for the task and a recommendation from dialogue principle 2: Self-descriptiveness
Efficiency features	Heuristic 7: Flexibility and efficiency of use	Golden rule 2: Seek universal usability	Dialogue principle 7: Suitability for individualization
Novice user guidance		Golden rule 2: Seek universal usability	Dialogue principle 4: Suitability for learning
Clutter	Heuristic 8: Aesthetic and minimalist design		Recommendations from dialogue principle 1: Suitability for the task
Error recovery	Heuristic 9: Help users recognize, diagnose, and recover from errors	Golden rule 5: Prevent errors	Dialogue principle 6: Error tolerance
Help documentation	Heuristic 10: Help and documentation		
Context		Golden rule 4: Design dialogues to yield closure	Dialogue principle 2: Self-descriptiveness
Predictable behaviour		Golden rule 7: Keep users in control	Dialogue principle 3: Conformity with user expectations

4.2 Integration of related studies' findings with established usability principles

The discussion below shows how the usability was measured in related studies with regards to the integrated set of heuristics.

Each of the usability problems and recommendations (that were made by each of the studies' researchers) was analysed and categorised under the heuristics where they are the most applicable, based on the discussion of each of the heuristics in Section 5.1. Some of the issues applied to more than one heuristic and were subsequently categorised and discussed under more than one heuristic. Some of the issues were divided into heuristics according to the recommendations that were provided for solving them.

Many of the studies were incomplete in that they do not provide recommendations for all the problems or report on improvements after problems had been fixed.

The Table 3 shows which heuristics were discussed in each of the studies. An "X" is used to indicate that the corresponding study addressed the heuristic. The bottom row indicates the number of studies that addressed each of the heuristics. The heuristics are sorted from most prevalent to least prevalent (from left to right). This refers to how many studies addressed the issue. Language problems were the most prevalent, error recovery and error prevention were the least prevalent, and feedback was not addressed at all (Table 3).

By looking at the table, a pattern can be observed in the amount of heuristics addressed from 2005 to 2016. Less heuristics are addressed in more recent studies. It can be inferred that this is as a result of newer websites having less usability problems. However, this can also be a result of the newer studies being more focussed on evaluating specific aspects.

One of the main observations of the review of related studies is that the most recent studies focused more on search tools and search results and much less on other issues. According to Swanson and Green (2011, p. 222), library website design is moving towards a "Googlized" search, which is a website design with a centralised search box, that searches across various databases and platforms.

The library website-related recommendations that resulted from the above integration is below the discussion of each of the heuristics.

5. Findings

The findings of this study consist of a list of heuristics for the evaluation of the IA of academic library websites as well as an IA framework that can be used to divide an academic library website into different evaluable dialogue elements. Additionally, an evaluation workflow is provided to explain how the heuristics and IA framework can be used.

5.1 Integrated heuristics for the usability evaluation of the IA of academic library websites

The following set of heuristics was compiled and adapted in this study for the evaluation of the usability of the IA of academic library websites, i.e., they relate to the arrangement, organising, structuring, or planning of website content. The heuristics are sorted according to the order in which it was presented in table 2 – i.e., according to the most prevalent heuristics in the related studies. Therefore, it is to be noted that there are fewer recommendations towards the end of the list and no recommendations for the last heuristic.

Below each of the heuristics are the recommendations that are applicable to that heuristic based on the analysis of related studies (discussed in Section 4.2).

Table 3. Summary of occurrences of discussions of heuristics in related studies

Study	Labelling	Organisation	Clutter	Novice user guidance	Help documentation	Efficiency features	Consistency	Predictable behaviour	Context	Task completion support	Controllability	Error recovery	Error prevention	Feedback
George (2005)	X	X	X		X	X	X		X		X			
King and Jannik (2005)	X		X	X			X	X	X				X	
Turnbow et al. (2005)	X	X					X							
Ward (2006)	X	X	X				X							
Manzari and Trinidad-Christensen (2006)	X	X	X	X	X	X	X				X			
MacMillan et al. (2007)	X					X	X			X				
Duncan and Holliday (2008)	X	X			X				X					
Kitalong et al. (2008)			X					X		X				
Mvungi et al. (2008)	X	X		X	X	X			X					
Oldham (2008)	X		X			X		X		X				
Dougan and Fulton (2009)	X	X	X	X			X							
Emde et al. (2009)	X	X		X		X		X						
Rogers and Preston (2009)	X	X	X		X	X			X					
Swanson and Green (2011)	X		X	X	X			X				X		
Tidal (2012)	X	X	X											
Becker and Yannotta (2013)	X	X												
Dominguez et al. (2015)	X	X	X				X							
Pant (2015)	X	X		X	X	X		X						
Chase et al. (2016)				X	X			X						
Wu and Brown (2016)	X	X	X	X	X			X						
Count	18	14	12	9	9	8	8	8	5	3	2	1	1	0

The following discussions of each of the heuristics are based on the integration of the existing usability principles in table 2 and the inclusion of appropriate IA specific sub-criteria, as well as practical findings from related studies, reworded as recommendations.

5.1.1. Labelling

According to Nielsen's (1995b) second heuristic: "Match between system and the real world", the system should use terminology and concepts that the intended user is familiar with and avoid the use of system-oriented terms (Nielsen, 1995b).

One of the recommendations under ISO's dialogue principle 2: "Self-descriptiveness", states that the intended users should immediately be able to comprehend the terminology that is used in a dialogue (ISO 9241-110, 2006, p. 7). There is also a recommendation under ISO's third dialogue principle "Conformity with user expectations" which states that the vocabulary that is used in the system should be based on the user's existing knowledge. It also specifies that it should be familiar to the user in the context of the task, but that it does not "prohibit improvements of established vocabulary to make it better suited for the task".

This aspect of usability corresponds directly to the IA component category, "labelling systems" which also specifies that terminology in labels should correspond to the content it represents (Rosenfeld et al., 2015, p. 82).

Recommendations:

According to related studies in the field of academic library website usability, library jargon that is specific to the library was one of the main problems found on academic library websites and therefore should be avoided (Becker and Yannotta, 2013, p. 7; Dominguez et al., 2015, p. 109; Dougan and Fulton, 2009, p. 234; Duncan and Holliday, 2008, p. 312; King and Jannik, 2005, p. 237; Oldham, 2008, p. 230; Turnbow et al., 2005, p. 227; Ward, 2006, p. 208; Wu and Brown, 2016, p. 161). Common everyday language that users are likely to be familiar with, should be used where possible (Tidal, 2012, p. 97). The language used in labels should be clear (George, 2005, p. 168), concise (Becker and Yannotta, 2013, p. 7), comprehensible (Emde et al., 2009, p. 31), and meaningful (Mvungi et al., 2008, p. 181). Terms that are ambiguous or misleading (Rogers and Preston, 2009, p. 207), vague (Pant, 2015, p. 903), or redundant (Dougan and Fulton, 2009, p. 234) should be avoided. Long labels should start with an identifying keyword (Dougan and Fulton, 2009, p. 233). Different labels that overlap in meaning should be renamed to be more distinguishable.

5.1.2. Organisation

In addition to the discussion in "labelling", Nielsen's second heuristic also states that information should "appear in a natural and logical order" by following real-world conventions (Nielsen, 1995b). This concept is distinct from the first part of the description of the principle, which is concerned with the language that is used in the system. Therefore, they were split into two separate principles since the first one deals with IA labelling systems and the second one deals with IA organisation systems.

Additionally, the following IA-related criteria also applies to this heuristic. Information should be grouped and classified logically (Rosenfeld et al., 2015, p. 58). Documents or categories that are grouped together should fit well with each other and the degree of overlap between categories should be low (Toub, 2000, p. 18). And finally, child content objects should represent parent content objects (Toub, 2000, p. 18).

Recommendations:

The system should be organised to reflect the way users look for information (Turnbow et al., 2005, p. 227). Important links should appear in noticeable locations or main sections and important information should be accessible from the homepage (George, 2005, p. 173). A link to the homepage should be easy to find and listed first if it is in a list of links (George, 2005, p. 175; Manzari and Trinidad-Christensen, 2006, p. 165). Help links should be prominent and easily accessible (Mvungi et al., 2008, p. 179).

The website should use clear organisation and categorisation. A small number of main navigational categories should subdivide information into logical sections (Becker and Yannotta, 2013, p. 15). Multiple pathways to general content areas should be provided (Duncan and Holliday, 2008, p. 312). Content should be structured and grouped correctly (Rogers and Preston, 2009, p. 205) and sorted according to possible user goals (Rogers and Preston, 2009, p. 207).

The website should be easy to navigate (Dougan and Fulton, 2009, p. 236; Tidal, 2012, p. 93). The layout structure should be intuitive (Ward, 2006, p. 210).

5.1.3. Clutter

According to Nielsen's eighth heuristic, "Aesthetic and minimalist design", the system should not provide the user with irrelevant information or information that is not needed for the successful completion of tasks (Nielsen, 1995b). There are two recommendations under ISO 9241's first dialogue principle: "Suitability for the task" that apply to this issue. The recommendations specify that the dialogue should not present the user with information that is not needed for the successful completion of tasks (ISO 9241-110, 2006, p. 10). Additionally, to reduce clutter on a website, Duckett (2011, p. 472) states that links in main navigation bars should be limited to eight links.

Recommendations:

All pages should have simple layouts (Dougan and Fulton, 2009, p. 219) and should be clutter free (Manzari and Trinidad-Christensen, 2006, p. 164). Pages should not contain too many links (Dominguez et al., 2015, p. 118; Dougan and Fulton, 2009, p. 219; Wu and Brown, 2016, p. 165). Additionally, links should not contain too many words (Dominguez et al., 2015, p. 118). Duplication of information on a page should be eliminated (Ward, 2006, p. 208). Non-essential information should not appear in multiple locations on a page (Rogers and Preston, 2009, p. 205). There should be a good balance between breadth and depth (Oldham, 2008, p. 232). Pages should not be too long, requiring users to scroll too much (Oldham, 2008, p. 232). The system should not make a user feel lost (Tidal, 2012, p. 94).

5.1.4. Novice user guidance

According to ISO's fourth dialogue principle, "Suitability for learning" (ISO 9241-110, 2006, p. 10), and Shneiderman et al.'s second golden rule "Seek universal usability" (Shneiderman et al., 2016), additional explanations, rules, and underlying concepts that assist the user in gaining a conceptual understanding of the interactive system should be provided. Additionally, guidance and support should be provided to help the user learn how to use the system (ISO 9241-110, 2006).

Recommendations:

Descriptions for unfamiliar terms should be provided for clarification (Manzari and Trinidad-Christensen, 2006, p. 164). Additional explanations should be provided for basic library terms (instead of changing the labels) (Emde et al., 2009, p. 29; Manzari and Trinidad-Christensen, 2006, p.

164). Tooltips should be used to reveal additional explanations for terms or the target destination of links (Mvungi et al., 2008, p. 177). New users should be provided with clear navigational choices that guide them to the right resources (King and Jannik, 2005, p. 240). Information about expected search results as well of the scope of a search box should be provided so that users will know what search boxes to use (Swanson and Green, 2011, p. 227). Primary search tools should be emphasised (King and Jannik, 2005, p. 240; Swanson and Green, 2011, p. 226). Search results should be annotated automatically to help users distinguish between the different types of results (Swanson and Green, 2011, p. 227). Novice users should be provided with web forms that allow them to communicate with library staff (Pant, 2015, p. 903). Users should be able to differentiate between different resources (Chase et al., 2016, p. 36).

5.1.5. Help documentation

According to Nielsen's tenth heuristic, "Help and documentation" (Nielsen, 1995b), it is still a good idea to provide help, even though a user should be able to use the system without documentation. A user should be able to find documentation easily when the need arises. The help and documentation should be easy to search and easy to use without containing too much information.

Recommendations:

Help documentation should provide help and instructions on using library resources and services (Duncan and Holliday, 2008, p. 307). Instructional help should be provided on how to search for other libraries' resources (Mvungi et al., 2008, p. 178). Tutorials should be accessible from a "Help" link (Mvungi et al., 2008, p. 179). A sitemap should be included as a supplemental navigation system (George, 2005, p. 168; Rogers and Preston, 2009, p. 205).

5.1.6. Efficiency features

According to Nielsen's seventh heuristic, "Flexibility and efficiency of use", a system should incorporate ways for the expert user to speed up the interaction, such as shortcuts, which in turn must not affect novice users (Nielsen, 1995b). This means that it must allow the expert user to navigate faster with less frequent actions.

This principle is equivalent to Shneiderman's second golden rule, "Seek universal usability", which states that the design must cater for various users regarding aspects such as experience in computer use, age, and disabilities. A developer can easily add features for expert users such as shortcuts that enable them to work faster (Shneiderman et al., 2016).

Dialogue principle seven, "Suitability for individualisation", is applicable to the feature that Nielsen (1995b) mentioned as an example of features that support "flexibility and efficiency". A dialogue is suitable for individualization if the interaction and presentation can be customised or modified to suit the user's individual capabilities and needs (ISO 9241-110, 2006, p. 14; Travis, 2012, p. 45).

Recommendations:

A site search feature should be provided for users who prefer not to navigate through browsing (Manzari and Trinidad-Christensen, 2006, p. 167; Pant, 2015, p. 912; Rogers and Preston, 2009, p. 205).

Search tools should support the ways users search for information, i.e., if they prefer to search for journal articles directly, the system should allow it (Emde et al., 2009, p. 30).

5.1.7. Consistency

According to Shneiderman's first golden rule: "Strive for consistency", situations that are similar should require similar sequences of actions (Shneiderman et al., 2016). The same conventions (for example, terminology, and layout) should be followed throughout the interface (Nielsen, 1994, p. 153). The system should behave consistently within tasks and across similar tasks (ISO 9241-110, 2006, p. 8).

Recommendations:

The website should have a consistent global navigation structure (George, 2005, p. 168). There should be consistency in the placement and labelling of navigational elements (George, 2005, p. 174; Turnbow et al., 2005, p. 227). The order of links should stay the same on every page (Manzari and Trinidad-Christensen, 2006, p. 165). Terminology should be consistent throughout the website (MacMillan et al., 2007, p. 431). The search box should stay in the same location on each of the webpages (MacMillan et al., 2007, p. 431).

5.1.8. Predictable behaviour

According to Shneiderman's seventh golden rule, "Keep users in control", users should feel like they are in control at all times. This can easily be done by not changing familiar behaviour and by responding to their actions in the way that they expect the system to respond (Shneiderman et al., 2016).

This principle is equivalent to ISO 9241's third dialogue principle, "Conformity with user expectations". A dialogue conforms with user expectations when it corresponds to the user's predictions in the context of the interaction and uses commonly accepted conventions (ISO 9241-110, 2006, p. 8). Recommendations include that "formats should follow appropriate cultural and linguistic conventions".

Recommendations:

Users should know how search boxes will behave before they use them (King and Jannik, 2005, p. 240). Search boxes should not cause confusion (Wu and Brown, 2016, p. 161). Search boxes should make use of web searching conventions (Kitalong et al., 2008, p. 178,193). Information that users expect to find on an academic library website, such as the library's address, telephone number, and library calendar, should be provided (Oldham, 2008, p. 232). Intuitive icons should be used (Emde et al., 2009, p. 25).

5.1.9. Context

According to Shneiderman's fourth golden rule, "Design dialogues to yield closure", the system should inform the user of where they are in a dialogue and if they are in a dialogue that consists of a range of steps/sub-pages, users' progress should be indicated, i.e., they know where they are, and how many steps they are away from the end. According to ISO 9241's second dialogue principle: "Self-descriptiveness" users should also know what they can do next (ISO 9241-110, 2006, p. 7). IA theory specifies that a user's context within the web and the website should be indicated (Rosenfeld et al., 2015, p. 177).

Recommendations:

Breadcrumb trails should be provided to assist users with navigation and context (King and Jannik, 2005, p. 240; Mvungi et al., 2008, p. 180). Labels should be grouped under subcategories if main categories are too broad (Duncan and Holliday, 2008, p. 309; Rogers and Preston, 2009, p. 207).

5.1.10. Task completion support

According to Nielsen's sixth heuristic, "Recognition rather than recall", all objects, actions, and options must be made more visible so that users are not required to remember information between different dialogues, thus minimising the user's memory load during the interaction. A user should also be able to access instructions for using the system anytime, when needed (Nielsen, 1995b).

This principle is equivalent to Shneiderman's eighth golden rule, "Reduce short-term memory load" which states that the system should not require a user to remember aspects of the system to complete a task because they have a "limited capacity for information processing in short-term memory". The system must not require a user to remember information from one screen to use it on a different screen (Shneiderman et al., 2016).

This problem is directly addressed by ISO 9241's first dialogue principle, "Suitability for the task". A dialogue is suitable for a task if it helps the user to complete the task effectively and efficiently. It also specifies that the user should be able to focus on the task and not the technology used to perform the task (ISO 9241-110, 2006, p. 5). The first recommendation states that the user should be presented with all the information that is needed for the successful completion of the task (ISO 9241-110, 2006, p. 5), which corresponds with Nielsen's (1995b) description of heuristic six. Other recommendations include that the "format of input and output should be appropriate to the task" or that default values should be provided where typical input values are required (ISO 9241-110, 2006, p. 8). One of the recommendations from ISO's second dialogue principle: "Self-descriptiveness" is also relevant in this context. The recommendation specifies that the information that a user is presented with at any step should guide a user in completing a task (ISO 9241-110, 2006, p. 7).

Recommendations:

The authentication system should be simplified with a single sign-on feature so that users are not required to use a different password to access different parts of the same system (Kitalong et al., 2008, p. 193; MacMillan et al., 2007, p. 432; Oldham, 2008, p. 235).

5.1.11. Controllability

According to Nielsen's third heuristic, "User control and freedom", The system should provide the user with a simple and efficient way to go back to where they came from if they landed in an unwanted situation (Nielsen, 1995b).

This principle is similar to Shneiderman's sixth golden rule, "Permit easy reversal of actions". This principle states that actions taken by a user should be reversible. When a user knows that they are allowed to undo errors, this feature relieves anxiety and encourages them to explore the system (Shneiderman et al., 2016).

This principle is similar to ISO 9241's fifth dialogue principle, "Controllability", which states that the user must have control over the pace and sequence of the interaction (ISO 9241-110, 2006, p. 11; Travis, 2012, p. 45). A dialogue is considered controllable if it allows the user to initiate and control

the direction and the pace of the interaction until the user has reached their goal (ISO 9241-110, 2006, p. 11).

Recommendations:

The website should provide functionality that allows a user to go back to previous pages, such as an interactive breadcrumb trail (George, 2005, p. 177; Manzari and Trinidad-Christensen, 2006, p. 167).

5.1.12. Error recovery

According to Nielsen's ninth heuristic, "Help users recognize, diagnose, and recover from errors", all error messages should be expressed in plain language and must clearly indicate what the problem is. It must also allow the user to solve the problem by suggesting an appropriate solution (Nielsen, 1995b).

This principle is equivalent to the second part of Shneiderman's fifth golden rule, "Prevent errors", which states that a system should allow a user to recover easily when they have made an error, by detecting that they have made an error and by providing clear instructions to a simple solution (Shneiderman et al., 2016).

This principle is also equivalent to ISO 9241's sixth dialogue principle, "Error tolerance", which states that the interaction should be forgiving when users make errors (Travis 2012:45). A dialogue is error-tolerant if a user can easily correct their mistakes and still complete their task (ISO 9241-110, 2006, p. 12). Recommendations include that the user should be assisted with detecting and avoiding errors in input, and be provided with explanations to help correct errors. The system must also validate input before processing it, and it should be able to correct errors automatically, if possible. When the system corrects errors automatically, it should inform the user of the correction and provide the user with an opportunity to override the correction (ISO 9241-110, 2006, p. 12).

Recommendations:

A search system should make users aware if it has corrected misspelt search terms (Swanson and Green, 2011, p. 225).

5.1.13. Error prevention

According to Nielsen's fifth heuristic, "Error prevention", the best designs do not only have good error recovery but also prevent users from making those errors in the first place. A system must always eliminate conditions where users are likely to make errors or warn a user through a "confirmation option" about what might happen in situations before they take action (Nielsen, 1995b).

This principle is similar to Shneiderman's fifth golden rule: "Prevent errors", which states that the system should prevent users from making serious errors (Shneiderman et al., 2016).

Recommendations:

A visual cue should be provided next to external links to warn users that they will navigate away from the website (King and Jannik, 2005, p. 240).

5.1.14. Feedback

According to Nielsen's first heuristic, "Visibility of system status", the system must provide appropriate feedback within a reasonable period of time so that the user is always informed about

what is going on (Nielsen 1995). The goal of this principle is to find out if the system clearly communicates with the user to "reveal what is happening in the system" (Nielsen, 1994, p. 154), which includes providing status information and showing that input has been received (Nielsen, 1994, p. 153).

This principle is similar to Shneiderman's third golden rule, "offer informative feedback", which states that there should be feedback for every action that a user takes when using an interface (Shneiderman et al., 2016). It also specifies that the feedback can range from modest to substantial, based on the severity of the action taken by the user, which expands on Nielsen's requirement that the feedback should be appropriate.

The recommendation under ISO's third dialogue principle, "conformity with user expectations", specifies that suitable feedback should be provided for user input and actions immediately where users expect it, that the type and length of feedback depend on user needs, and that the feedback should be constructive (ISO 9241-110, 2006, p. 8). The recommendation under ISO's fourth dialogue principle "suitability for learning" specifies that feedback should help the user gain an understanding of the system and that feedback should provide users with a result that indicates if activities have been accomplished successfully (ISO 9241-110, 2006, p. 10).

Recommendations:

None of the related studies reported on problems relating to feedback or provided relevant recommendations for improvement. This finding is discussed in the conclusion.

5.2 IA framework

In this study, six dialogue elements were identified that can be found on academic library websites.

The dialogue elements were defined based on characteristics of elements that can easily be identified across different academic library websites for the purpose comparing the entire element against the list of 14 heuristics. Dialogue elements should be easily identifiable, distinguishable, comparable across different academic library websites.

The dialogue elements identified in this study were defined and categorised based on the two IA components that users use to move through an interface, i.e., (embedded) navigation systems and search systems (Rosenfeld et al., 2015) as discussed in section 3.3.3 and 3.3.4.

The global (or primary) navigation system (hyperlinks that are consistently present on all webpages), was defined as the first category of dialogue elements. For the purpose of this study, it was split into the two distinguishable elements, header and footer (as a single dialogue element), and a main navigation bar (conventionally at the top of all webpages, as part of or near the header).

The local (or secondary) navigation system (hyperlinks that allow users to explore pages within the website's sections that allow users to explore links that are relevant to the information being displayed on the current page and can typically be found on the side of a page in the form of a sidebar). Consistently appears on most (but not necessarily all) internal pages, however the content can vary from page to page and commonly the homepage has a completely separate layout to internal pages, therefore, the two dialogue elements in this category is the homepage content and internal page content.

Search systems, specifically site search that allows you to search for website related search queries and resource search systems, normally a separate search system on academic library websites that allow users to search for resources available via the library.

These elements are identified as elements that is conventionally present on large websites, however, they may not necessarily be present, for example, some websites may not have a website search feature.

These elements were identified based on the analysis of four academic library websites in Silvis (2017), it is a guideline that can be used if you want to perform comparable evaluations. It is only a guideline and evaluations are not limited to these elements only. If an additional, mutually exclusive dialogue element can be identified in a website, it can be included in the evaluation and compared to the fourteen heuristics, therefore, for every new element that is identified, it should be evaluated using the same procedure of comparing the element to the 14 heuristics.

In summary, an academic library website can be divided into the following six dialogue elements, based on IA literature, as discussed in Section 3.3.3 and 3.3.4:

Global navigation structures

1. Dialogue element 1: Header and footer
2. Dialogue element 2: Main navigation bar

Local navigation structures

3. Dialogue element 3: Homepage content
4. Dialogue element 4: Internal page content

Search systems

5. Dialogue element 5: Site search feature
6. Dialogue element 6: Resource search feature

These dialogue elements are represented in Figure 1 and Figure 2, with numbers that correspond to the numbers in the list above. Industry standard placeholder text, *Lorem Ipsum* (Wilson, 2001), was used to represent body content in the figures.
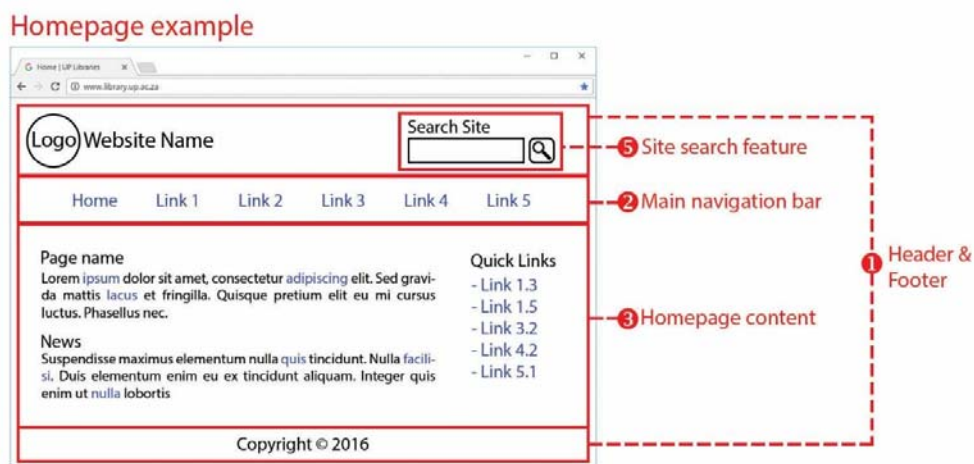

Figure 1: Example of dialogue elements that can be found on an academic library website homepage
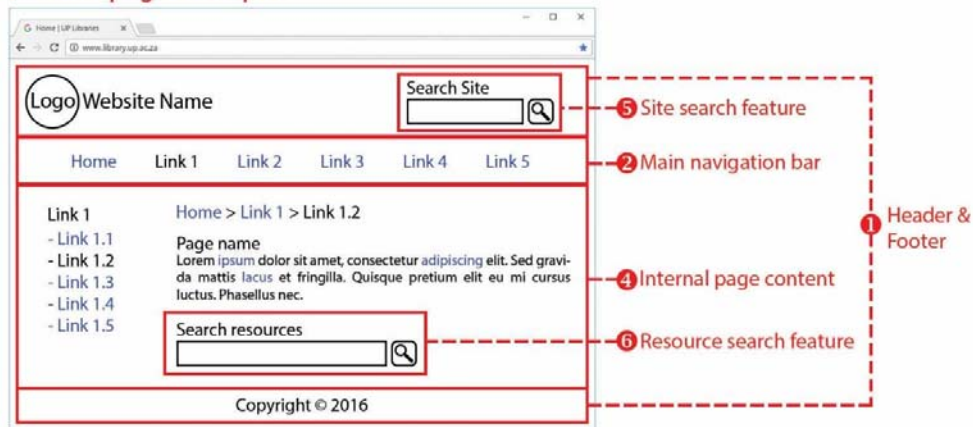
Figure 2: Example of dialogue elements that can be found on an academic library website internal page

An evaluation workflow is presented next to explain how these dialogue elements can be identified in academic library websites and how heuristic evaluations can be conducted on these dialogue elements.

5.3 Evaluation workflow

The following steps can be used as an evaluation workflow for the heuristic evaluators who are involved in the evaluation of the usability of the IA of academic library websites.

Step 1: Identify project participants

The first step involves identifying all of the participants that will take part in the evaluation process. Firstly, the researcher (i.e., the project manager) and evaluators must be identified. The evaluators are not required to be usability experts or information architects. A greater variety in evaluators will result in a greater variety of problems identified, e.g. librarians, web developers, and usability experts.

The project manager oversees the project while the evaluators perform the heuristic evaluations according to the instructions provided by the researcher. The researcher can also be one of the evaluators or the sole evaluator.

Step 2: Identify dialogue elements

The researcher is to identify the dialogue elements that will be evaluated so that each of the evaluators evaluate the same dialogue elements.

For example, the project manager can start by identifying the elements that make up dialogue element 1, the header and footer. A screenshot can be provided for the homepage and an internal page so that the dialogue element can be highlighted and the different elements it consists of can be numbered for ease of reference. This can be done for each of the dialogue elements. This will ensure that all evaluators refer to elements using the same numbering and will make it easier to compare different evaluators' reports.

The IA framework presented in section 5.2 can be used for this purpose.

Step 3: Commence the first pass through the system

After evaluators had been briefed and are familiar with the dialogue elements that are to be evaluated and the heuristics that are to be used, each evaluator is to evaluate the system independently.

When commencing a heuristic evaluation, it should normally consist of two passes through the system, as suggested in Section 3.2. The first pass is when the evaluators familiarise themselves with the system and the various dialogue elements that they are to evaluate. The second pass is conducted in step 4.

If all of the dialogue elements do not exist in the website, this is to be included in the evaluation report, as missing dialogue elements has a great negative effect on the usability of an academic library website. For example, the lack of a site search feature (dialogue element 5) has a great negative impact on usability for users who prefer to use a search bar to move through a website.

Step 4: Evaluate each of the dialogue elements independently

The evaluators are to perform a complete heuristic evaluation using the heuristics presented in Section 5.1 for each of the dialogue elements identified in step 2. Therefore, the evaluators are to start with the first dialogue element, e.g., header and footer, and compare it to the full set of criteria and recommendations, before moving on to the next dialogue element and repeating the same process for each of the dialogue elements. For example, if five dialogue elements were identified for a website, the process will be repeated five times.

Throughout the evaluation, the evaluators should note down all the problems, observations, and possible recommendations for improvement, and present this in the form of an evaluation report.

The evaluator may encounter that each of the criteria are not relevant or that they have no comment, in which case, they can simply state this observation, e.g. this heuristic is not applicable to this dialogue element, and move on to the next heuristic.

Step 5: Writing the report

The format and structure of the evaluators' reports are to be decided by the researcher conducting the research. Each evaluator is to use the same format as this will facilitate the comparison of reports.

For the purpose of consolidating the different reports, each of the evaluators can be provided with template and guidelines to follow when writing the report. For example, evaluators can use the following format for headings DE1: H1, DE1: H2, DE1: H3, etc., where DE denotes the dialogue element number and H denotes the heuristic number for that dialogue element. This will result in information that can easily be grouped together across different reports.

It is recommended that comments are made for each of the heuristics, even if there are no problems, to state this observation. Both problems that have a negative effect on the dialogue element itself and the effect that it has on the overall usability of the site should be noted.

The evaluators should not feel limited by the set of heuristics and sub-criteria. If a problem is found that cannot easily be categorised into any of the heuristics, it is to be reported as an uncategorised problem which can potentially be added to the list of heuristics for future evaluators.

Step 6: Consolidation of the reports

Finally, after the independent evaluations have been completed by the heuristic evaluators, the researcher is to compare the reports to create a single report that reflects the findings from all the evaluators.

If the evaluators used a template as suggested in step 5, this can easily be done by comparing each of the evaluators' corresponding findings for each heuristic evaluated for each dialogue element. The content of each of the evaluators' corresponding findings in the template can be consolidated through qualitative content analysis. This will make it easy to determine if different evaluators made the same or contradicting findings about each of the heuristics, which can be discussed when writing conclusions.

6. Conclusion

This study made various contributions in the fields of usability and IA. Each of the contributions is briefly discussed below.

6.1 Heuristics for the evaluation of academic library websites

The purpose of this study was to present a framework and guidelines on how existing heuristics can be applied to academic library websites so that different evaluators can perform evaluations independently and return comparable evaluation reports.

Existing lists are not necessarily usable without adapting them appropriately first, which was one of the goals that this study aimed to achieve. This study provides a consolidated list of three existing lists of heuristics that was adapted to be applicable to websites in the library environment and provides a framework and workflow for using these heuristics. This list can be reused and applied for the evaluation of various websites.

6.2 IA framework

There are no *specific* guidelines on how a heuristic evaluation should be conducted. The definition by Nielsen (1995a) provides a general recommendation and states that each dialogue element on a website should be compared to a list of usability principles during a heuristic evaluation. However, it does not specifically define the dialogue elements that should be evaluated, only that complicated interfaces can be divided into separate dialogue elements that each focuses on a different part of the interface. This study provided an IA framework that can be used to divide an academic library website into six dialogue elements based on IA theory. Each of the dialogue elements is well-defined and can be evaluated separately.

Even though the IA dialogue elements created in this paper are rather simplistic, it demonstrates a clear starting point for identifying dialogue elements on websites if one is to perform a heuristic evaluation.

6.3 The methods used in this study can be replicated for the evaluation of other types of websites

Website IA and usability is the same inside and outside academic libraries. The dialogue elements and heuristics used in this study can be adapted to apply to different types of websites. The dialogue elements that other websites consist of may differ slightly, however, the same principles discussed in Section 3.3.3 and Section 3.3.4 can be used to identify dialogue elements in other websites. Additionally, the heuristics can also be adapted if necessary.

6.4 Value of collaboration between library staff, web developers, and usability experts

This study proves that a usability expert, specifically an information architect, can be an essential part of a website (re)development team and can make a substantial contribution to the usability of academic library websites. The collaboration between library staff, web developers, and usability experts can have great positive effects on the usability of a website. The evaluation methods presented in this paper provided a strategy that encourages collaboration between people in these different roles. A library website can benefit greatly from a user-centred design process that includes expert evaluation and user-based testing throughout the design process.

6.5 State of usability studies on academic library websites

Based on the review of related studies, universities still struggle with usability problems on their academic library websites. Based on the finding that none of the studies reported problems with regards to feedback, it can be concluded that these studies are also incomplete.

6.6 Future work

Future work can be done to validate the heuristics by conducting heuristic evaluations of existing academic library websites and determining if the list of heuristics is comprehensive enough to address all the problems and to improve the list if not. Additionally, the heuristics and framework devised in this study can be used to conduct a heuristic evaluation of an existing academic library website with the purpose of providing recommendations for improvement.

7. References

Becker, D.A. and Yannotta, L. (2013), "Modeling a library website redesign process: Developing a user-centered website through usability testing", *Information Technology & Libraries*, Vol. 32 No. 1, pp. 6–22.

Brinck, T., Gergle, D. and Wood, S.D. (2001), *Designing Websites That Work: Usability for the Web*, 1st ed., Morgan Kaufmann, San Francisco, available at: http://proquestcombo.safaribooksonline.com/book/web-design-and-development/9781558606586 (accessed 16 April 2016).

Burmester, M. and Machate, J. (2003), "Creative design of interactive products and use of usability guidelines – a contradiction?", *Proceedings of HCI International*, Vol. 1, presented at the 10th International Conference on Human - Computer Interaction, Lawrence Erlbaum Associates, Crete, pp. 43–47.

Chase, D., Trapasso, E. and Tolliver, R. (2016), "The perfect storm: Examining user experience and conducting a usability test to investigate a disruptive academic library web site redevelopment", *Journal of Web Librarianship*, Vol. 10 No. 1, pp. 28–44.

Danino, N. (2001), "Heuristic evaluation - a step by step guide article", *SitePoint*, 3 September, available at: https://www.sitepoint.com/heuristic-evaluation-guide/ (accessed 17 October 2016).

Dix, A., Finlay, J., Abowd, G.D. and Beale, R. (2004), *Human-Computer Interaction*, 3rd ed., Pearson, Harlow.

Dominguez, G., Hammill, S.J. and Brillat, A.I. (2015), "Toward a usable academic library web site: a case study of tried and tested usability practices", *Journal of Web Librarianship*, Vol. 9 No. 2–3, pp. 99–120.

Dougan, K. and Fulton, C. (2009), "Side by side: What a comparative usability study told us about a web site redesign", *Journal of Web Librarianship*, Vol. 3 No. 3, pp. 217–237.

Duckett, J. (2011), *HTML & CSS: Design and Build Websites*, 1st ed., Wiley, Indianapolis, available at: http://catdir.loc.gov/catdir/enhancements/fy1306/2011932082-t.html (accessed 19 September 2016).

Duncan, J. and Holliday, W. (2008), "The role of information architecture in designing a third-generation library web site", *College & Research Libraries*, Vol. 69 No. 4, pp. 301–318.

Emde, J.Z., Morris, S.E. and Claassen-Wilson, M. (2009), "Testing an academic library website for usability with faculty and graduate students", *Evidence Based Library and Information Practice*, Vol. 4 No. 4, pp. 24–36.

Garrett, J.J. (2011), *The Elements of User Experience: User-Centered Design for the Web and Beyond*, 2nd ed., New Riders, Thousand Oaks, available at: http://proquestcombo.safaribooksonline.com/9780321688651 (accessed 19 March 2015).

George, C.A. (2005), "Usability testing and design of a library website: An iterative approach", *OCLC Systems & Services*, Vol. 21 No. 3, pp. 167–180.

Gullikson, S., Blades, R., Bragdon, M., McKibbon, S., Sparling, M. and Toms, E.G. (1999), "The impact of information architecture on academic web site usability", *The Electronic Library*, Vol. 17 No. 5, pp. 293–304.

Hasan, L. (2013), "Heuristic evaluation of three Jordanian university websites", *Informatics in Education*, Vol. 12 No. 2, pp. 231–251.

Henry, S.L. (2012), "WCAG overview", 2 October, available at: https://www.w3.org/WAI/intro/wcag.php (accessed 13 October 2016).

Information Architecture Institute. (2013), "What is IA?", 18 April, available at: http://iainstitute.org/en/learn/resources/what_is_ia.php (accessed 4 May 2014).

ISO 9241-11. (1998), "Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 11: Guidance on usability", 19 March, available at: https://www.iso.org/obp/ui/#iso:std:iso:9241:-11:ed-1:v1:en (accessed 3 October 2014).

ISO 9241-110. (2006), "Ergonomics of human-system interaction -- Part 110: Dialogue principles", available at: https://www.iso.org/obp/ui/#iso:std:iso:9241:-110:ed-1:v1:en (accessed 8 October 2015).

King, H.J. and Jannik, C.M. (2005), "Redesigning for usability: Information architecture and usability testing for Georgia Tech Library's website", *OCLC Systems & Services*, Vol. 21 No. 3, pp. 235–243.

Kitalong, K.S., Hoeppner, A. and Scharf, M. (2008), "Making sense of an academic library web site: toward a more usable interface for university researchers", *Journal of Web Librarianship*, Vol. 2 No. 2–3, pp. 177–204.

Krug, S. (2014), *Don't Make Me Think, Revisited a Common Sense Approach To Web Usability*, 3rd ed., New Riders, Berkeley, available at: http://proquestcombo.safaribooksonline.com/book/web-design-and-development/9780133597271/firstchapter (accessed 17 March 2015).

Lazar, J., Feng, J.H. and Hochheiser, H. (2010), *Research Methods in Human-Computer Interaction*, 1st ed., John Wiley & Sons, Chichester, available at: http://books.google.co.za/books?hl=en&lr=&id=H_r6prUFpc4C&oi=fnd&pg=PT17&ots=xYZ9Hk9eIH&sig=2oA_F4qnTxmZwXZ6HXXVNoTp7uM (accessed 28 August 2014).

Lynch, P.J. and Horton, S. (2009), *Web Style Guide: Basic Design Principles for Creating Web Sites*, 3rd ed., Yale University Press, London, available at: http://webstyleguide.com/wsg3/3-information-architecture/index.html (accessed 23 March 2015).

Macefield, R. (2014), "An overview of expert heuristic evaluations", *UX Matters*, 2 June, available at: http://www.uxmatters.com/mt/archives/2014/06/an-overview-of-expert-heuristic-evaluations.php (accessed 4 May 2016).

MacMillan, D., McKee, S. and Sadler, S. (2007), "Getting everyone on the same page: A staff focus group study for library web site redesign", *Reference Services Review*, Vol. 35 No. 3, pp. 425–433.

Manzari, L. and Trinidad-Christensen, J. (2006), "User-centered design of a web site for library and information science students: Heuristic evaluation and usability testing", *Information Technology & Libraries*, Vol. 25 No. 3, pp. 163–169.

Mustafa, S.H. and Al-Zoua'bi, L.F.S. (2008), "Usability of the academic websites of Jordan's universities: An evaluation study", *Proceedings of the 9th International Arab Conference for Information Technology*, Tunisia, pp. 31–40.

Mvungi, S.H., de Jager, K. and Underwood, P.G. (2008), "An evaluation of the information architecture of the UCT Library web site", *South African Journal of Libraries & Information Science*, Vol. 74 No. 2, pp. 171–182.

Nielsen, J. (1994), "Enhancing the explanatory power of usability heuristics", *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, presented at the SIGCHI Conference on Human Factors in Computing Systems, ACM, New York, pp. 152–158.

Nielsen, J. (1995a), "How to conduct a heuristic evaluation", *Nielsen Norman Group*, 1 January, available at: https://www.nngroup.com/articles/how-to-conduct-a-heuristic-evaluation/ (accessed 1 October 2016).

Nielsen, J. (1995b), "10 Usability heuristics for user interface design", *Nielsen Norman Group: Evidence-Based User Experience Research, Training, and Consulting*, available at: https://www.nngroup.com/articles/ten-usability-heuristics/ (accessed 12 January 2015).

Nielsen, J. (1999), *Designing Web Usability*, New Riders, Indianapolis.

Nielsen, J. (2012), "Usability 101: Introduction to usability", *Nielsen Norman Group*, 4 January, available at: http://www.nngroup.com/articles/usability-101-introduction-to-usability/ (accessed 1 August 2014).

Nielsen, J. (2013), "Converting search into navigation", *Nielsen Norman Group*, 16 March, available at: https://www.nngroup.com/articles/search-navigation/ (accessed 13 October 2016).

Nielsen, J. and Mack, R.L. (1994), *Usability Inspection Methods*, John Wiley & Sons, New York.

Norman, D.A. (1988), *The Psychology of Everyday Things*, Paperback Book Club edition., Basic Books Inc., New York.

Oldham, B.W. (2008), "Focus groups and usability testing in redesigning an academic library's web site", *Journal of Web Librarianship*, Vol. 2 No. 2–3, pp. 219–246.

Pant, A. (2015), "Usability evaluation of an academic library website: Experience with the Central Science Library, University of Delhi", *The Electronic Library*, Vol. 33 No. 5, pp. 896–915.

Petrie, H. and Bevan, N. (2009), "The evaluation of accessibility, usability, and user experience", in Stepanidis, C. (Ed.), *The Universal Access Handbook*, Vols. 1-0, CRC Press, Boca Raton, pp. 1–16.

Pickard, A.J. (2013), *Research Methods in Information*, 2nd ed., Facet Publishing, Chicago, available at: http://cds.cern.ch/record/1513638 (accessed 12 September 2014).

Preece, J., Rogers, Y. and Sharp, H. (2015), *Interaction Design: Beyond Human-Computer Interaction*, 4th ed., John Wiley & Sons Ltd, Chichester.

Rogers, R. and Preston, H. (2009), "Usability analysis for redesign of a Caribbean academic library web site: A case study", *OCLC Systems and Services*, Vol. 25 No. 3, pp. 200–211.

Rosenfeld, L. and Morville, P. (1998), *Information Architecture for the World Wide Web*, O'Reilly &

    Associates, Inc., Sebastopol, CA, USA.

Rosenfeld, L., Morville, P. and Arango, J. (2015), *Information Architecture: For the Web and Beyond*,

    4th ed., O'Reilly Media, Sebastopol, available at:

    http://proquestcombo.safaribooksonline.com/book/web-development/9781491913529

    (accessed 8 June 2016).

Sherwin, K. (2016), "University websites: Top 10 design guidelines", *NNGroup*, 24 April, available at:

    https://www.nngroup.com/articles/university-sites/ (accessed 22 February 2017).

Shneiderman, B. (1986), *Designing the User Interface: Strategies for Effective Human-Computer

    Interaction*, 1st ed., Addison-Wesley Longman, Boston.

Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S., Elmqvist, N. and Diakopoulos, N. (2016),

    Designing the User Interface: Strategies for Effective Human-Computer Interaction, 6th ed.,

    Pearson, Boston.

Silvis, I.M. (2017), *Heuristic Evaluation of the Information Architecture of Academic Library Websites*,

    Unpublished master's dissertation, University of Pretoria, Pretoria, April.

Stewart, T. and Travis, D. (2003), "Guidelines, standards, and style guides", in Jacko, J.A. and Sears,

    A. (Eds.), *The Human-Computer Interaction Handbook*, 3rd ed., Lawrence Erlbaum

    Associates, London, pp. 991–1005.

Swanson, T.A. and Green, J. (2011), "Why we are not Google: Lessons from a library web site

    usability study", *Journal of Academic Librarianship*, Vol. 37 No. 3, pp. 222–229.

TecEd. (2016), "Heuristic evaluation", available at: http://teced.com/services/usability-testing-and-

    evaluation/heuristic-evaluation/ (accessed 1 October 2016).

Tidal, J. (2012), "Creating a user-centered library homepage: A case study", *OCLC Systems & Services*,

    Vol. 28 No. 2, pp. 90–100.

Tognazzini, B. (2014), "First principles of interaction design (revised & expanded)", *askTog*, 5 March,

available at: http://asktog.com/atc/principles-of-interaction-design/ (accessed 15 June

2015).

Toub, S. (2000), *Evaluating Information Architecture*, Argus Associates, Ann Arbor, available at:

http://argus-acia.com/white_papers/evaluating_ia.pdf (accessed 17 February 2015).

Travis, D. (2012), *Bluffers' Guide to ISO 9241*, 8th ed., available at:

http://www.userfocus.co.uk/resources/iso9241/part110.html (accessed 13 October 2015).

Turnbow, D., Kasianovitz, K., Snyder, L., Gilbert, D. and Yamamoto, D. (2005), "Usability testing for

web redesign: A UCLA case study", *OCLC Systems & Services*, Vol. 21 No. 3, pp. 226–234.

Usability.gov. (2013), "Visual design basics", 8 October, available at: http://www.usability.gov/what-

and-why/visual-design.html (accessed 27 January 2015).

Ward, J.L. (2006), "Web site redesign: The University of Washington Libraries' experience", *OCLC*

Systems and Services, Vol. 22 No. 3, pp. 207–216.

Wilson, J. (2001), *Lorem Ipsum - All the Facts*, available at: http://www.lipsum.com/ (accessed 22

July 2016).

Wodtke, C. and Govella, A. (2009), *Information Architecture: Blueprints for the Web*, 2nd ed., New

Riders, Berkeley, available at:

http://proquestcombo.safaribooksonline.com/9780321591999 (accessed 23 March 2015).

Wu, J. and Brown, J.F. (2016), "Website redesign: A case study", *Medical Reference Services*

Quarterly, Vol. 35 No. 2, pp. 158–174.

Zahran, D.I., Al-Nuaim, H.A., Rutter, M.J. and Benyon, D. (2014), "A comparative approach to web

evaluation and website evaluation methods", *International Journal of Public Information*

Systems, Vol. 10 No. 1, pp. 21–39.