

The impact of information architecture on academic web site usability

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Abstract: Recent studies of web-site use indicate that people do not come to the web for an 'experience', they come for information. Yet, to date, web-site design has been synonymous with the 'look and feel' of a site overlooking the significance of a site's information architecture. In this study, we assessed the effect of the information architecture of an academic web site: how information is categorised, labelled and presented, and how navigation and access are facilitated. Twenty-four participants from six faculties attempted to answer typical questions often asked within an academic milieu. They were able to find the answers to just over half the questions successfully and, in subjective assessments, gave the site a failing grade. We address how the information architecture affected their ability to negotiate the site and, additionally, make recommendations for the key ingredients: information design, access tools, and navigational aids.

1. Introduction

The web is used as a source of information and for the dissemination of information by many different public and private organisations. After many usability tests, Nielsen (1999) concluded that people do not come to the web for an 'experience' - they come for information. Similarly, Kahle who monitors use of, and archives, the web has reported that 'roughly two-thirds of users are looking for specific information' (Korman, 1998). Yet, the impact of a web site's information architecture on the ability of a user to navigate that site is overlooked by many web-site designers, who tend to focus primarily on the site's 'look and feel'. How information is categorised, labelled and presented and how navigation and access are facilitated - the information architecture - determines not only whether users will and can find what they need, but also affects user satisfaction and influences return visits. This issue is not just a matter for traditional purveyors of information. It also affects e-commerce sites. Recently, Forrester Research concluded that poorly designed web sites can lose 50 per cent of potential sales when people cannot find what they are looking for, and that 40 per cent of users do not return to a site when that first experience is negative (Harley, McCarthy and Souza, 1998).

Results from studies of e-commerce web sites (eg, Tilson, Dong, Martin and Kieke, 1998; Harley,

McCarthy and Souza, 1998) offer insights to universities which also operate in a competitive marketplace. Speculatively, potential students may not return to a university site if their information needs are not met in the initial visit, or if the information is difficult and frustrating to locate. In addition, the efficiency and effectiveness of current students and faculty may be compromised when the information organisation is not so intuitive that users can negotiate clear pathways. Finally, a poorly designed web site projects a poor corporate image to alumni and potential sponsors.

Academic web sites service many different user groups from potential recruits to current students; from faculty, staff and alumni, to benefactors and partners. These heterogeneous groups have diverse needs: some functional ('how do I register?'), some informational ('what are the pre-requisites of course X?'), some structural ('who is the dean of faculty X?'), some time-related ('when is study week?') and some with spatial characteristics ('how do I get to department X from here?'). Is the information architecture of a web site sufficiently intuitive to enable users to respond efficiently to concerns such as these? To answer this question, we examined the impact of information architecture on the usability of one such academic web site, that of Dalhousie University, a site that has won three awards within the last five years.

2. Related Research

2.1 Web-site usability and information architecture

The visual appearance and impact of a web site is but one aspect of web site design. Utility, the ability of the web site to do functionally what it is supposed to do, is another. A third aspect often overlooked is usability: how effectively a person can use that functionality. Norman (1988) explained that products are usable when a person can figure out what to do with them and when the person can tell what is going on. In essence, a site may be visually appealing, contain all the resources that meet the site's objectives, but still be humanly unusable. Spool (1998) in a user study of nine e-commerce sites found that, although graphics may have an important marketing effect and visual impact on the user, graphic design elements had no correlation (positive or negative) with a user's success in finding information. How effectively the user navigated the site was more significant.

Information architecture has been defined as 'simply a set of aids that match user needs with information resources' (Davenport, 1997), and as 'a structure or map of information which allows others to find their personal paths to knowledge' (Wurman, 1996). Rosenfeld and Morville (1998) popularised the concept by using it to define a blueprint for information organisation and access for web sites. Their blueprint specifies the classificatory structure, labelling of concepts within that structure, navigation and searching systems. This is not a new approach, but defines an information ecology that has a basis in theories of the organisation of knowledge (Shera, 1965; Ranganathan, 1937; Foskett, 1996), in cognitive psychology (Lakoff, 1987; Rosch, 1975; Roth and Shoben, 1983; Medin, 1989), and in menu design research (Norman, 1991; Paap and Cooke, 1997) and hypertext navigation (Woodhead, 1991; McKnight, Dillon and Richardson, 1991).

The foundation of such a blueprint is a classificatory scheme that includes classes and subclasses that are hierarchically ordered so that each class shares the same or similar attributes and characteristics. Ideally, each class represents a distinctive concept with discriminating and unambiguous labels and with controlled lexical relations: synonymy, homonymy, polysemy, metonymy, hyponymy/hyperonymy, meronymy and antonymy. In essence, this is standard menu design for information retrieval systems (Giroux and Belleau, 1986; MacGregor and Lee, 1987) with roots in the traditional organisation of knowledge.

Information retrieval menus typically represent the key topics or categories of information. But a body of information may be organised in many different ways: mirror an organisation's formal structure, reflect the functional use of the site, provide pathways by client need and interest, reflect a chrono-

logical sequence, reveal the frequency of use, or show a geographical orientation. Often one method is chosen as a single pathway to the information base.

In addition, the framework may be represented in different forms: as hierarchical or tree structures, the traditional approach; or as cyclic/acyclic networks that provide multiple and parallel pathways to the same information node. These lists may be presented in a simple or graphic-enhanced textual-list, as an abstract visual representation of the structure, eg, a sitemap, or as a map of the organisation (Shneiderman, 1998). The framework may also be hidden from the user. A blueprint also identifies two additional aspects. The first specifies how the structure will be navigated and how the user will identify position, eg, at the top of the structure. The second is complementary to information design: it provides for other types of access tools (Rosenfeld and Morville, 1998).

The choices available for an information architecture are myriad but, optimally, must suit the purposes for which the site is intended and meet the needs of its user group. Many schemes exist within the organisation of information (Taylor, 1999) for designing classificatory structures and labelling concepts. Similarly, much research has been conducted on the representation and presentation of menu structures (Norman, 1991; Papp and Cooke, 1997). Unlike the design of traditional online catalogues and video-text systems, web-sites often serve two primary purposes: to find information and to perform a task, eg, request an item on inter-library loan, register for a course, order a product, play a game and so on. Integrating both to serve multiple user groups is a complex task. The resulting information architecture must be easy to use and/or learn, with a clearly understood structure that is represented by distinctive labeling. It must be humanly usable.

2.2 Studies of Academic web-sites

Few studies of any aspect of academic web-sites have been conducted. Typical is that of Stover and Zink (1996) who evaluated forty randomly selected university and college library web sites in Canada and the United States on the assumption that librarians would provide exemplary models of well organised sites. They used ten criteria that included the number of links on a home page, the number of typographical errors present on a page and the purpose of the site. Notably, none of the criteria specifically addressed information architecture. Yet, Stover and Zink (1996) concluded that 'many of these pages are badly designed, difficult to navigate and a poor reflection on the institution'. Similarly, King (1998) examined the pages of research libraries in another web-site feature-counting exercise.

Corry, Frick and Hansen (1997) applied user-centred design principles to the redesign of a university Web site. Initially, they conducted a needs analysis to identify the types of information that potential

users of the web site might seek. Potential users included high school students, current students, faculty, staff and alumni. New web-site prototypes were developed; a subset of the 339 questions collected in needs analysis were used in a series of user tests comparing new prototypes with the old structure. Despite this systematic approach, Corry and colleagues only allude to the information organisation problem in their redesign. In the labelling of menu choices, for example, the formal name assigned to the university housing division, 'Halls of Residence', was assigned as an option in the hierarchical menu structure. Yet 'housing' was shown to be a more clearly understood term in user testing. Corry and colleagues reported the need for each named link to match its destination, which on the surface seems a reasonable request. Yet the distinction is really one of concept class and the name of an instance of that class (Buchanan, 1979). Arguably, 'housing' is the basic level of categorisation, the one most readily distinguishable from other categories (Rosch, 1975). In the housing example, user interests were compromised at the expense of seeming to be consistent within the organisation's formal structure. No other studies of information architecture of academic web sites were uncovered during our investigation.

3. Dalhousie University's Web Site

The Dalhousie University web site (www.dal.ca) was chosen for this study because it had received awards for its design, it was a convenient choice as a body of users was accessible for user testing and, more importantly, it had a limited number of options for navigating the site. As illustrated in Figure 1, this web site has five main menu choices at the top level (or 'homepage'), each with annotated entries that elaborate on the option. (Figure 2 illustrates the options on the second level for each of these menu choices.) To the extreme left of the

main menu block are four other choices: 'News', 'Events', 'What's New?' and 'DalTech', each of which accesses a page of links; this latter set is present only at the homepage. The four buttons on the bottom of the screen lead to different types of information. *Policy* provides an explanation of the Dalhousie policies on web-site standards; *Help* provides a single screen of useful items primarily about web page options at Dalhousie; *Search* leads to a listing of tools, many of which are external search tools, but neither searches only this site, except for those that search for people at Dalhousie. *Contact* lists names and phone numbers for registration and admission.

The top two menu levels (homepage and second-level) are consistent in style and presentation. The four buttons on the bottom in Figure 1 appear on all pages with the exception of *Policy* which is dropped at the second and third levels in favour of a *Dal Home* button. Although not evident in Figure 1, the buttons and annotated text to the right of each button are multi-coloured, giving a pleasing visual appearance. This design is applied consistently in



Figure 1: Dalhousie University Web Site as it appeared during the study

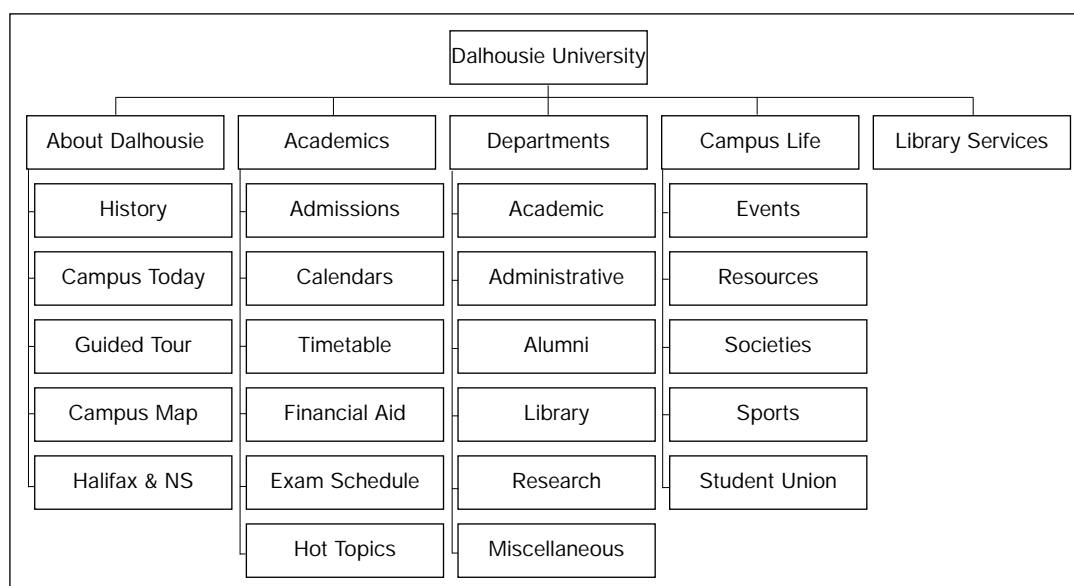


Figure 2: Schematic Representation of the First and Second Level Menu Structure

the top two levels, but changes as the information becomes clearly the responsibility of a particular administrative or academic unit.

At the time of testing, the multi-layered menu was the only pathway through this site; the site had no search engine, no index (except for small sections at lower levels) and no alternative types of access tools such as site maps. Because of a lack of other access methods, the site was ideal for *in situ* user testing of aspects of an academic web site's information architecture.

4. Methodology

4.1 Participants

Twenty four people (nine males and fifteen females) from six Dalhousie University Faculties participated in the study. Half were under 25 years of age, although the ages ranged from under 20 to over 50. The twelve undergraduate students, nine graduate students and three faculty were in general experienced computer and web users; 62.5 per cent had more than five years of computer experience while 75 per cent had used the web for one to five years. The web was also a part of their academic daily life as almost half (45.8 per cent) used the web once per day. Approximately half used the Dalhousie web site from once a day to several times a month. Their use of the Dalhousie web site varied from course selection to job posting as illustrated in Table 1. All participants volunteered and no incentives were given for participation.

To look for information about:	# of Participants (%)
Courses	16 (66.7)
Services	9 (37.5)
Regulations	2 (8.3)
Professors	7 (29.1)
Library	11 (45.8)
Societies	3 (12.5)
Events	3 (12.5)
Other*	6 (25)
*The <i>Other</i> uses were: job postings, off-campus housing, graduate program information, exam schedule and degree requirements.	

Table 1: Reasons for using the Dalhousie Web Site

4.2 Tasks

Participants were assigned one key task: to find the answers to a set of six questions using the Dalhousie web site. To ensure that the questions were representative of typical uses of this web

site, a dozen students and faculty were asked about the reasons for which they previously had accessed the web site, a method somewhat similar to that used by Corry, Frick and Hansen (1997). The six questions used in this study (see Appendix I) came from an analysis of these responses. The questions varied by the location of the answer within the web site and the level of difficulty. No question used terminology present in the top-level menu and all questions had answers on the Dalhousie web site. Questions were randomly assigned to each participant.

In addition, participants responded to a perceptions test containing a series of questions related to their ability to use the web site. This test contained four Likert-scaled and three open-ended questions (see Appendix II). As a final task, participants verbally explained (post task) the approaches taken in responding to questions.

4.3 Materials

Participant sessions were captured using Microsoft Camcorder which enabled the session to be reviewed after the task was completed so that participants could elaborate on the decisions made. WinWhatWhere Investigator, a software product that logs user actions, including pages displayed and the time taken between each mouse click, was used to collect details about user pathways taken while responding to the questions.

4.4 Procedures

Prior to the study all procedures were pre-tested using three graduate student volunteers. The study was conducted over a period of eight days in early November 1998. Participants accessed the Dalhousie University web site using Netscape Communicator 4.05 loaded on a Pentium PC with a 15 inch monitor. The computer, located in a seminar room, was networked to the Dalhousie local area network. Each participant was tested individually.

At the start of the session, participants completed a short demographic survey and were allowed a practise session if they were unfamiliar with Netscape. Participants were given the questions in a stapled bundle with only the first question visible and were given a maximum of three minutes to answer each question. If the answer was not found after three minutes, they were asked to move on to the next question. After answering the six questions, participants responded in writing to the perceptions test. After this was completed, an unstructured interview ensued. Microsoft Camcorder was activated to replay the session while an audio recorder taped the participant's comments. As the session re-played on the screen, the participants commented on the choices made, their reasons for making certain choices, their expectations about the choices and their approach to the question.

5. Results

We used several methods to assess the data for three characteristics:

a) user performance: by assessing the number of questions for which answers were found, the time taken to answer the questions and the amount of time spent choosing from options on the second-level menu;

b) user perceptions: by assessing responses to a series of Likert-scaled questions and analysing the results from the open-ended survey questions;

c) user strategies: by analysing the paths taken to respond to questions and user explanation of their approaches.

We experienced software failure which resulted in missing videos and missing pathways for two participants.

5.1 User Performance

5.1.1 Answers to Questions

Answers to questions were deemed to be 'found' or 'not found.' As this was neither a test of memory nor comprehension, answers which were known in advance but could not be located in the web site were considered 'not found'. The average number of answers that were found was 3.7 (see Figure 3); participants could locate the answers to only 62 per cent of the questions.

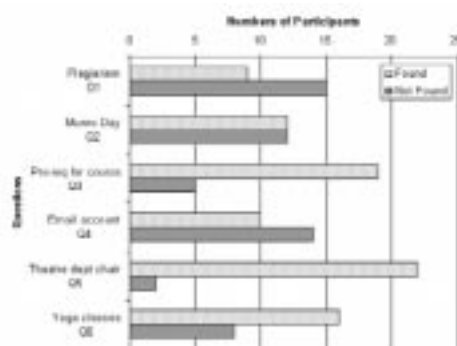


Figure 3: Number of Answers 'Found' and 'Not Found'

5.1.2 Amount of time spent looking for the answer

Previous research suggests that users should take no longer than 60 seconds to find answers to questions at web sites (Bachiochi *et al*, 1997). An expert user of this web site - someone who clearly knew the correct path to take for each question - took on average 13.6 seconds per question, significantly under the recommended time. In this study, participants when successful took on average 88.3 sec-

onds to find an answer to a question, significantly more than the 60 seconds recommended to find information in web-sites ($t = 7.02$, $d.f. = 21$, $p < .0005$) and significantly more than our expert user.

Because participants were asked to stop looking after 180 seconds, we wondered if limiting participants to just three minutes was adequate for this web site, especially since the successful ones took more than a minute to find answers. Unsuccessful participants took 171 seconds per question, which represents both the point at which participants gave up looking and the point at which the researchers asked them to stop. This significantly different amount of time ($t = -5.68$, $d.f. = 21$, $p < .001$) indicates that when the answer was humanly 'findable', it was locatable in much less time than the three minutes allotted to participants.

5.1.3 Amount of time spent examining second-level menu choices

The amount of time spent making decisions among menu choices indicates the degree of difficulty in interpreting the terms or differentiating among the terms. The first-level menu (homepage) was not examined because it was the starting point for all of the questions. It was difficult to specify the point at which participants finished reading the questions and began making a selection. This was not the case at the second level. As illustrated in Figure 2, the second-level menus contained between five and eight different menu choices. Participants spent 41.6 seconds choosing and selecting from the second-level menu choices for correctly answered questions and 118.7 seconds for others ($t = -3.20$, $d.f. = 21$, $p < .004$). Thus, when the route was intuitive, participants spent less than half a minute making a selection; when choices were not so intuitive, participants spent nearly two minutes just interpreting and analysing the options.

5.2 User Perception

5.2.1 Quantitative Data

Participants responded to four six-point Likert-scaled questions regarding their perception of the web site (See Appendix II). The cumulative average, when the values assigned the four variables were summed, was 13 out of a possible score of 24, an average of 54 per cent. We additionally examined these ratings to determine if they were influenced by:

- the success of participants in finding answers,
- their prior use of the Dalhousie web site, or
- their academic experience: faculty and graduate students compared with undergraduate students.

a) Success

Success was operationalised as: successful (four to six answers were found) and unsuccessful (one to

three answers were found); twelve participants fit each category. On average, those in the successful group rated the web site 15.3 while those in the unsuccessful group rated it 10.8 ($F(1,23) = 5.3, p = .031$). Thus those who were less successful in finding answers to questions tended to rate the web site lower than those who were more successful.

Each rating was examined to determine if it matched the aggregate rating. As illustrated in Table 2, there were disagreements. The 'ease with which information can be found on the web site' was the only variable in which a significant difference existed between the two groups ($F(1,23) = 8.86, p = .007$). Thus both successful and unsuccessful participants felt somewhat uncomfortable with the web site, did not find the organisation intuitive and were dissatisfied in general with the web site. The unsuccessful participants tended to rate the ease of finding information lower than those who could find answers.

	Perception Ratings		
	Average	Successful	Ratings
Comfort	3.6	4.2	3.1
Easy to Find	3.2	3.9	2.5
Organisation Clear	2.9	3.3	2.5
Satisfaction	3.3	3.8	2.6
Average	13	15.2	10.8
Note: Numbers in bold indicate significant differences at .03 or less			

Table 2: Average Ratings Compared with Level of Success in Answering Questions

b) Web-Site Use

Web-site use was defined as high use and low use. Slightly more than half (thirteen) of the participants used the Dalhousie web site from once a day to several times per month (defined as 'high use'); the remaining participants (eleven) used the site more rarely or never (defined as 'low use'). Overall, there were no statistically significant differences between the high use and low use groups in the aggregate ratings. The amount of prior experience did not impact their perception of the web site.

Individual ratings were also examined. Of the four variables, only the one that measured perceptions of information organisation (See Table 3) was significantly different ($F(1,22) = 5.18, p = .033$). Those who used the Dalhousie web site more frequently

	Perception Ratings		
	Average	Low Use	High Use
Comfort	3.6	3.2	4
Easy to Find	3.2	2.9	3.5
Organisation Clear	2.9	2.3	3.4
Satisfaction	3.3	3	3.5
Average	13	11.3	14.4
Note: Numbers in bold indicate significant differences at .033			

Table 3: Average Perception Ratings Compared with Frequency of Use of the Web Site

tended to rate the organisation higher than the infrequent users (2.3 for the infrequent users and 3.4 for the frequent users, out of a possible score of 6). However, the average rating assigned this variable was the lowest of the four.

c) Experience

We also compared the more experienced academics (faculty and graduate students) with the undergraduates. There were no differences between the two.

5.2.2 Qualitative Data

In addition to assessing Likert-scaled variables on the perception test, participants were invited to respond to two additional questions: what did you like most? and what did you like least? Responses tended to be related to five topics: the visual impact, the access tools, labelling, categorisation, and content:

Visual Impact

In general, participants found the site visually attractive, although some recognised that these aspects did not extend throughout the site. The attention to visual appearance was not always evident at the school/department sections of the site.

Access Tools

The most frequently mentioned omission was the lack of a search engine. On the other hand, some found the alphabetical indexes, eg, in the calendar section, useful. Some menu structures were considered confusing. As one person said: 'It is unclear what the various icons labelled *Policy*, *Help*, *Contact*, and *Search* are supposed to mean'.

Labelling

The words used in some menu labels and icons were sometimes perplexing. Participants, in particular, identified problems with the top-level menu. As one participant wrote: 'Kind of hard to know if something is under departments or academics'.

Categorisation

The most highly mentioned issue was the confusing categorisation. Said one: 'Sometimes the information was not clear as to where it would be.' Comments like 'poorly organised', 'confusing' and 'I couldn't find anything I wanted to know' were typical.

Content

Participants liked the content. They noted the online calendar and timetable and frequently mentioned the academic departmental information. Some did not realise that there was so much information available on the site.

5.3 User Strategies

User pathways from the top-level menu to the page containing answers were assessed for generalised patterns of behavior in an attempt to understand why participants could not answer the questions and had poor perception of the site. Participants used three strategies in their approach to finding information on this web site: i) matched the concepts behind the labels, ii) used a process of elimination, and iii) used trial and error. In general, they proceeded systematically from the first to the last in an attempt to find an answer.

Participants first examined the question and tried to match their interpretation of the question with one of the five major buttons on the main menu. If the label such as *Departments* or *Campus Life* was not immediately meaningful in the context of the question, they examined the annotation on the right side of the label (see Figure 1), looking for appropriate word or concept matches. If no match was evident, they examined the set of four buttons at the bottom of the page. *Search* was a frequently used option as participants expected to find a place 'to type words into'.

Successful participants correctly interpreted the top-level menu choices and navigated through the menu levels to the correct page. In some cases, the conceptual organisation needed to respond to the question was well understood by participants. For example, when locating the chair of Theatre department, participants zeroed in on *Departments* and then selected *Academics* and finally *Theatre*, using a process somewhat similar to their use of the printed university calendar. Although participants often mentioned the confusion of two same-name labels at different levels of the menu hierarchy (see Figure 2 for the use of *Academic(s)*), they almost instinctively navigated the hierarchy for questions that were department- or course-related. This was not unexpected given that two-thirds of participants had previously used the web site for course information (see Table 1).

When no word or phrase on the homepage was considered an appropriate match, or when the selection from the homepage proved to be a false lead, participants' actions became either a 'process of elimination - nothing looked plausible', or a look for the best match - 'I was just picking anything that seemed reasonable'. When answering the yoga class question, for example, one participant said: 'I went to *Campus Life* because I saw *Sports* as one of the headings. To me it's more a relaxation thing than a fitness thing, but I thought, well, a lack of categories; pick *Fitness*. I was kind of confused here..., but then I saw *Adult Leisure* and I thought "OK, this is closer".' In other cases, participants analogously relied on their real-world knowledge. In responding to the question about a special Dalhousie holiday called Munro Day, one participant said: 'I was guided by my experience with the calendar. That Munro Day should be listed under *Academics*

strikes me as bizarre, but again in a process of elimination, when I didn't find it under *About Dalhousie* I thought that since it was in the hard copy of the calendar it would probably be somewhere in the virtual copy of the calendar.'

When selection after selection did not lead them closer to the answer, participants' actions became less systematic. Said one: 'I think I was just sort of guessing from here - jumping on a link hoping to find an answer. I was hoping that I'd stumble across it, I guess.' They often could not quite believe that the answer was not contained within a page and returned multiple times to the same page.

In the process of navigating up and down the menu pathways, they experienced perceptual confusion with the colourful menu buttons on the top levels of the site. Said one: 'They all look alike and I never know if I'm back at the beginning, at home, or if I'm still in one of the sub-categories.' Thus despite the consistent presentation style of the menus choices, participants got lost in the hierarchy as well as perplexed by the categorisation and labelling.

In an unusual twist, participants attempted to put themselves in the shoes of the designers. In responding to the email question, one participant said: 'I looked at the descriptions for each title on the page and *Campus Life* seemed like the closest so I chose that one first. I really had no idea where to look. I was thinking student-wise.' This person then changed strategies to look at computing sciences, communications and even attempted to find someone who was in charge of computer accounts.

Participants had not unrealistic expectations about what they expected to find underneath the menu choices. To answer the plagiarism question, many participants looked under the *Policy* button at the bottom of the page, believing that it would lead them to the general policies of the different departments. Instead they found the university's policy for its web site. Some thought that *Academic Links of Interest* 'might refer to something else within the Dalhousie web site' and not to a list of external university sites. Trying the *Help* button at the bottom of the page was a last-ditch effort in a hunt for advice on how to proceed, but, it lead only to a list of contact names within Dalhousie.

Participants did not easily abandon the quest for the answer. For example, a typical participant made 21 selections, visited 17 different pages and took nearly three minutes to find out how to get an electronic mail account at Dalhousie. One participant explained his/her process as follows [menu labels are italicised in this transcript]:

'I know that the library and computing services are kind of close together so I first went into the [*Library* page]. Nothing jumped out,

And then I found Internet, but it just talked about resources.

I went back *Home*, figured that it's a *Department*;

I thought maybe *Administrative* - looking for Computing Services.

Then *Academic Computing* - didn't see anything.

Went to the *Killam Library*, but it was just a little story there.

Went to *UCIS* which I wouldn't have gone to if I didn't know what it stood for.

[Went to *Services*]. I figured academic accounts would be a service; I was hoping it would give you something there that would explain how to get an email account.

[went to *Internet Services*] - again because I knew that was what IS stood for.

And then it says *Username Applications* and I suppose again you have to know that you need a username to get an email account.

It doesn't actually spell it out. It doesn't say "email applications". [it says] *Username for Internet service host* which then allows you to have all these things...

Some computer person wrote this page, it's very technical and uses a lot of jargon, words that if all you wanted to know was how can I get email and didn't know anything about Internet Services or usernames or anything like that...'

The above participant was not an anomaly. Even when the participant was familiar with the process, he/she still had difficulties navigating the menu structure. In response to the same email question, one person elaborated: 'That was the one I found hardest to find, and I think I only found it because I'm familiar with their [University Computing and Information Services] web site because I work in the basement of the Killam.

I went to *Campus Life* and then *Resources*:

I thought it might be under *Student Services*.

Then I went to *Academics*, *Departments*, and *Administrative*, because they have services and facilities. ...

I went to the *User Support Help Desk*, then *Email* and *Internet* but there was nothing there. I checked *Email* but it didn't say where to get it.

[I tried *what is my email address* because] I figured that maybe if someone wants to know what their email address is, it would tell you how to get it set up as well, but it wasn't there.

I went to *Services* and scrolled down.

Then I went to *Help Desk*,

Then *FAQs* 'How do I get an email user name?'

In summary, participants attempted to take a systematic approach by following the path from menu to menu interpreting menu labels and differentiating from among those labels at each stage. When this process failed, they became less and less logical in their approach, selecting anything that seemed reasonable. The menu structure did not effectively aid their quest. When the pathway from top-level menu to the information was not straightforward, they got lost in the structure.

6. Discussion

Overall, participants' performance in using the Dalhousie web site to find answers to questions was poor - and these were not difficult questions. These questions represent typical concerns of an academic community. Participants could find the answers to only approximately 60 per cent of the questions. They spent considerably more time looking for answers to the questions than either an expert or the recommended time limit for information search at web sites. In their own assessment, they gave the web site a 55 per cent rating, a D grade on the University's own grading scale. They were clearly dissatisfied with their experience and performance, and this includes those who met with some success and those who could be classed as frequent Dalhousie web-site users. Why was the performance so poor and user perception so unfavourable?

Some participants believed that with more time, they would have found the answers, but some simply gave up looking in frustration and exasperation before the three minutes had elapsed. Interestingly, some were able to find the answers efficiently, while others did not and in one person's words 'would not have been able to find the answer in a million years'. This distinction was also evident in the time participants spent making choices at the second-level menu. They either were able to make a correct interpretation or they spent a considerable amount of time - almost 4.5 times longer - trying to interpret the menu labels. This bi-modal effect likely reflects the diversity of the community and indicates the need for multiple approaches to the information. As one person said: 'I find [keyword searching] much more useful than pre-organised icons; the people who design icons may or may not classify things the same way I do.'

The categorisation of options and labeling of those choices was not clear to all users; menu labels do not adequately describe the content of the pages they lead to. Seeing certain words in the menus led participants to make their choices, and conversely, not seeing anticipated words that they deemed useful led to confusion. Discriminating among the options seemed to be difficult for many participants and there are many instances of this difficulty.

A 'university calendar,' for example, is a well-understood concept - university rules, regulations, cours-

es, faculty and departments - and participants were conversant with that definition as indicated by their facility in navigating the departments and course information. But when confronted with a need to find a Julian calendar, they implanted the menu label, *Calendar*, with the new definition. 'I was trying to find some sort of calendar for school hours or office hours' said one. Another reflected: 'When I go to a web site, I want to be able to find out something specifically. If it says *calendar*, I want a calendar. I want an actual January, February, March. I don't think of a calendar as courses.'

While conceptually participants understood the distinction between the two uses of the word, in practice, when focused on chronology rather than academic matters, they mapped the new concept to the formerly well-understood word. While this may be interpreted simply as the classic homonym problem, noteworthy is the way participants adopted a particular set of expectations about the word once primed. The system should be equally adaptable.

The web site selectively uses formal departmental names as some menu choices, and these choices were often interpreted differently by participants. When looking for the email question, one participant said: 'Maybe I should have gone elsewhere, but I went under *Campus Life* because it says that there are student services there.' Participants defined their notion of a service somewhat differently than the university. UCIS and its information resources were also a problem, except for those already conversant with the University Computing and Information Services Department and its *Facilities and Services Guide*. Corry and colleagues (1997) had a similar problem with *UCS Knowledge Base* which represents a key source of computing information at Indiana University. Users in their study clearly did not understand that it was a valuable source of information and initially ignored it. That behaviour changed when the menu label was converted to the everyday, familiar language: *Answers to computing questions*. Yu, Prabhu and Neale (1998) also replaced corporate-centric link names such as *Business Imaging Systems* with user-centric terms to improve usability.

Participants were clearly confused with the inclusiveness of some terms. For example, *Academic and Departments*, which are individual menu choices on the main menu, were treated by participants as synonymous. The use of these two words reflects the organisational culture of Dalhousie, but the distinction is lost on all who are not insiders. The use of *Academic* in the upper level of the hierarchy is clearly an example of the use of metonymy, and could be interpreted as a metaphor. Metaphors were not found to be successful as menu labels in a previous study (Toms and Kinnucan, 1996). In a second example, *University Regulations* and *Academic Regulations* are two menu options that could be interpreted also as synonyms. Participants distinguished between the two but not with the same interpretation as the web-site designer. As

one participant stated: 'I thought university regulations would be more general things. I thought the academic part because especially where you're writing, that's clearly something academic; that's not walking across the grass in front of the A&A [Arts & Administration Building].' This was confirmed by another who said: 'I suspect that [the answer] is under university regulations, but that is confusing because this [plagiarism] is an academic issue.'

The relationship between the label used and its underlying concept was not clearly delineated in all cases. *Hot Topics* is a concept popularised by the web and considered to be a list of frequently accessed World Wide Web sites. Dalhousie uses it as a subset of *Academics*, to contain a potpourri of items such as convocation information, a guest-book and a picture tour of Dalhousie's campus. This use of the term clearly confused participants who focused on the concept of 'hot'. Said one, 'I tried *Hot Topics* because plagiarism is a fairly hot topic'. In another case, yoga was interpreted as a sport, as a fitness activity and as a relaxation activity; participants who followed one persuasion or the other were clearly baffled by the pathway they were forced to choose. In both of these cases the label chosen was a poor representation of the concept underlying it.

Participants used physical location to inform their choices and seemed to assume that physical proximity in the real world meant conceptual closeness within a menu hierarchy. 'I know that the library and computing services are kind of close together so I first went into there [the Library page].' Other participants were more definitive, explaining that the computer centre was located in the basement of the library and, thus, they started looking under *Library* for information on how to get an email account. 'I figured since I know where it is, downstairs underneath the library, to look under library might make sense.'

In a separate example, one participant went to the *Dalhousie Arts Centre* to look for the chair of the Theatre Department because the department is physically located in the Centre. Making physical proximity synonymous with conceptual similarity is a novel approach from a classification perspective.

In a surprising move, participants did not blame themselves for the inadequacies, but blamed the system, unlike the conclusions of many other studies of computer use. Said one of the plagiarism question: 'This is a really key issue and it is so well hidden that after all these attempts [I could not find it]. That is not a very well designed page.' In fact, poor design not only hid information, but created a false sense of security and reliability.

'They have the possibility for a keyword search; that's a good thing. It didn't end up helping me, but at least it made me feel like if I couldn't find the information it probably wasn't there, which is good. That is information too.'

The keyword search mentioned searches only a sub-site. Yet, the participant assumed that no answer meant, not only that no information was available on the sub-site, but also that no information was available anywhere on the site as a whole.

In addition to categorisation and labelling problems, the Dalhousie web site has poor navigational capabilities. In general, one expects to find a standard menu of navigational aids present on all web pages. The buttons on the bottom of the Dalhousie pages, eg, *Help* and *Search*, are not navigational buttons, and were misleading. More general functions would be consistent with general guidelines and more useful to users. Relying on the navigation provided by browsers such as Netscape and Internet Explorer does not help (Cockburn and Jones, 1996; Bachiochi *et al*, 1997). Second, users are never given cues as to where they were in the menu structure, eg, at the second level, third level, etc, which at times meant that users became lost and confused in the menu hierarchy. Third, the menu hierarchy is narrow and deep, rather than the preferred wide and shallow (Kiger, 1984; Jacko and Salvendy, 1996). Poor navigation demands many mouse clicks to get to a page of information, results in significant cognitive overload for the user, and also contributes to the 'being lost' syndrome.

Clearly, the designers of this web site do not see the university and its programs, services, and general organisation in the same way as the students and faculty; there is a conflict in mental models. From these results, frequency of use is not a contributing factor to the learnability of this site, as frequent users were as dissatisfied as the infrequent users. Typical responses of participants are represented by these two:

Participant #1: 'Now if I really needed to find something this probably isn't the way I would do it since I've realised how hard it is to use.'

Participant #2: 'I've never really gone through it before, and now if I was ever trying to find something I'd think I would never find it and I'd try to find it another way.'

More poignant was the participant who found an answer, but commented on the process:

'I couldn't tell you how I got in there; if I was to do it again, I'd probably go through the same rigamarole for another hour, trying to figure it out.'

Another said: 'I can make a phone call and get the information so much quicker.'

Not unlike many other academic web sites, this site contains the pages from a group of loosely organised units - a set of academic silos - united under a common umbrella. While this describes the organisational culture of many universities, the result is more likely associated with the need to exert auton-

omy and academic freedom, and establish corporate identity within an individual unit or faculty, rather than servicing the needs of the organisation's client base. Participants on the other hand see the site as *the university* - as an integrated whole - a tightly coupled grouping of informational units organised to suit their particular needs. Bringing the two sets of needs together is not an unsurmountable task, but not a straightforward task.

7. Recommendations for Web Site Information Architecture

From our research, people experienced difficulty using a single pathway, distinguishing and interpreting among the choices at various levels and navigating the structure. We recommend that the design of a web site's information architecture address:

Multiple access points

User groups have diverse needs and so predicting and devising solutions that will service individuals is not feasible. Multiple pathways and multiple ways of accessing those pathways will provide multiple options and be more likely to meet the breadth of user diversity. The site should have the following:

Search engine

Users expect to find keyword searching, although keyword searching is not necessarily a panacea for all information problems.

Site map

A visual representation of the structure of a web site gives users a global view of the information contained on the web site, while concurrently providing a local context. The use of site maps may resolve some of the user confusion and feelings of 'being lost'.

Alphabetical index

When search engines and categorical menus fail, an alphabetical index of all pages and the functions represented by those pages provide cues. Users may find the information by recognising the concept. Cognitively, recognition is less intensive and demanding than recall.

Multiple categorical menu structures

Providing a single approach to information access does not address the diversity of potential user groups and their needs. This is amplified below under 'Information Design.'

FAQ (Frequently Asked Questions)

While one might have difficulty conceptualising an FAQ as an access point, FAQs have become a defined and well-understood cybergenre (Crowston and Williams, 1997). Users arrive at a web site with an expectation of finding one.

Navigational aids

Because web sites have an inherent hierarchical structure dictated by the technology, good navigational aids are an imperative. Those aids should be represented as a standard menu on each page and include:

- a) the ability to get to the top-level menu from anywhere on the site (including from sub-sites);
- b) the ability to use/access any of the access tools from anywhere on the web site;
- c) the ability to determine easily one's location within the hierarchy.

Information Design

User pathways are expressed by categorical menu structures which contain four characteristics:

a) Scheme

There are multiple approaches for organising a set of categories:

- i. by semantic topic
- ii. by organisational structure
- iii. by spatial location
- iv. by chronology
- v. by function
- vi. by user group
- vii. by frequency of use

While many web pages use a single type, clearly from this research a hybrid is necessary. The types used will vary with the information to be categorised.

b) Categories

Categories defined within the scheme must be distinct and mutually exclusive. This is particularly important as this determines the pathway that users take.

c) Labelling

Labels must be explicitly related to the concept that it represents, be unambiguous and be written in the language of the user population.

d) Presentation

The menu structure must be broad and shallow. This will minimise effort including mouse clicks, cognitive overload, and so on. Multiple menus can be accommodated simultaneously by grouping elements into like categories based on a theme - one that is defined by the type of scheme in place.

8. Conclusions

The organisation of information, the labelling of concepts and the lack of navigational aids clearly impacts the usability of this web site. In this study, participants were confused by the terminology, some of which is university specific, and by the way the choices were arranged. Dissatisfaction with the site, which has been complimented for its visual appeal, is related to the difficulty of interpreting and navigating the menu structure. While these results may not be definitive, as this is but one study, results indicate a site with problems, especially when 24 users who spanned the campus user groups (representing all but potential students) so clearly cannot find basic everyday types of information.

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Appendix I. Questions used in Study

1. Can a student be expelled from Dalhousie for committing plagiarism?
2. When is Munro Day?
3. What is the pre-requisite for MATH 2001.03 (Intermediate Calculus)?
4. Where does one go to activate an email account?
5. Who is the chair of Dalhousie's theatre programme?
6. What time are yoga classes offered at Dalhousie?

Appendix II. Perceptions Test

Overall web-site usability: Please circle the number that most closely corresponds with your feelings on this experience.

1. I felt comfortable using this web site for these tasks.
Strongly disagree 1 2 3 4 5 6 Strongly agree
2. It was easy to find the required information on the web site.
Strongly disagree 1 2 3 4 5 6 Strongly agree
3. The organisation of information on the web site was clear to me.
Strongly disagree 1 2 3 4 5 6 Strongly agree
4. Overall I was satisfied with this web site.
Strongly disagree 1 2 3 4 5 6 Strongly agree
5. What did you like most about this web site?
6. What did you like least?
7. Other comments: