

**Web-based information searching:
Understanding student experiences to enhance the development of this
critical graduate attribute**

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Citation

Edwards, S. L. (2004) In *3rd International Lifelong Learning Conference, 13th-16th June* (Eds, Appleton, K., Macpherson, C. and Orr, D.) Central Queensland University, Rydges Capricorn International Resort, pp. 106-115.

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ABSTRACT

Exploring essential differences between four categories of variation in student experiences of information searching, this paper outlines each category's structure of awareness. This structure reveals the way in which variation influences learning design to bring about the ways of experiencing searching we want students to engage in.

INTRODUCTION

Analysing student viewpoints, and their references, in submitted papers can be both rewarding and frustrating; rewarding if the student shows great promise and an obvious understanding in their work, and frustrating when it is clear that the student has totally misunderstood the subject matter and failed to recognize, or locate, relevant references. Questions roll around the teacher's brain, begging for answers to this puzzling phenomenon, while answers remain fleeting, vague, and even confusing. What is clear is that student experiences of web-based information searching are varied. Furthermore, their reference lists reveal many students hold a basic ability to search for information, but an inability to perceive resources that are both relevant and significant.

This paper reports research findings highlighting how structural variations reveal the essential differences in student experiences of web-based information searching. The intention is to amplify a previous paper (Edwards & Bruce, 2002), which provided the focus and meaning of four categories of variation in student searching experiences. This paper will show how the identified structural variations can be used to design activities that may bring about the ways of experiencing searching we want students to engage in, so on graduation they are able to search more effectively. In order to understand this, variation theory will be outlined, explaining how to apply this theory in teaching. The implications for both assessment and curriculum design will be provided, along with potential ways to encourage students to increase their searching skills.

THEORETICAL FRAMEWORK

Today's tertiary level students have grown up during the IT revolution. Exposed to popular media culture that suggests someone can "googlehack" or "google" their problem to find an answer, students may have little comprehension of a world where searching for information does not involve a computer. Most believe searching is easy; they find the search window, type in the desired topic, click the search button, scan the results list, and select. Does this simplistic perspective, however, contribute to a lack of understanding of the information environment? We need to know how students approach their searching, in order to help them deal with the information resource environment in a more productive and professional manner.

Information Searching Research

Over the past four decades, there have been numerous research studies into information searching end-user characteristics. For this period the work of the most interest would be Kuhlthau's work looking at students working on assignments and their experiences when using information in the library (Kuhlthau, 1988). This work led her, over the next few years, to eventually describe information literacy in terms of a "way of learning" (Kuhlthau, 1993). Preliminary studies looking at information searching behaviours

(Cole & Kuhlthau, 2000) have suggested that users make an attempt to define what they deem to be information in each individual context. That is, what to one person seems highly relevant, to someone else would be useless, as it does not suit his or her needs in their own work or study environment.

Information science research is showing an emerging interest in applying educational research into the variety of ways needed to understand the searching process (Kuhlthau, 1988; Limberg, 2000a, 2000b). Limberg and Kuhlthau's work is particularly relevant to this study, in that they show that the variation in the users' experience of searching can highlight areas where a gap exists between the search process and the learning outcomes. Limberg's work goes further to suggest that information seeking is actually not content specific, but is a more general process. This process, however, cannot be described without relating it to the content of what is learnt. These latter studies confirm that human factors in web-based searching behaviour must not be ignored.

What is clear, is that the searching experience involves a combination of factors. We need to understand the variation in the experience of internet searchers, and we should be looking at their "way of learning" (Kuhlthau, 1993). In doing so, we may identify why particular search behaviour is evident, and in understanding the underlying reasons for the approach, we may be able to build a framework to help individuals move into more satisfying search experiences.

METHODOLOGY

Based on previous research and teaching observations, this research had a series of broad aims. This paper reports findings from the research aiming to consider the variation in ways students search for information when using the Internet and library databases, and attempts to recommend teaching and learning strategies for curriculum design based on managing student's experiences. Ethical clearance was obtained.

As the research aimed to make sense of the students' understanding of the information searching and retrieval concepts, the research was undertaken using phenomenography (Bowden & Walsh, 2000, p.1). Phenomenography looks at the different ways people experience or conceive a range of phenomenon (Marton, 1988). In simple terms it is a way to describe how things appear to people (Marton & Fai, 1999).

Variation Theory

Central to understanding phenomenography is appreciating how the findings may apply in teaching. Teaching and learning research to date has found that ways of experiencing something are essential to what learning takes place (Shulman, 1986). Marton & Booth contend that qualitatively changed ways of experiencing something is the most advanced form of learning (Marton & Booth, 1997). If we can describe learning as coming to experience something in a changed way, we should also acknowledge that experiencing something must require the ability to discern this new way of seeing the experience. Discernment then, is a significant attribute of learning (Runesson, 1999).

In order to discern a difference, however, we must have experienced a variation from our previous experience. To explain simply, if everything in the world was brown, then we would have no concept of what the word "brown" meant, nor what the word "colour" meant either (Bowden & Marton, 1998; Runesson, 1999). Once shown that apart from brown, there is also blue or green, then we have experienced a variation and

discerned a difference in what we have previously experienced. Variation then is the primary factor needed for discernment, which will lead to learning (Bowden & Marton, 1998). If at the same time we noticed that the object had a different colour and that it was smaller or larger, or of a different texture, then we have simultaneously discerned other aspects of this experience against possible variations. To discern then it is necessary to experience the variation (Runesson, 1999).

Variation, therefore, is a primary factor in encouraging student learning, but in order to understand what variations to use in the classroom to encourage student learning, it is first necessary to understand the varying ways of experiencing something, in this case, information searching. Phenomenography aims to uncover the variations in an experience, and describes these variations as a finite set of categories. These categories reveal the space of the variation, or, the varying ways of seeing information searching. Having found the variations, we can use them to identify ways to encourage students to discern another aspect of the information searching experience, an aspect they have previously not discerned. We can structure the learning environment to ensure students experience the variations of the information searching experience. By doing so, we may encourage learning.

Gathering and Analysing the Data

Using the phenomenographic method the identified variations in the experience of information searching were found. With a broader database than that presented in the previous paper (Edwards & Bruce, 2002), the data gathering encompassed first year, third year, and postgraduate student perspectives. The participants were QUT students (Queensland University of Technology) from the faculties of IT (Information Technology), Science, and Creative Industries (dance students). Different cultures, ages and genders were represented. From 43 interviews, the final transcripts comprise 31 first round interviews and 12 second round interviews. Both interviews were used to identify variation in information searching experiences. The second interview was analysed to reveal students' perceptions of influences on their learning.

Analysis of the data was undertaken according to traditional phenomenographic approaches. After the development of the categories of description of the phenomenon (Edwards & Bruce, 2002), the categories have been further analysed to distil the essential structural variations in which the phenomenon is experienced. In this way, we can clearly identify the variation found in each group's way of looking at the world.

Ways of Experiencing Information Searching

A framework of four categories captures the variation in the student's different ways of searching and learning to search for information. It is important to note that the investigation with first year students in various faculties has confirmed the categories previously reported (Edwards & Bruce, 2002).

Category 1: Information searching is seen as looking for a needle in a haystack.

Category 2: Information searching is seen as finding a way through a maze.

Category 3: Information searching is seen as using the tools as a filter.

Category 4: Information searching is seen as panning for gold.

Expanding each categories awareness structure illustrates the essential differences between them, showing that each may be characterized in terms of different foci, and in different ways of seeing the information environment, the information tool structure,

and their awareness of the quality of information. Table 1 shows the essential category structural variations, and following that each awareness structure is further illustrated.

Table 1 Structure of Awareness for each Category: Significant Differences

	Primary Focus	Internal Horizon Focus	External Horizon	Areas not attended too	Structure of Awareness Summary
Category 1	Search Topic	<ul style="list-style-type: none"> • Strong focus on search box. • Ask for help from a variety of people. • Revert to printed textbooks and dictionaries. • Use one or two favourite search engines. 	<ul style="list-style-type: none"> • Little or no search strategy planning. • little/no use of other search engines (uses favourite). • Rarely considers searching tool structure • Confusion over meaning and use of synonyms or Boolean techniques. 	<ul style="list-style-type: none"> • Unplanned attention to information environment. • Search tools structure is usually not considered. • Information quality seldom considered. 	The student's focus is on the topic. The "haystack" (information environment and search tool formation) is without structure, so it is difficult for students to appreciate environment is designed to help. Often confusion between different tools evident and confusion over tool searching options.
Category 2	Topic & Search Process	<ul style="list-style-type: none"> • Strong focus on using the tools. • Basic search strategies. • Search tool favourites, still. • Library resources more important. • People a primary focus. • Boolean & synonym use understood & used occasionally. 	<ul style="list-style-type: none"> • Little attention to the information environment. • Wildcard concept clearly understood / occasionally used. • Reflection encourages more refined search strategies. 	<ul style="list-style-type: none"> • Barely consider information quality. • Search tool structure remains a mystery. • Public domain Internet databases (like NASA) occasionally used. 	Growing emphasis on using the tools to find the topic. The planning of the search has become more important. Students begin to consider using advanced search features, and begin to speak about information quality aspects, though this is not considered in search strategy. There is a growing awareness of the rich variety of available search tools.
Category 3	Search Tool Structure	<ul style="list-style-type: none"> • Focus on search tools • Topic is secondary. • Structure of information environment clearly understood. • Refined search strategies used. • Search Tool structure understood & actively used in searching • Tools help refine the topic, and filter results. 	<ul style="list-style-type: none"> • External horizon limits blurred. • Term analysis undertaken (thesauri). • Domain searching to limit results • Internet/library databases used as needed. • Use of advanced search features. • External public domain databases considered. 	<ul style="list-style-type: none"> • Information quality not considered in search strategy, but Information quality important • Primary or secondary sources of information are not considered. 	This category's structure of awareness reveals a clear understanding of the information environment, with virtually every aspect of the environment in focus. They have an ability to reflect over results to filter them into a more useable sized set using the search tool features, Boolean and wildcards, and so forth, as their instruments.
Category 4	Information Quality	<ul style="list-style-type: none"> • Information quality has surpassed all other aspects as the major focus. • Clearly, within the internal horizon is virtually every other searching aspect previously considered in the preceding category descriptions. 	<ul style="list-style-type: none"> • The only aspects remaining in the external horizon limits are external database vendors, internet databases (like NASA), and term analysis. • It is not that these aspects are not considered important, they are simply brought into use when, and if, required. 	Nil	Clearly, the focus on the character/quality of the information resource is the major difference from the previous categories. As only primary sources of information are important enough to be included in result sets, the search will be refined to limit results these sources only.

Category 1 Structure of Awareness: Finding a needle in a haystack.

Figure 1 shows the pictorial interpretation of the structure of awareness in Category 1¹. Imagine this image as a lens through which the student views the world. The structure of awareness is broken down into an internal and an external horizon. Within the internal horizon circle, the worldview is clear and in focus. The internal horizon shows us the primary focus of this experience. Here, the primary focus is the topic, with a strong focus on the search box or search window. There is also an emphasis on asking for help from a variety of people, or reverting to textbooks/dictionaries to help

¹ Due to conference paper limits, the Structure of Awareness figures for Category 2, 3 and 4, have not been included. The visual structure of awareness will be provided for each category at the conference.

understand the topic before searching. Students tend to resort to one or two search engines only, their favourites, which they trust because that is what they have always used; usually selected based on the recommendation of peers, teachers or library staff.

Within the external horizon limits, the lens is not as clear, nor the items within it in focus. In this experience, the unfocused outer lens shows us there is only ad hoc attention to planning a search strategy. Despite awareness of the multitude of search engines available, little or no use is made of more than one or two engines. Where the search tool structure has aspects designed to help with searching, they are rarely considered. In fact, numerous aspects of searching are not within the worldview of this experience. For example, Boolean searching techniques and synonym use are in some cases unknown, or they are blurred. They are almost outside the external horizon limits. Students may have heard the use of these terms in classes, but they have little or no understanding of how to use these techniques when searching.

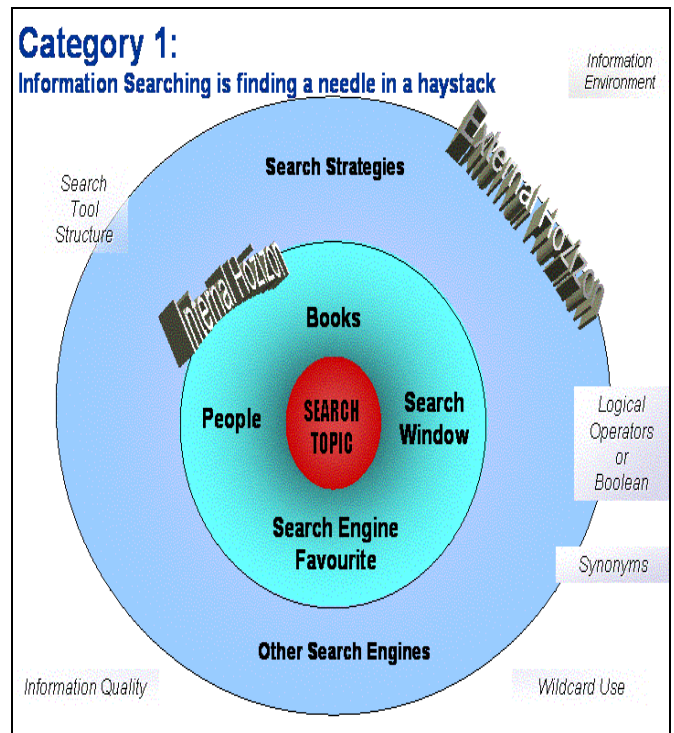


Figure 1 Category 1 Structure of Awareness

Outside the external horizon are a number of searching aspects that are not in focus for this experience, showing how little is attended too in this experience. There is only unplanned attention to aspects of the information environment, with little or no distinction between library catalogues and databases, and the searching tools structure (including search options, advanced features and help) is usually not considered. Aspects such as information quality and wildcard use are seldom considered.

To summarise then, the structure of awareness associated with this experience suggests that the student's focus is on the topic. Although they are aware of the information environment, they have no appreciation of the importance of the structure of that environment, or the structure of the tools that they use to find information. As the environment is a haystack without structure, it is difficult for students to appreciate that the environment may actually be designed to help them find their topic. In this category there is often confusion between different search tools evident and confusion over tool searching options and search features.

Category 2 Structure of Awareness: Finding your way through a maze.

The primary focus of this experience is the topic and the search process; with a growing emphasis on using the tools to find the topic. The internal horizon limits of this experience include a basic search strategy formation, and a continuing strong preference for search tool favourites. Library resources are now considered more important; students suggest using the catalogue to understand their topic. People remain a primary focus for this experience. Boolean and synonym use is occasionally considered more important, and now clearly understood, but likely to be used after some reflection has

been made on the initial search results. The experience includes a much stronger focus on using the tools to find the information they require.

Within the external horizon limits, some attention, on an ad hoc basis, is paid to aspects of the information environment. More clearly in focus now is wildcard use, and this is occasionally used when searching. Reflection has begun, which encourages more refined search strategies, though little attention is given to aspects that may help students into a more productive search experience, such as information quality or using the search tool advanced features in search strategies. In fact, the search tool structure remains a mystery to many in this experience. Other public domain Internet databases (like NASA) are occasionally considered and used.

Category 2's structure of awareness shows us that the process, or the planning, of the search has become more important, with students beginning to use advanced search features, and speak about aspects of the quality of the information found. They have a growing awareness of the rich variety of search tools available.

Category 3 Structure of Awareness: Using the tools as a filter.

The structure of awareness associated with this experience, shows that the student's focus is, primarily on the tools, and the topic is almost of secondary importance. There is a strong awareness in this category of the structure of the information environment, and little, or no, confusion between the different search tools available. Refined search strategies are used, with students more aware of the structure of each of the search tools, even showing an ability to adapt their searching based on the search tool used. Primarily search tools are used to help refine the topic, and filter the results into a smaller set.

In this category, the external horizon limits show a blurring of the edges. That is, while aware of the quality of information, it does not factor into searching strategy. Term analysis is undertaken when and if required. Domain searching to limit results is used when required. More specialised internet/library databases are used when considered important. This group is more likely to consider using the advanced search features and help buttons on the search tools in use. Public domain database providers may be more frequently considered, and, if accessible, commercial database vendors used.

Category 3's structure of awareness reveals a clear understanding of the information environment, with virtually every aspect of the environment in focus. They have an ability to reflect over results to filter them into a more useable sized set using the search tool features, such as searching options and advanced searching, as their instruments.

Category 4 Structure of Awareness: Panning for gold.

The focus of this category remains firmly fixed on the quality of information. It has surpassed all other aspects as the major focus. Within the internal horizon is virtually every other searching aspect previously considered in the preceding category descriptions. The only aspects remaining in the external horizon limits are external database vendors, internet databases (like NASA), and term analysis. It is not that these aspects are not considered important, they are simply brought into use when, and if, required. Clearly the focus on the character/quality of the information resource is the major difference from the previous categories. As only primary sources of information are important enough to be included in result sets, the search will be refined to limit results these sources only. Most secondary sources of information will be filtered out.

DISCUSSION OF FINDINGS AND FURTHER DIRECTIONS

The structure of awareness of the categories has revealed the variation in the experience of information searching. Students are, in some experiences, frozen in their ability to find information as they see through a haystack or a maze when they attempt searching. This lens hampers their ability to use the information environment more effectively. Aspects of the search tool features and the information environment are, to some, at best a hazy image, and at worst, an aspect clearly misunderstood.

When teaching information searching skills, then, what could be done? Clearly, we need to encourage students to discern another information searching experience. There are four areas which could be considered here; provide students with opportunities for reflection; improve assessment to make it both authentic and encourage students to see the variation; use online tools to further enhance the learning experience; and finally, encourage staff development to enable understanding and application of the findings.

Of particular importance would be to encourage those students who see through a haystack lens, that in fact the haystack has both structure and form. Students must be encouraged to reflect using exercises that support searching skill development. The exercises they undertake should not be purely isolated experiences; an expectation on student reflection and ample time to reflect is required. Students need to see things happening differently to what they have previously experienced in order to discern a difference.

Assignments for these students should be authentic and encourage reflection across the variation of the experiences. Students should be expected to use the search tool features and actively explore the information environment in assessment items. Having used them, they should be encouraged to reflect upon the information environment, and to reflect upon what happens when they use Boolean operators or wildcards. They should be asked to report on the features of search tools, explaining the significance of these features, and explain why they would be useful when searching. Information quality needs to be both experienced by them, and reflected upon, so that students see the benefit of using quality information for assignments (Edwards & Bruce, in press, 2004).

Online tools can be utilised to enhance learning. In an existing QUT IT subject unit, an interactive media section of has been developed and added to the unit's online site. This will be on trial in late Semester 1, 2004. The intention has been to develop a teaching tool for the students to work on their final assignment for the unit. The assignment and the site focuses on helping students learn to search web-based information resources through a variety of experiences, potentially opening for them a different worldview.

Finally, staff development should not be ignored. This research led to the development of a half day guided workshop for academic staff; although when first offered both academic and library staff attended. The workshop was designed to be both informative and participatory. All who attended were involved in the process of the development of potential teaching and learning resources, and the development of strategies using assessment to encourage students to search more effectively for information resources.

CONCLUSION

Overall, there is a need to design exercises and assessment to lead students into the structure of the experience considered desirable. It is essential to allow students the time

to reflect and comprehend the variation in information searching experiences. Consider your existing exercises and assessment items and ask yourself, does this assignment encourage the students to move into a higher level of information searching experience? Does it encourage the students to firstly experience something in a new way, and by so doing, encourage them to discern a variation in their information searching experience. If we can do this, we will move our students into a deeper understanding of the searching experience, we will provide them the opportunity to discern a variation in what they have previously experienced, and hopefully, we may encourage learning.

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