

## Chapter 21

# Panning for Gold: Understanding Students' Information Searching Experiences

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### Introduction

When was the last time you observed someone searching the Internet or library databases and wondered, “Why on earth did they do it that way?” Searchers are prepared to sit for long periods trying to find the elusive and even rare item they require, yet spend little time learning how to search more effectively. Reflections of this nature led to the research reported in this paper. Observing students over a period of a number of years, all studying within one unit in the Faculty of Information Technology (FIT), Queensland University of Technology (QUT), it became clear that efforts to understand what students were experiencing while web-based information searching would be valuable for both the students and ongoing curriculum design. This paper reports on research intended to discover both the student experiences and the likely ways to encourage students to pan for gold rather than junk when they search. The research was undertaken using a phenomenographic approach. The paper will outline the background to the study, explain the research method and objectives, and present findings. Both teaching and learning strategies and curriculum design have been strongly influenced by this project.

### Background

There can be little dispute that the Information Technology (IT) revolution has changed the way we attempt to solve information problems. Tertiary level students, who have grown up during the IT revolution regularly exposed to popular media culture, easily relate to the idea of

someone who “googled” or “googlewhacked” their problem to find an answer; the terms are even appearing as words in dictionaries (OneLook Dictionary Search, n.d.). In an age where googlewhacking is becoming part of everyday speech and life, there may be little understanding of a world where searching for information does not involve a computer. Students believe searching is easy; they find the search window, type in the desired topic into the search textbox, click the search button, scan the results list and select a few from the first page or two of results. However, this simplistic perspective may be contributing to a lack of understanding of the information environment, leaving students in a world of possible impediments to searching, without the insight of ways to improve the process. As teachers, we see the results of their searching in assignments that have been developed from inferior information resource citations. We need to know how students learn to search and how they approach their searching, in order to help them deal with the information resource environment in a more productive, even a more professional, manner.

### ***Information Searching Research***

Most contemporary research into web-based searching behaviour currently falls into two broad categories. The first of these could be described as classic information retrieval research. The second is research into Internet searching or use. In both areas, researchers have attempted to understand both information search patterns and searching behaviour and, in some cases, attempts have been made to understand the experience of the end user.

Growing out of information retrieval or information management roots, classic information retrieval (IR) research traditionally considers database, online catalogue and other information retrieval system searching. The primary focus is often related to the design of the retrieval system (Robertson & Hancock-Beaulieu, 1992) or the likely relevance of the final results (Jansen & Pooch, 2000). Studies have commonly considered what have become known as recall or precision ratios, which look at the number of relevant and non-relevant documents retrieved, compared with the number of relevant documents actually available (Sparck-Jones & Willett, 1997). While it is possible from this research to identify trends in typical interactions between searchers and the system (Silverstein, Henzinger, Marais, & Moricz, 1999), they quantify rather than explain search behaviour.

Other investigations have focused on web-based searching behaviour, ranging from pure database searching and likely information retrieval (Jansen & Pooch, 2000), to search strategies and information seeking in context approaches (Fidel et al., 1999; Klobas & Clyde, 2001; Wiley, 1998). Typically some form of quantifying measure has again been used in most of these approaches leading to attempts to describe the average web-based searching behaviour (Jansen & Pooch, 2000), showing that the majority of searchers use two terms in a query, little or no Boolean operators, typically view no more than the first ten results displayed and stay online for 10-15 minutes maximum when performing a search. There have been few studies to date attempting to identify how these searchers decide on their approach, or to discover the variations in experiences that are occurring (Fitzgerald & Galloway, 2001). We believe the challenge is to identify the variation in searching behaviour, rather than norms.

The literature of end user behaviour is more complex. Over the past four decades, there have been numerous research studies into 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; Tobar, 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.

We need to place the end user firmly in the picture. In so doing, we may uncover the various ways searching is currently approached and any triggers that may encourage quality in both the searching process and the results.

Research findings to date seem to point towards only minor differences in approaches used in searching library databases compared with search engines. This brings about further questions and implications for teaching and learning (T&L) and curriculum design. We need to understand why students approach searching IR systems in their present manner and the variations in the approaches used.

The searching experience is not solely about recall and precision ratios, it is not solely about computer literacy skills, it is not solely about whether the interface or the system tool is well designed and it is not solely about the cognitive abilities of the end user. 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 a particular search behaviour is evident and, in understanding the underlying reasons for the approach, we may be able to build a framework to help people move into more satisfying search experiences.

## **The Research Project**

Based on this summary of research findings and our teaching observations, our research project had a series of broad aims including:

1. To determine variation in the ways students approach information searching when using the Internet and library databases.
2. To determine variation in students’ ways of learning to search for information when using the Internet and library databases.
3. To recommend teaching and learning strategies for curriculum design that are based on managing students’ experiences.
4. To determine if there are levels of sophistication in information searching, or other differences in student information searching behaviour approaches.
5. If levels do exist, to identify any triggers to move from one level of searching sophistication to another level.

Ethical clearance was obtained.

### ***Design of Research Approach***

For research purposes, it was important to make sense of the students' understanding of the information searching and retrieval concepts within the context of their individual educational experience. That, coupled with a desire to understand and study student approaches to learning to search, means that this research naturally lent itself to phenomenography.

Phenomenography is a research method adapted for mapping the qualitatively different ways in which people experience, conceptualise, perceive, and understand various aspects of, and phenomena in, the world around them (Marton, 1986, p31; Marton, 1988). It is an interpretive research approach that has been used within the IT domain to explore conceptions of programming (Booth, 1990; Bruce et al., 2004), information systems (Cope, 2000) and information literacy (Bruce, 1997).

As there is no prescriptive format to conduct the phenomenographic research, when phenomenography is used it requires that the procedure adopted is documented and the individual variations in the method used explained (Bowden & Walsh, 2000).

### ***Gathering and Analysing the Data***

Data gathering during 2000 – 2003 involved investigations of student diary work and a series of 44 interviews were conducted over several semesters. The 32 participants were all QUT (Queensland University of Technology) students from the IT, Business, Education, Science and Creative Industries (Dance) faculties, at both the undergraduate and post-graduate levels (refer Table 1).

In all cases, each student had a few years' experience of information searching, without having had formal training in the task. Different cultures, ages and genders were represented, and the participants included students from non-English speaking backgrounds (refer Table 2).

Two thirds of the students who participated were enrolled in a FIT (Faculty of Information Technology) subject ITB322, Information Resources. Our experience in this unit provided the original motivation for the research. The unit is open as an elective to a variety of faculties across the campus. In the unit students learn to identify, retrieve and evaluate print and electronic business information resources

that are relevant to a variety of problems; thereby applying their knowledge in Internet, Intranet and virtual library environments. Primarily the unit is designed to encourage learning about a variety of information resources and their uses, independent of the format of those resources. The curriculum focuses on information retrieval techniques across a wide area of information resources that will be useful in the future careers of each student.

*Table 1. Representation of Course and Levels of Study*

Total Number of Students	32
Postgraduate	9
Undergraduate 3rd Yr	11
<i>1st Yr</i>	
<i>IT</i>	3
<i>Business</i>	1
<i>Education</i>	2
<i>Science</i> (NB: 2 students in Double Degrees)	6
<i>Creative Industries</i>	2
Undergraduate 1st Yr Total	12

*Table 2. Demographic of Participants*

Gender	
Male	16
Female	16
International Students	12
Linguistic background	
English Native Language Students	23
Non English Speaking Backgrounds	9

Approximately one-third of the students participated in both interviews; one at the start of the semester, followed by a second round interview, with the same student, at the end of the semester. The final transcripts comprise 32 first round interviews and 12 second round interviews. Both interviews were used to identify variation in experiences of searching. The second interview was analysed to reveal students' perceptions of influences on their learning. In the first interview,

each participant completed a small information literacy assessment task. In a small number of cases, the first interview also included an information search for a set topic. The students were videoed using a think-aloud protocol, where we asked them to talk through what they were experiencing as they searched. We asked them to clarify their thoughts and actions when necessary. See Table 3 for more detail.

*Table 3. Methods of Data Collection*

Total Student Interviews	44
<i>1st Round Interviews</i>	<i>32</i>
<i>2nd Round Interviews</i>	<i>12</i>
Student Diary Analysis	10
Video and Transcripts of a Web-based Information Search	10

In each of the two interviews, to start the dialogue with participants, entry level questions were made concrete, asking them to describe a search they had recently done and then asking them to explain further about what they actually did in that searching process, and why. Respondents were invited to explain their experiences in both graphical and written form.

Transcripts of the interview were the primarily tool for the analysis of the data. From the analysis of the interview transcripts, the researcher developed the categories of description of the phenomenon. Put simply these categories are our interpretation, based on the analysis of the data, of the variation in an individual's, or a group's, account of the way they experience information searching (Cope, 2000). Each category represents one way in which the phenomenon is experienced. In this way we can clearly define both the meaning and the focus of each group's way of looking at the world.

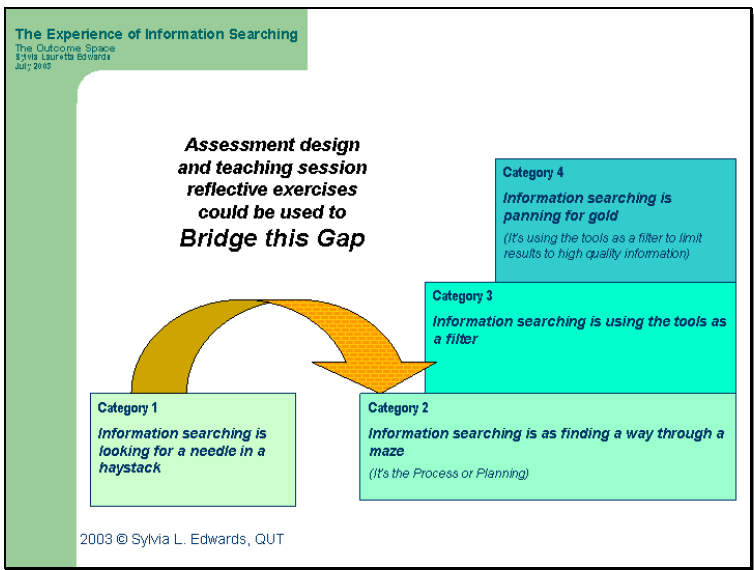
## **Ways of Experiencing Information Searching**

Analysis of the data gathered to date suggests an initial framework of four categories that capture students' different ways of searching and learning to search for information. Each of the categories have been described using the words expressed by the students as they described their experiences.

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

2. Information searching is seen as finding a way through a maze.
3. Information searching is seen as using the tools as a filter.
4. Information searching is seen as panning for gold.

These four categories can be mapped into an outcome space (refer Figure 1). The outcome space reflects the hierarchical relationship between the categories found to date and presents the possibility of further categories yet to be identified. The investigation with first year students in various faculties confirms the categories found to date.



*Figure 1. The Experience of Information Searching Outcome Space*

The data suggests that there may be two or three further categories of the experience of information searching yet to be found as the study has only included tertiary level students to date. It is expected that lower levels of IT confidence and neophyte searchers may indeed have a different experience to any of those listed, and they may be less aware of the information environment and its structure. It is also suspected that there is a further category, above Category 4, experienced by information professionals with a number of years experience at information searching and different ways of approaching searching.

Each of the already identified four categories is associated with different meanings being assigned to the search experience. They are also

associated with different awareness structures, different approaches to learning and different search outcomes. The awareness structures are differentiated in terms of different foci and in terms of different ways of seeing the information environment, the information tool structure and the awareness of the quality of information. The following sections briefly outline each of the four categories according to their meaning, the structure of awareness, the approach to learning evident and the likely search outcomes.

**Category 1: Information Searching is Seen as Looking for a Needle in a Haystack.**



*Figure 2. Category 1 Searching  
(Image from MS Clip Art)*

**Meaning:**

In this category students see information searching as similar to **looking for a needle in a haystack**. If you consider the image described, a haystack has no structure and no form. It is not designed in any way to make it easy to search. In fact, its sheer bulk and mass make it very difficult to search when looking for a small needle that may not even be

recognizable when found. In this category a significant amount of attention is directed towards the topic, their needle! They appear to see it as imperative to understand the topic or they will "never find it out there."

**Structure of awareness:**

The structure of awareness associated with this experience suggests that the students' focus is on the topic. Although they are aware of the information environment, they have no appreciation of the importance of either 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 to appreciate that the environment may actually be designed to help them find their topic. In this category there is often confusion evident between different tools and confusion

over tool searching options. (Note: Int 1:5(p.6) = Interview 1: Participant 5 (p. 6 of transcript))

*Int 1:5(p.6) truncation* is more like, let's say you have the 'or' 'not' 'and' and you try to use these words. Let's say you want both (*Topic 1*) and (*Topic 2*), you put the 'and' in it so you come up with both of them. That means it has to have both of these terms in it. And 'or' will be either this or either this, so any of them will do.

### **Approach to learning:**

In this category and the other categories, the approach to learning is characterised by three dimensions. Firstly, their IT confidence is at a medium level in this stage. They are comfortable with IT, but not confident. They are comfortable enough to start searching for online resources, but their lack of confidence also probably interferes with their appreciation of the structure of the information environment. They have little understanding of the structure and not enough confidence to push further into the environment to understand it better.

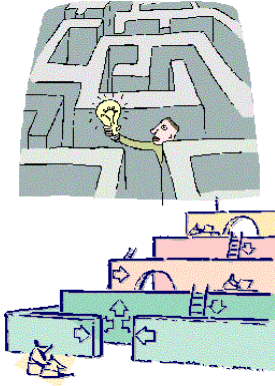
*Int 1:5(p.9)* Firstly ...I'm not familiar with the topic. Alright. I'm just over the head with (*the topic*). Secondly, I think it is also because I can't really do my search that well, with all these.

Secondly their planning is poor, or possibly non-existent, in this stage. There is no apparent understanding of any necessity to plan and therefore there is little reflection occurring either. This reflection is the third dimension in their approach to learning. There is little or no attention being given to what they have just seen. The likelihood is that the searcher will switch tools and switch terms at the same time, showing little evidence of approaching the search process in a reasoned manner.

### **Search outcomes:**

Finally there appears to be a correlation between the quality and character of the search outcomes and the way of experiencing searching. This correlation may link back to the reflection process, in that as there is little or no planning or reflection taking place, it is likely that the search process will be abandoned. There is usually an assumption that the information required is not available at this source, or the tool in use is of poor quality and does not index the required information.

## **Category 2: Information Searching is Seen as Finding a Way through a Maze.**



*Figure 3. Category 2 Searching  
(Images from MS Clip Art)*

### **Meaning:**

In this category students see information searching as **the process, or the planning, of a search**. They still focus on the topic, but there is a strong emphasis appearing on the choice of terms and synonyms. Database choice is also important, as is retrieving results into a useable format for later work. The haystack has been replaced by the image of a maze, or a labyrinth. A maze has both structure and a way out! That is, there is a feeling that if they persist

through all the dead ends they find, eventually they will find the way out of the maze and achieve the required results.

### **Structure of awareness:**

With both the topic and the search process in focus, an interest in and awareness of the structure of the information environment begins to appear. Along with this growing awareness, there is also an awareness of what the tool search features will allow them to do.

*Int 1:3 (p.4)* ...I try and find a search engine that has an advanced search option and do it that way and specify whereabouts I want the web site to be.

In this category the students begin to use advanced search features, talk about some aspects of the quality of the information found and discuss likely information sources for different topics. Information quality does not appear to be a major focus yet in their searching technique, but they are aware of its importance.

*Int 1:5 (p.1)* Because (Yahoo) is just one of those sites that actually gives you a lot of information. I tried a few like Askjeeves and all that. Askjeeves is more theoretical. That's what I've realised. It is more theoretical. It gives you more stuff on what is global position-

ing system and something, but not really much on distributors. Yahoo is very distributor oriented. ....

In general, students in this category are more attuned with the different tools available but still talk about them interchangeably.

### **Approach to learning:**

Again IT confidence is at a medium level in this stage. They are comfortable with IT, but not overly confident. They are comfortable enough searching for online resources and, with a growing awareness of the structure of the information environment, they have begun to plan their searches and show some signs of reflection, changing terms searched on the basis of previous results. In this stage there is often talk of an early “quick and dirty” search used to enlighten them about the topic terms and then refine their search based on a preliminary result.

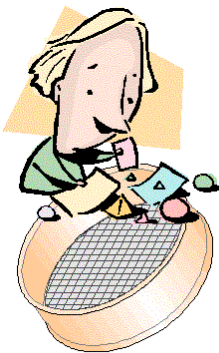
### **Search outcomes:**

In this category they are more likely to persist, consider alternatives and persevere to find results. However, there is still a tendency to blame the tool rather than question their own abilities.

### **Category 3: Information Searching is Seen as Using the Tools as a Filter.**

#### **Meaning:**

In this category students see information searching as **using the tools as a filter** to find information. The imagery here is a filter that will sift through the junk and provide them with a more useable and smaller set of results. They can undertake a search whether or not they understand the search topic. In fact, they tend to use the tools to help them understand the topic as well as to find the required information. The



*Figure 4. Category 3 Searching  
(Images from MS Clip Art)*

tools, therefore, can be used to enhance their understanding of the topic.

### **Structure of awareness:**

The structure of awareness associated with this experience means that the students' focus is primarily on the tools and the topic is of secondary importance.

*Int 1:1 (p.4)* I always use a broad search first. Just with one, or two or three terms first. And then I get just an overview on the issue and I try to narrow it down. Because I always gets more articles than I can handle. I can't read them all, so. And I often use the abstract, especially on the QUT library, I also use, I just read about the abstract, and just look at articles I want to use.

There is a strong awareness in this category of the structure of the information environment and little, or no, confusion between the different tools available. They are much more aware of the structure of each of these tools and show an ability to adapt their searching based on the tool they are currently using. In this category, while aware of the quality of information, it does not factor into their searching strategy. Primarily the tools are used to help refine the topic and filter the results to a usable sized group.

*Int 1:6 (p.1)* ... I had to search Internet definitely, but I also had to search some library to get a general information about (*topic*), and I also had to find the recent updates because the issue had to be current. So I had to search many many many fields, so I went to Internet first because it is the easiest way to get information that is Internet connected. ...I prefer to go to Metacrawler because it is a meta-search engine. ... Then I would probably go to the library and find books about (*topic*) and (*sub-topic*), because it is needed for general definitions.

### **Approach to learning:**

IT confidence in this category is much more obvious, but also less likely to interfere with the search outcomes. Students are more aware of their possible mistakes and take necessary steps to correct them. Although the students did not notice all mistakes, the majority of them were both noticed and corrected.

Planning is evident, and may even be written down before searching and referred to during the process. This planning often includes an analysis of the terms and a more pronounced attempt to identify synonyms before proceeding.

Reflection is also evident. While the reflection process may not be written down, nor changes in search strategy noted, there are attempts throughout the search process to identify any alternative synonyms and change strategies based on the results of the first attempts.

### **Search outcomes:**

As reflection is starting to be more refined, students experiencing searching in this way tend to be successful in searching. Most items missed in searching would be due to the unplanned stages of reflection.

Given the search process tends to work, however, and they are aware of the structure of the information environment and the tools, it is unlikely that greater attention will be given to more thorough planning and reflection.

### **Category 4: Information Searching is Seen as Panning for Gold.**



*Figure 5. Category 4 Searching  
(Image from MS Clip Art)*

resource for information.

### **Meaning:**

In this category students see information searching as **panning for gold (it is using the tools as a filter to limit results to higher quality resources)** during the search process.

An understanding of the topic is not required, as they use the tools to help them both understand the topic and find the required information. Most importantly, they focus on using the appropriate tools to find the primary

### **Structure of awareness:**

The focus of this category is primarily on the structure of the tool, followed by the topic, and includes for the first time a focus on the character or quality of the information resource. This character/quality awareness is the major difference from the previous category. As the awareness of primary and secondary information is heightened, the tools and their structure are used to both refine the topic and refine the search, to help filter out poor quality items (for example, domain name searching).

*Int 1:4 (p.5)*... but if you do a search on say (*topic*) or something, and you'll end up with thousands of pages. But if you put lecture notes or tutorial on the end of it, it narrows it down quite a bit.

### **Approach to learning:**

IT confidence is at its peak levels, but over-confidence is not likely to interfere, as they are aware of possible mistakes and more likely to correct themselves. While it remains possible that screen and typing errors will be missed, they are more inclined to notice mistakes, correct them and, if necessary, to ask for help from peers.

Strong planning and reflection are evident and include the preceding analysis of the term and an identification of potential synonyms before searching, occasionally writing down changes in search strategy, and changing their strategy based on results of first attempts.

The major difference here again is that the process also includes reflection on information character/quality, which is not evident in other levels. They are also more inclined to stop a search, reflect upon improvement, then reattempt later a previously failed search. This reattempt may be minutes, days, or even weeks afterwards.

### **Search outcomes:**

As reflection is more refined and across a series of the information tools, taking into account their structure and the quality of information required, this group is usually successful in searching.

## **Discussion of Findings and Further Directions**

Summarising the categories described above, the approaches have ranged from information searching being seen as looking for a needle in a haystack, to using the tools as a quality filter to find information. The data also suggests that confidence with IT, in some cases, may be a hindrance to a student's ability to learn to search more effectively.

Furthermore, over the research period, students enrolled in the subject unit have reported a perceived improvement in their searching skills. Students indicate they are searching faster, more accurately, and retrieving higher quality results. Most notably, they also state that they find these new skills are transferable to other units during the semester. The students identified two major reasons for this level of improvement, the time to reflect upon their searching and consider ways of improvement, and a committed and caring team of teachers over the course of a unit of study (Edwards, 2000; Edwards & Bruce, 2002; Edwards & Bruce, 2004).

Based on the findings from this study, the existing unit is now taught with a stronger emphasis on reflection. By reflection we mean encouraging the students to consider, to contemplate, to muse over and to think about what they are doing when they are searching. Since Schön (1983, 1987) suggested to us that a defining characteristic of professional practice was the ability to reflect on our action so as to engage in the process of ongoing and continuous learning, as teachers we are very familiar with the concept of reflective practice. It is time we encouraged our students to use the same sort of reflective practice (Kolb, 1984). In the unit students are actively encouraged to reflect over various aspects of their searching experiences as a continuous process. This is done in two ways. Students are encouraged to consider what they have learnt about searching in a personal journal, which is submitted as part of the unit assessment. Students are also asked to reflect on the searching process in a second assignment, where the marking criteria have been changed to echo the importance of panning for gold. In all of the unit assignments, a larger proportion of marks are awarded for both the selection of high quality resources and for the student's depth of understanding of their importance, based on their own reported selection justification.

Furthermore, the existing research has been extended into current curriculum development to enable future students to develop a more pow-

erful understanding of the information searching phenomenon. A small website outlining the categories and encouraging reflection was developed (Edwards, 2004) and first offered for student use in 2004. A separate interactive media section of the original IT unit's website has also been developed. This site was named ROSS, which stands for Reflective Online Searching Skills, and trialled in 2004. The intention was to develop a teaching tool for the students to work on their final assignment for the unit. These site trials are continuing and work is underway to develop ROSS for use in other units across the university to encourage students' search skill development. We anticipate that this new teaching tool will facilitate the development of ways to encourage a move between categories by enabling the students to perceive changes in their worldview.

The outcomes of this investigation have provided a rich level of insight into the variety of information searching experiences of tertiary level students. Based on the findings, work is now underway to encourage students to pan for gold when information searching, rather than thrash around in the debris of a haystack.

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