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Diehm, Rae-Anne & Lupton, Mandy (2012) Approaches to learning information literacy : a phenomenographic study. *The Journal of Academic Librarianship*, *38*(4), pp. 217-225.

This file was downloaded from: http://eprints.qut.edu.au/51049/

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http://dx.doi.org/10.1016/j.acalib.2012.05.003

Approaches to learning information literacy: a phenomenographic study

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Abstract

This paper reports on an empirical study that explores the ways students approach learning to find and use information. Based on interviews with 15 education students in an Australian university, this study uses phenomenography as its methodological and theoretical basis. The study reveals that students use three main strategies for learning information literacy: 1) learning by doing; 2) learning by trial and error; and 3) learning by interacting with other people. Understanding the different ways that students approach learning information literacy will assist librarians and faculty to design and provide more effective information literacy education.

Approaches to learning

This paper reports on a phenomenographic study investigating university students' approaches to learning information literacy. From a phenomenographic perspective, learning is seen as comprising two dimensions: content and process. The content is the 'what' of learning, that is, the subject content and skills that are acquired by the learner. The process is the 'how' of learning, that is, the act of learning.[1] The act of learning is regarded as the student's approach to learning. An approach to learning encompasses:

- The student's intention (to understand or reproduce)
- The student's focus (on the task or learning material itself, or on its underlying purpose and meaning)
- The way in which the student engages in learning (organising and integrating, or simply memorising the content of what is being learned).[2]

Several factors influence students' approaches to learning. These may be personal, situational and contextual. Personal factors include the student's prior knowledge and experience and interest or motivation. Situational and contextual factors include their perceptions of the learning situation, subject content, particular task requirements, teaching, the course and the university environment.[3,4,5]

Previous research has indicated that there are two primary approaches to learning, described by Marton and Saljo[6,7] as surface and deep. A surface approach to learning is characterised by passive engagement and using strategies such as memorising and rote learning, while a deep approach to learning is characterised by active engagement and includes theorising and meaning-making.

The approach students use to learn is important as it impacts on the quality of students' learning outcomes.[8,9] Ramsden argues that 'what students learn is indeed closely associated with how they go about learning it'.[10] Unlike learning styles and preferences, approaches to learning are not considered stable characteristics of a learner, rather they are the learner's response to a situation. Thus, it is possible they can be influenced to improve student learning and understanding.[11] It is therefore helpful for educators to understand how students go about learning and what their intentions are in a learning situation, so that teaching activities can be designed to influence approaches and maximise learning outcomes.

Research on learning styles and approaches can be used by faculty and librarians to inform information literacy education. While Sanderson[12] argues there is insufficient criticality regarding the use of research into learning styles and perspectives, she believes that both offer useful frameworks to understand how students learn, in addition to practical strategies for teaching. In this paper we investigate university students' approaches to learning information literacy within the discipline of education.

Students' approaches to learning information literacy

Students' experiences of information literacy have been reported in several phenomenographic studies.[13,14,15,16,17] Some of these studies have found that there is a relationship between approaches to learning and information literacy. Furthermore, the studies have shown there are similarities and differences between approaches to learning information literacy in different disciplines.

For instance, Lupton[18] found that first-year university students researching an essay in an environmental studies course approached their essay in three primary ways: seeking evidence, using background information, and applying learning. She found that students who were seeking evidence to support an existing argument took a surface approach to learning. They collected facts and figures on the topic, and saw the essay task as an end in itself. By contrast, students who used background information to develop an argument sought to make meaning and understand their essay topic (deep approach). Students who were interested in applying learning to solve environmental problems went beyond the assignment in aiming to helping their community overcome environmental problems (deep approach).

In a later study Lupton[19] found that third-year university students approached studying music composition in terms of acquiring and applying techniques (surface approach), through a discovery process of trial and error (deep approach) and through expressing oneself (deep approach). Similarly, she found that students approached studying tax law in terms of acquiring and applying techniques (surface approach), undertaking a discovery process in learning about their topic (deep approach) and undertaking a knowledge building process in order to understand the tax law system (deep approach).

These studies illustrate the experience of students in different disciplinary contexts. In the next section, we describe the methodology of our study conducted with students undertaking education degrees.

Methodology

The research question addressed by this study is "How do students approach learning information literacy?" A phenomenographic research approach was chosen to investigate students' experiences of learning information literacy. Phenomenography is a qualitative, interpretative research approach 'for mapping qualitatively different ways in which people experience, conceptualize, perceive and understand various aspects of, and phenomena in, the world around them'.[20]

Phenomenography originated in educational research in the 1970s, where it was developed to gain a greater insight into student learning in educational settings. It has received considerable support in information literacy research.[21,22,23,24,25] In terms of the current study, phenomenography is an appropriate research approach as the study is intended to build upon previous phenomenographic research, including the original approaches to learning research.[26,27,28]

In phenomenographic studies, the methodology is designed to elicit variation in students' experiences, and to map that variation into a set of logically related categories known as an 'outcome space'. The participants were student volunteers drawn from undergraduate and graduate education programs at an Australian university. They comprised nine pre-service or trainee teachers and six practising teachers. They were drawn from traditional undergraduate and graduate text-based courses (N=8) and undergraduate Technology Education (N=7). The Technology Education students were chosen to provide contrast to the text-based students as their program has a practical problem-based orientation and comprises the design and construction of artefacts such as furniture, pulleys, or mechanical and electronic devices. The total of 15 participants reflected the recommended minimum number in a phenomenographic study to achieve a range of variation in experiences whilst remaining practicable.[29]

The students' experiences were elicited in semi-structured interviews. Students were asked open-ended questions, starting with a specific focus on a project or assignment the student had recently completed, to a more general focus on their learning across their years at university. An extensive number of probing questions were used to follow the threads of students' responses and explore them in more depth. The questions included:

1. Can you tell me how you went about this project/ assignment?
2. Can you describe a time during this project/assignment when you found and used information effectively? Why was it effective?
3. Can you remember a time when you weren't successful in finding and using information? What happened? How could you have learned to do that?
4. How would you describe your approach to learning to use information?
5. Finish this sentence for me. Learning to use information effectively is…
6. What would have assisted you earlier to learn to find and use information?

Phenomenographic analysis involves numerous readings of the transcripts looking for similarities and differences in experiences.[30] Phenomenographic researchers do not enter the data collection or analysis phase with predetermined theories, hypotheses or categories. Instead researchers need to bracket their own perceptions in order to look for qualitative differences and relations between people and the phenomenon they are experiencing.

The range of variation in experiences is grouped into clusters called categories of description. The categories of description are empirically based insofar as they can be demonstrably justified by evidence from the transcripts.[31] While the categories represent qualitatively different ways of experiencing the phenomenon, the categories are also connected in a logical way. The resulting logical structure is often hierarchical with the higher category subsuming the categories below it. This hierarchical or nested structure reflects increasingly complex ways of experiencing the phenomenon.[32] The categories map the collective experience of the phenomenon rather than representing individuals. As such, individual's experiences are often distributed across a number of categories.

Results

In exploring students' experiences of learning information literacy, this research study had two parts. Firstly, it explored the way students experienced learning information literacy – that is, how they viewed what they were learning. Secondly, the study explored how students approached learning information literacy. While this article reports on the second part of the study, the approaches are described in the context of the results of the first part. This is because we found that there is a

relationship between students' experiences of learning information literacy and their approach to learning.

In part one of the study (reported elsewhere), [33] six categories were identified which describe students' experiences of learning information literacy:

1. Learning to find information
2. Learning a process to use information
3. Learning to use information to create a product
4. Learning to use information to build a personal knowledge base
5. Learning to use information to advance disciplinary knowledge
6. Learning to use information to grow as a person and to contribute to others

For each of the six experiences, students reported qualitatively different approaches to learning. In the following section, we describe the approaches to learning which accompany the categories above. We outline students' strategies and intentions in learning information literacy. Quotations from the transcripts are used to provide evidence of the students' approaches, identified with pseudonyms for the participants. Table 1 provides an overview of the findings.

	Category 1: Finding information	**Category 2: Developing a process**	**Category 3: Creating a product**	**Category 4: Building personal knowledge**	**Category 5: Advancing disciplinary knowledge**	**Category 6: Contributing too the community**
Intention of learning	Learning to find information	Developing a process	Learning to create a product to complete assessment	Building a knowledge base	Advancing disciplinary knowledge	Contributing to others
Strategies of learning	*Learning by doing* – hands-on, teach yourself, practise skills	*Learning by doing* – experiencing	*Learning by doing* – focus on engaging with & using the information	*Learn through knowledge building processes* – reflect, internalise & construct knowledge	*Learning through the research process* – making links between the literature, research, knowledge base & experience	*No explicit strategy* - immersed in learning, part of the person's life & being, not a conscious or separate activity
	Trial & error – experimenting with different sources, keywords, tools	*Trial & error* – experimenting with different techniques, designs, materials, methods of construction. Make mistakes & change the process	*Trial & error* – more planned approach to design & construction by experimenting with different things then picking one & developing it	*Trial & error* – making mistakes & focussing on analysing them to learning from them & building understanding		
	Interacting with other people – seeking assistance, observing	*Interacting with other people* – working collaboratively, sharing expertise, helping each other	*Interacting with other people* – engaging with information through interacting with others	*Interacting with other people* – engaging with information through engaging with others to build knowledge e.g. learns from experts	*Interacting with other people* – engaging with key people selectively	*Interacting with other people* – others are a source of learning & a recipient of the benefits of using information responsibly

Table 1 Students' approaches to learning information literacy

Category 1: Learning to find information

When students experience learning information literacy as learning to find information, the student's intention is to learn find the best, most relevant information in the most effective and efficient way. The intention is in response to a particular need or with a specific assignment in mind.

(1) Learning to find information by doing

Learning by doing involves students engaging with information sources and tools in an active physical and intellectual way. In this category students describe hands-on activities, trying things out, practising, teaching oneself, gaining experience and working one's way through a program or application:

> CODY: I always did it myself and did it the hard way. I forced myself to learn the library system for that and when it came to doing real assignments I knew how to look up books.

Students also experience learning by doing as learning skills to use computers, the library catalogue, library databases and the Internet. Percy explains how he learned to search the Internet:

> PERCY: Simply by doing it. Getting on the Internet and doing it.

Practising a skill to apply and reinforce learning is seen as a particularly important strategy in learning to use computers:

> SANDY: I'm not so good at computers but I think the more I use the computer, the better I can handle it. Practice can make us feel more confident.

(2) Learning to find information by trial and error

Learning by trial and error involves students experimenting and trying different information sources, tools and keywords. The serendipitous character of trial and error is described by Kimberley when she finds that one information source leads to another, more successful one:

> KIMBERLEY: I began by going onto the electronic databases and I found that I wasn't getting what I would call "hot hits". It occurred to me that I might try a more generic search engine like Google Scholar, although the full-text of the information is not always available, so then I go back to the university databases and look there.

Other times trial and error has a more purposive character as illustrated by the following example from Cody, who describes a strategy for finding information:

> CODY: Trial and error basically. When I started off in first year I was told to go straight to the library and I'd get six or seven books and I'd read through all of them and get bits to put into my reference list. But I found that if you go to the Internet first and jump to as many sources as you can you can figure out what your own opinion is on the research. And once you have that you can find other authors in the library who agree or disagree with what you are saying.

All students in the study mentioned trial and error as a strategy for learning to use library databases. While most students acknowledge there were similarities with databases, they often appear to be confused by the different interfaces and they recognise it is important to develop the skills to work out how to use each relevant database.

Trial and error is a strategy that students particularly reported using when learning to identify keywords to form search statements. Students describe using certain keywords in a database and after evaluating the search results, perform new searches using the different terms they find. They also describe frequently starting with general terms before moving to specific ones. Andrew describes learning to search databases and construct searches:

> ANDREW: I use trial and error. It was just a matter of looking through them and doing keyword searches again, using those words and strings of words and trying to see what it produced for my topic.

(3) Learning to find information by interacting with other people

In this strategy, students report interacting with other students, lecturers, tutors, library staff, and experts, professional contacts and friends outside of the university. Other people are both a primary source of information and a referral to sources of information, as illustrated by Jeanette:

> JEANETTE: Other students are good sources of databases, ways of finding information. Lecturers and academic skills advisors are helpful.

Students actively seek assistance in learning to find information. This sometimes takes the shape of simply observing others while they use a computer or library database, either as a strategy for learning (Veronica) or to use people as a source of information (Cooper):

> VERONICA: People [help me learn to find information]. Not always just people at university. Even observing what other people are doing on computers. I watch the lecturer when he is on the computer.

> COOPER: If you are looking for information, this library has been a good source of information. The people on the help desk have been good.

Students report that getting assistance from other people is sometimes a circuitous process, which includes being shown how to do something or observing another person doing something, then doing it themselves while the other person watches and provides feedback. In this example, Callam uses people as a strategy for learning to find information:

> CALLAM: Working with someone else who does know and seeing someone do and discussing it, watching someone do it once then doing it myself, getting their feedback, then I can do it – that's how I learn best.

Regardless of whether the interaction with other people is as a source of information or for learning to find information, this serves a specific purpose and immediate need. It also is the result of students identifying a deficit of knowledge and skills.

Category 2: Learning a process to use information

When students experience learning information literacy as learning a process to use information, the students' intention is to develop an effective and efficient process that suits both the student and the task. In this way, the process accomplishes the task requirements and is adapted to fit the individual. The generic process can then easily be used again. Technology Education students also intend to develop and adapt techniques as a process for solving problems. Table 2 describes the processes to use information that were commonly reported by students.

Process	Process is directed at…
Highlighting Post-it notes Colour coding	Reading texts
Paragraph construction and numbering	Writing essays
Paper and electronic filing systems Using bibliographic software e.g. EndNote	Managing and organising information
Problem solving steps	Solving a problem
Construction techniques Techniques for working with different materials and tools	Designing and constructing components for products and artefacts

Table 2 Processes for using information

(1) Learning a process by doing

In a similar way to category one, students report learning processes by physically undertaking activities and learning by doing. Technology Education students learn techniques for using timber or plastic by working with these materials. They also draw heavily on the processes developed through their years of trade experience:

> CODY: I have learnt how to do things [in my past job] and I know it works for me so I don't want to change too much now. I use the same strategies.

(2) Learning a process by trial and error

Trial and error may be purposive in that the student intends to establish a process to meet an ongoing need such as essay writing. However, the process maybe also one that is learned and adapted over a period of time as the student undertakes a specific activity such as essay writing or cutting timber. What distinguishes trial and error in this category from that in category one is the focus on making mistakes and the outcome that results from the mistakes. As illustrated by Zachary, students reflect on mistakes and as a result of this reflection, the process for using the information is refined:

> ZACHARY: As you go through a process, you hit stumbling stones that make you re-evaluate what you are going to do and you try something else and if that doesn't work you might go back and try a different path.

(3) Learning a process by interacting with other people

Interacting with other people facilitates students developing a process. As in category one, students seek assistance from other people. In this category there is a more active two-way process of working with other students. Examples of this type of engagement described by students include learning through working cooperatively and collaboratively in pairs or groups. Activities include exchanging ideas, sharing knowledge and expertise, dividing up activities to share the workload, helping each other and learning from each other, as Cody reports:

> CODY: It was actually good because we started out with 60 guys and there were 10 straight out of high school so a lot of them were older tradesman. When it came to writing assignments, the younger ones would excel because they had come straight out of school, they were used to writing assignments so we were teaching them how to do things. But when it came to the practical, the time for building things, we were on the back foot and they were teaching us how to do things.

Category 3: Learning to use information to create a product

When students experience learning information literacy as learning to use information to create a product, the students' intention is to complete assessment items. In this category students report learning about their subject as well as learning to use information. This develops further in later categories.

(1) Learning to create by doing

As with the previous categories, students describe learning information literacy as action oriented. While students may learn as they go, students may also learn afterwards. In this case, students may not know the product has not worked well until they receive feedback from the lecturer, and in most cases this feedback is delayed. For example, Percy reports his use of boxes for an 'egg drop' was successful in terms of the solution it provided to the problem, but clearly was not as successful as he first thought, as the lecturer did not mark his assignment very highly:

> PERCY: In our engineering subject, we had to do an egg drop. I went back to the idea of using boxes. It was a quick process that came together. I tested it and it worked really well. But the lecturer doesn't like boxes and the mark reflected that.

(2) Learning to create by trial and error

In this category trial and error is more intentional, critical and less haphazard. Technology Education students describe evaluating and justifying their choices. For these students, what precedes construction is the design phase – a practice of ideation that involves developing ideas by initially trying different things, picking the best one then developing it to a final stage. Howard describes the broader development of the product through the design, construction and testing phases. It moves beyond developing a process to developing a whole product.

> HOWARD: In engineering, we had to do an egg drop. It would have been easy to get a lot of sponge and drop it in but they wanted things that had elasticity and that had a breaking point, rigid materials. I did a lot of trial and error with smaller ones and the basic design came out and I thought that's good, I developed that.

(3) Learning to create by interacting with other people

Students in category three engage with subject content through interacting with other people. This reflects a greater intellectual involvement and active engagement with the information. For example, Karlee uses others as a sounding board:

> KARLEE: My mother is by default studying education. I will have been reading all of these journal articles for an assignment and we sit at the kitchen table sipping coffee and I'll be telling her all about it. I think that is where a lot of my stuff actually works its way out. I bounce ideas off her.

Other people might include other students, friends or family members but might also include key contacts outside of the university gained through teaching practice or work. Importantly in this case, people are both a *source of information* <u>and</u> *a means to engage with it*.

This category sees students create text-based work and artefacts through engaging with information – critiquing, synthesising and presenting their view to others, backed by evidence. In the practical context, Technology Education students weigh up choices and justify their design and construction choices to others.

Category 4: Learning to use information to build a personal knowledge base

When students experience learning information literacy as learning to use information to build a personal knowledge base, their intention is to develop personal knowledge and understanding. Students seek to understand subject content (rather than simply recalling), in order to teach it to their own students.

(1) Knowledge building processes

Learning in this category extends beyond learning subject content through producing products, to forming an understanding that underpins a personal knowledge base. Students report that building their knowledge base occurs through an iterative cycle of reflecting, applying and integrating existing knowledge. As Percy explains, a personal perspective is gained when he makes links with his prior knowledge:

> PERCY: When you are given a subject you have to write or get information about, you write down what you already know about that subject before you read anything else…What I find is that when you are putting it altogether is that you stand back and think 'How does this relate to that and that relate to this?' So you are getting like a matrix of information and you see the inter-relationships.

One of the strategies to build knowledge that students describe is to ask questions. This enables them to develop a more critical awareness and see the inter-relationships between information, which facilitates knowledge building. For instance, Kimberley explains that asking questions helps her look at information in a new way. This leads her in new directions, based on her changed understanding of the subject:

> KIMBERLEY: I have to keep asking questions… I have been using the information to help me to answer some of these questions in the first instance or to point me in the direction from which I can get more information and better answers and deeper understanding of the questions I had been thinking about. I am also using the information to extend my knowledge base because citations within the information will point me to other areas. Then I have been using it to help me put my thoughts together in writing. I have been using the information to ask more questions.

Learning through knowledge building processes also refers to applying knowledge in new situations in order to build knowledge and understanding. Percy explains that applying knowledge is a key step in building understanding. He also identifies the importance of learning information literacy as an enabler of this:

> PERCY: Learning to use information effectively is… applying it. Both applying information to what you have done straight away and applying it to something different.

(2) Building a knowledge base through making mistakes

As in category three (creating a product), making mistakes does not have the same character as it does in categories one (finding information) and two (developing a process). While mistakes are analysed, the focus is on building new knowledge as the outcome of reflecting on errors.

> PERCY: One thing I have found here actually is making mistakes is a really good thing. It goes against everything I was always taught. I have worked out that it is okay to make mistakes but when you do make mistakes, you have to sit down and look at it and observe it and see where the mistakes are and see what happens because of the mistakes. So I am saying you analyse the mistakes.

(3) Building a knowledge base through interacting with other people
While interactions with other people may serve a specific need such as an assessment item as they do in category three, in this category the interactions also serve the long-term development of the student. Students describe building knowledge about new areas from experts such as lecturers or people outside of the university.

> DAVID: This year I have gathered information off marine engineers for engineering. I knew what I wanted but I didn't know about it. I didn't understand but it is good when you can find someone that does.

Category 5: Learning to use information to advance disciplinary knowledge

When students experience learning information literacy as learning to use information to advance knowledge, their intention is to contribute to disciplinary knowledge. More specifically, students intend to answer a research question or address a research problem and because of this, no undergraduate experiences are reflected in this category. In learning to use information to advance knowledge, students describe needing to draw on divergent domains of knowledge and make leaps and assumptions based on reliable and recognised methods of investigation and evidence.

(1) Advancing knowledge through the research process
Students report undertaking specific activities related to learning information literacy and the research process as seen in other categories. For example, students learn to find information, synthesise and write by doing or trial and error as they do in other categories. In the same way as category four, advancing knowledge does not occur by independently doing specific activities; rather it occurs through making links between these activities and other elements.

Students identify these other elements as being their knowledge base, their experience, the literature of the discipline and their research. Students make links between their already substantial knowledge base in the discipline area of education and with their professional practice and experience. This body of knowledge combines with the scholarship of the literature and their own research. Keegan explains that these elements come together in the research process:

> KEEGAN: You have a number of building blocks, which you put in place. One is your literature base, one is your research base, one is your experience and you have your bridge. Seeing what is out there as an alternative path and then coming up with a synergy of this research information with that research information and then take the plunge, make a statement and then be able to support it.

(2) Advancing knowledge through interacting with other people
The foremost experience of interacting with other people in this category is the mentoring relationship between graduate students and their academic supervisors. Students reported that the supervisor guides their learning and challenges their thinking. Elizabeth's relationship with her supervisor personifies this:

> ELIZABETH: I asked this lecturer to be my supervisor and what happened was she took time with me. We communicated excellently and I would talk to her and she would throw it back to me. It was just little thoughts and ideas and I wrote them down. The more she would say to me to provoke my thoughts on different matters, the more I would research.

Students also describe undertaking various activities that involve interacting with other people, for example, individual consultations with librarians or workshops on research methods. As with category four (building personal knowledge), students report that interaction with people is select

and generally limited to a small number of people who can provide key information literacy, research methods or subject information.

Category 6: Learning to use information to grow as a person and to contribute to others

When students experience learning information literacy as learning to use information to grow as a person and contribute to others, their intention is to use information in a socially responsible way.

Growing and contributing through less intentional strategies

The approach to learning in this category is different in that there appears to be no explicit strategies. Students may undertake many activities to learn to use information as they do in the other categories but there are no distinctive strategies. Students seem to become immersed in learning and they experience it in every part of their life and being. Learning is not a separate activity and students are not always conscious of a strategy or an intention to learn as explained by Kimberley:

> KIMBERLEY: Learning is happening all the time. I could be in a conversation with a stranger for the first time and I am learning. I could be sitting here so I can write and I am learning... Every moment is potentiated with a learning opportunity. There is nothing that you can tell me that I am not going to be interested in because to me it is all part of life.

(1) Growing and contributing through interacting with other people

In this category, students engage with information through interacting with other people as is seen in previous categories. However, the focus on the relationship with people is 1) to learn to use information appropriately, and 2) as a means to learn to understand others. For instance, Elizabeth appears to see interacting with other people as a two-way learning opportunity: as a facilitator of her own learning and an opportunity to give back and teach others.

> ELIZABETH: The generations today, they teach me stuff. It is really quite interesting. I never know what I will learn today and they will show me new things and new ways… so for me it's an exchange and learning from each other… so as much as I can give out to them I give out.

Discussion

The common strategies that students in this study used were learning by doing, trial and error and interacting with other people. These strategies had different qualities depending on the nature of the category. We suggest that the explicit use of strategies in the more complex categories (categories 4-6) may offer enhanced student learning. In this section, we suggest teaching and learning approaches for collaborative partnerships between librarians and faculty.

Learning by doing

Learning by doing is an active approach to learning to engage with information. Learning by doing is closely related to learning how to do things skilfully.[34] It involves the students doing things for themselves, either individually[35] or in a group. While this learning may often be self-directed, it is often guided by a teacher or peer.

As evidenced by our study, learning by doing is prominent in developing processes and completing assessment. Thus, librarians and faculty need to create opportunities for more action oriented learning to occur.[36] As learning of this nature is reinforced with practice,[37,38] students need repeat opportunities to practise and apply skills and processes. Doing reinforces learning, enhances recall and understanding and facilitates transfer of learning. Thus, workshop-based classes where students are actively doing are more effective than lecture-based classes where students maybe more passive.

However, it is important to note that 'mere activity does not constitute experience'.[39] Activities such as those used by the students form the basis of their experience, but the experience itself is not sufficient to result in learning. While students in the more complex categories (categories 4-6) also learn from undertaking activities, they do not build or extend knowledge through a focus on doing activities. For example, in category four, students use internal knowledge building processes such as reflection, abstraction and interpretation. They make links with their existing knowledge and experience and as a result, the information assumes personal meaning.

In his foundational theory of experiential learning, Kolb[40] reports there are four stages a student must undergo (although they may enter at any stage and move back and forth between stages): concrete experience, reflective observation, abstract conceptualisation and active experimentation. These stages provide the important links between the experience and learning, so the experience does not simply remain an activity. Rather it is an experience 'with meaning'[41] as the student interprets and constructs and learns from the experience and is then able to transfer it. Kolb's model is similar to a learning approach recommended by Toohey[42]: encountering the content to be learned, getting to know more about it, trying it out for oneself, getting feedback, reflecting, making adjustments and trying again.

Learning by doing is enhanced by reflective practice. Bruce[43,44] proposes that opportunities for experiencing, reflecting and applying learning are critical elements of learning information literacy. Hughes, Bruce and Edwards[45] also describe an iterative information literacy education model of plan, act, record and reflect, mirroring the cyclical and dynamic nature of student learning. In our study, students' awareness of learning information literacy as being an enabler to learning subject content was enhanced by undertaking reflective assessment items. This awareness prompted their intention to improve their information literacy capabilities. Therefore, through faculty-librarian collaboration, co-designed reflective assessment activities can be an important tool to facilitate both learning subject content and learning information literacy.[46]

Trial and error

Trial and error is a form of learning by doing. In our study it is the dominant strategy for learning to find information and develop processes to manage and use information. As reported earlier, trial and error appears to be characterised in two ways: 1) a haphazard trying of different processes, keywords, information tools and sources; and 2) a more planned and thoughtful experimentation that involves evaluating results and actions and subsequently modifying attempts.

Librarians and faculty can acknowledge the value of trial and error as a legitimate approach to learning while encouraging a more reflective and deliberate strategy. By structuring opportunities for students to reflect on each stage of the trial and error process rather than just at the end, librarians and faculty can assist students to think about their learning strategies and develop an approach of 'reflection in action'.[47] This can be built into one-off information literacy sessions or through ongoing search diaries or learning journals. Trial and error can also be explicitly used to encourage students to experiment, in order to try different strategies and ways of working, and therefore opening students up to new possibilities.[48,49] However, librarians and faculty should teach students strategies for dealing with inevitable frustrations and barriers[50] and acknowledge the uncertainty that forms part of information searching and using.[51,52,53]

Interaction with other people

This study has affirmed the significance of interacting with other people as an approach to learning information literacy. While the nature and intention of this interaction is different in each of the categories, it stresses the importance of the collaborative, cooperative nature of learning

information literacy and the 'social distribution of knowledge… where knowledge and skills are distributed amongst various people and that no single person has all the needed information'.[54]

From seeking assistance, observing others, soliciting feedback to sharing tasks and knowledge, students commonly interact with both peers and people who they believe have the expertise and knowledge to assist them.[55] Gross and Latham explain that students' choice of person reflects the immediacy, ease of access and the perceived expertise of the person, in addition to the level of comfort and familiarity of the students in the interaction.

While experts such as faculty and librarians are sought out, peers and people outside of the university are generally the first and preferred point of contact[56,57], often as a source of information and at a point of need.[58] For librarians and faculty, this creates an opportunity to acknowledge and encourage specific people as information sources and forms of assistance.[59] This also provides an opportunity for to encourage students to more fully utilise peer networks, for example, using strategies such as peer assisted study sessions, assessment that requires collaborative work, group learning circles and peer assessment.[60] Creating a classroom culture that values participation and sharing of knowledge and experiences also facilitates interaction and encourages learning through exposure to the views of others.[61,62] Creating opportunities for collaborative learning recognises the importance of information as 'socially constructed'[63,64,65,66] and the construction of knowledge and the 'social negotiation of meaning'[67] through interaction in communities with others.

Conclusion

As students use a variety of approaches to learning information literacy, it is clear that librarians and faculty need to work together to provide students with a corresponding variety of opportunities to experience, practise and experiment with ways of finding and using information; provide feedback on their progress; and require students to reflect on what and how they have learned. Through offering different opportunities and explicitly linking these to students' views of learning information literacy, librarians and faculty can encourage students to develop a more expansive repertoire of strategies and improve their learning outcomes.

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