

Information literacy for a sustainable career in engineering and technology

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Abstract: *Information literacy has become an important skill for undergraduate students due to societal changes that have seen information become a valuable commodity, the need for graduates to become lifelong learners to remain effective across their working lives, and the recognition by many stakeholders that information literacy is an underpinning generic skill for effective learning in higher education. Important elements in the design and delivery of information literacy training include the collaborative process between library and academic staff, the need to link generic information literacy skills into the specific discipline context of the students, and catering for a wide diversity in the student body including off-campus students. This paper describes a sequence of activities designed to help students learn and practice information literacy skills that have been purposefully designed and integrated into a first-year engineering and technology study unit as a core element of the unit syllabus.*

Keywords: *information literacy, lifelong learning, graduate attributes*

The importance of information literacy

There are many conceptions of what is meant by ‘information literacy’ (Klaus, 2000). The Council of Australian University Librarians has adopted the following definition from the American Library Association, “...an understanding and set of abilities enabling individuals to ‘recognise when information is needed and have the capacity to locate, evaluate, and use effectively the needed information’” (Council of Australian University Librarians, 2001). There are a number of factors that make information literacy an essential skill, particularly for students in higher education.

In many countries there has been (and continues to be) a fundamental change in industry, economy and society from a manufacturing/product basis to a service/information basis. Until the 1960s, Australia’s growth and development was driven by manufacturing (Australian Bureau of Statistics, 2003). However, since that time a combination of economic conditions and structural industry changes have seen new growth dominated by the service industries (Australian Bureau of Statistics, 2003). Such a societal change requires that people be equipped to deal effectively with information as a valuable resource and commodity. Developments in information and communication technologies (ICTs) have had (and will

continue to have) a profound impact on modern society and culture. Hence, it can be argued that information literacy is now an underpinning ‘liberal art’ that students require to not only operate effectively during their undergraduate studies and in their future workplace, but also to play an active and critical role in broader society (Blakeslee, Owens, & Dixon, 2001) (George, McCausland, Wache, & Doskatsch, 2001).

While many commencing engineering students may be regular computer users and may have access to a computer (Palmer & Bray, 2001), many do not have well developed information literacy skills – “Typing on a computer is not word processing and surfing channels on AOL is not information research” (Blakeslee et al., 2001). While having the ‘technological literacy’ to actually access computer-based information sources may be an important part of information literacy (Burkle & Sayed, 2002), technological competence is not the same as information literacy (Candy, 2000). Mature age students may have prior experience with paper-based access to information, and conventional entry students may be familiar with online searches using Google or Yahoo, but both may need assistance to effectively use the new academic information resources offered to them in higher education (Tenopir, 2002).

It is now recognised that if graduates of higher education are to operate effectively over their entire careers, not just immediately post-graduation, then they need to become ‘lifelong learners’; “Discipline specific skills in many areas have only a short life, and what will be needed in even the medium-term cannot be predicted with any great precision.” (Higher Education Council (Australia), 1992). Lifelong learning includes all formal, informal and occasional learning throughout life (Candy, Crebert, & O’Leary, 1994). Advances in technology, knowledge and society ensure that engineers, as much as any profession, must become lifelong learners to deal with this change. To become lifelong learners as graduates, students need to be appropriately prepared in their undergraduate studies. Many universities have explicitly identified the strategic link between information literacy skills and being an effective lifelong learner post-graduation.

The focus in the last decade on quality assurance and accountability in higher education has lead directly to a focus on the ‘outcomes’ of higher education, including issues such as graduate employability and graduate attributes (Higher Education Quality Council (UK): Quality Enhancement Group, 1996). The idea of graduate attributes generally encompasses two main types of student achievement; i) the attainment of a discipline- or field-specific body of knowledge; and ii) the attainment of more general, or generic, attributes which might be common to all, or most graduates. Many universities now include information literacy, either explicitly or implicitly, amongst their graduate attributes/outcomes identified in teaching or strategic plans.

In the case of undergraduate engineering education, required graduate attributes are also identified by the professional body that accredits undergraduate engineering programs, the Institution of Engineers, Australia (IEAust). The IEAust course accreditation manual includes the following required ‘generic attributes of a graduate’ that imply information literacy competency:

- “...
- ability to apply knowledge of basic science and engineering fundamentals;...
 - ability to undertake problem identification, formulation and solution;...
 - expectation of the need to undertake lifelong learning, and capacity to do so.” (Institution of Engineers Australia, 1999).

Elements in the delivery of information literacy

Naturally, the library plays a central role in the development and application of information literacy skills for students. However, this role cannot easily be abstracted from the learner's context. This includes both the discipline the student is studying and the mode in which the student's learning is mediated (ie, are they a face-to-face student, are they an off-campus student, are they an on-line student, etc?). It has already been noted that information literacy is an underpinning skill for effective learning, however, in practice, it is often 'integrated' into an existing curriculum or syllabus. This can lead to the simplistic view that it introduces 'extra objectives' into the curriculum and is not a core part of the study unit (Bruce & Candy, 2000). If we accept that information literacy is a key element of professional preparation, then it needs to be considered systematically in curriculum design (George et al., 2001). There are a number of important elements to consider in the design and delivery of information literacy training to undergraduate students.

Collaboration between academic and library staff is essential for the effective planning, development and delivery of training and resources to assist students in the development of information literacy. Information literacy is an essential graduate attribute, and libraries are the principle provider of the relevant discipline knowledge and information resources. However, students normally complete their study in the context of an academic course offered by a faculty or school. Hence both areas must cooperate to deliver these skills to the student (Orr & Wallin, 2001).

If information literacy activities are to be effective, they need to be properly planned; hence the collaboration between academic and library staff needs to commence with the planning of such activities. Library staff can provide input on program guidelines from information literacy professional associations, and academic staff can provide input on the characteristics of the learners and their learning context (Moran, 1998). Once the desired aims and learning outcomes have been identified, the process of achieving them that is suitable for the individual academic situation must be established (Orr & Wallin, 2001).

Generic approaches to information literacy have been reported by students as lacking relevance (Hill & Woodall, 1999; Orr & Wallin, 2001). It is reported that information literacy, while a generic skill, needs to be interpreted and delivered in the context of a student's specific discipline if it is to be effective (George et al., 2001). So, while we may refer to information literacy as a 'generic' skill because of its underpinning support of all study, it is not really a global, context-free attribute of all students irrespective of study discipline. Each discipline has its own unique 'literacies', and even within a discipline 'information literacy' may encompass a range of sources and strategies (Candy, 2000).

Information literacy training delivered when students have an immediate need for it in their studies is likely to find students highly motivated (Fjallbränt, 2000) and/or be most effective in teaching these skills (Hill & Woodall, 1999). Where training focuses on the use of electronic information resources, such training should demonstrate database resources that are appropriate to the students' discipline area (Tenopir, 2002). While the development of generic skills such as information literacy are enhanced by presenting them in a discipline context, it is also suggested that information literacy training must incorporate a balance between cognitive/theoretical and practical skills (Moran & Gibbs, 1999). The most effective learning environment for information literacy development is perhaps not just a discipline

context, but also a practical context; activity is important to reinforce theory (Blakeslee et al., 2001).

As the diversity of the undergraduate student population grows, there is a need to consider how information literacy skills training can be effectively designed and delivered to these various student groups (Moran, 1998; Orr & Wallin, 2001). It is recognised that on-line delivery of information literacy training is one way to address the needs of students who cannot attend face-to-face classes, and while off-campus students may be the principal beneficiaries of such on-line training, it then becomes available to all students who have access to the on-line learning environment, regardless of their mode of study (McCarthy, 2001).

While on-line resources can offer greater flexibility in the ‘place of offer’ of information literacy training, another closely related aspect of the increasing ‘client focus’ in teaching and learning is flexibility in ‘time of offer’ (McCarthy, 2001). The undergraduate engineering curriculum is notoriously full, and even for on-campus students (and especially for off-campus students) having information literacy training available on-line/on-call for use as required can be helpful (Hill & Woodall, 1999). The move in many areas (including engineering) to project- and problem-based learning means that students may be actively seeking information related to their studies. In this situation however, there is unlikely to be a particular point in time for a formal information literacy exercise that will suit all the students in a given class. In this circumstance, on-line information literacy training can help (Fjallbränt, 2000).

As both course materials and information literacy instruction move on-line, it is possible to provide both direct links from inside on-line course materials to on-line information literacy materials stored elsewhere, or to embed/integrate the on-line information literacy instruction directly into the on-line course materials – examples of both approaches can be found (Hill & Woodall, 1999; McCarthy, 2001; Tenopir, 2002).

The Deakin University engineering and technology program

The Deakin University School of Engineering and Technology offers three-year Bachelor of Technology (BTech), four-year Bachelor of Engineering (BE), Masters and Doctoral engineering programs in flexible delivery mode. The undergraduate programs are delivered in both on-campus and off-campus modes. As noted above, Deakin aims to ensure that its graduates are information literate. The engineering and technology study unit SEB121 Fundamentals of Technology Management is a first-year/first-semester unit that aims to provide an early element of this information literacy training, as part of the transition for students into university study.

In partnership with the School liaison librarian, a range of academic content, student activities and assessment have been incorporated into the unit as core elements, with the aims of:

- exposing and orientating students to the facilities and services offered by, and accessed through, the Deakin University Library ('the Library');
- exposing students to the rationale for, and the practice of, citing their information sources;
- providing general information literacy training;
- providing training and practise in using specific, discipline-relevant, on-line databases;

- encouraging students to become systematic and habitual users of the information sources available to them;
- providing easy access to information sources; and
- catering for the needs of both on- and off-campus students.

The following is an outline of the information literacy elements of SEB121.

Orientation week (or O-week) is the week prior to the commencement of the formal semester. In an O-week presentation to engineering and technology students, the School's liaison librarian addresses the students to provide an overview of the Library services and to invite students to participate in a self-guided Library orientation tour. As part of the tour on-campus students must book a time to attend, navigate themselves around the Library using a printed guide, and complete a short, on-line interactive tutorial on using the Library catalogue. This initial introduction to the Library is considered important, so students are offered a small reward (some stationery items and a voucher for a coffee at a campus restaurant) and a Certificate of Participation on completion of the tour. The interactive tutorial also provides some information that is required to successfully complete the first item of assessment in SEB121. The approach of providing an informal library orientation tour as part of O-week is documented elsewhere (Hill & Woodall, 1999). The self-guided tour remains available for the first two weeks of the semester, so that any students unable to attend in O-week are able to complete it prior to the due date for the first assignment. For off-campus students there are Library orientation resources available on-line which, again, involve the students completing the interactive tutorial on using the Library catalogue, so that they can complete their first assignment.

The course materials presented to both on- and off-campus students cover the issue of quality/validity of reference sources, intellectual property, academic integrity and plagiarism. Students are encouraged to consult the literature to develop their own knowledge in new areas, are exposed to sources of information they can use, are encouraged to use the work of others to support their own propositions, and are required to acknowledge all sources that they consult and incorporate into their work. An important element of this is exposure to, and practise with, systems of referencing, including formats for referencing on-line sources of information.

The third item of assessment for SEB121 requires on-campus students to attend a 'Library Information Literacy Skills Session' where students meet in small groups (no more than 15 at a time) with the School's liaison librarian. This session leads on from the previous self-guided tour (which is generic in content and available to all commencing students), and focuses on information resources specifically for engineering and technology students. The session is held in a computer laboratory inside the Library and the small group size means that students can individually trial their own catalogue, database and web searches during the session. The assessment element of this activity requires students to individually produce a formatted bibliography of references that they could use in the completion of the fourth item of assessment for SEB121 (which is a topical/informative report on any issue relating to engineering/technology). The bibliography produced must contain at least two textbooks, two periodicals and two web sites. This information literacy element is designed to provide a discipline-specific follow-up to the more general self-guided tour, purposefully held physically inside the Library, in a small group situation, with hands-on practise of the theory presented in the session, requiring students to practise different forms of referencing, and completing an exercise that will not only fulfil their immediate assessment requirement, but also directly assist them in the completion of their next assignment.

Off-campus students cannot normally attend this library session in person, but have available to them a comprehensive on-line Library skills/information literacy tutorial known as the Smart Searcher tutorial (Churkovich & Oughtred, 2002). Smart Searcher includes interactive tutorials on the following topics:

- the Deakin Library web site;
- searching using the catalogue;
- performing Keyword catalogue searches;
- understanding your research topic;
- referencing;
- finding journal articles; and
- searching the Internet.

Completion of the tutorials requires students to interactively demonstrate their basic mastery of the tutorial topics above. While the Smart Searcher tutorial is generic in the sense that it is designed for students from any discipline, in the context of the third and fourth assessment tasks, this knowledge is immediately put to practise in the discipline area of the student.

The study unit SEB121 has on-line resources available on the web. Apart from unit-related administration and academic material, an on-line discussion area, etc, direct links are provided to a range of on-line information resources, including:

- the general Library catalogue search page;
- the Keyword Library catalogue search page;
- a Library page of links to on-line resources for engineering and technology;
- a range of relevant, on-line, full-text databases provided by the Library;
- a range of Internet search engines;
- a range of material on the Internet related to SEB121 content; and
- the Smart Searcher on-line tutorial.

These resources are not targeted at a particular student group, and are available for all SEB121 students to use.

It was noted previously that flexibility in ‘time of offer’ is important – much of the potential ‘flexibility’ of information literacy resources will be lost if they are only offered at fixed times. The self-guided tour for on-campus students is scheduled multiple times each day during O-week and the first two weeks of the academic semester. The on-campus Library Information Literacy Skills Session is offered ten times over a two-week period during normal SEB121 tutorial times, both to keep the class size small and to permit students as much flexibility as possible in choosing their time to attend. The various on-line resources are available at all times – network permitting.

It is suggested that, “Assessment of information literacy in undergraduate education is essential...for faculty members and students to address the skills required to achieve information literacy” (Catts, 2000). Examples of assessment weightings for engineering information literacy activities can be found in the literature – five percent of a unit grade (Moran & Gibbs, 1999), and eight percent of a unit grade plus a further five percent for a project bibliography (Hill & Woodall, 1999). For SEB121, the self-guided Library tour has no direct assessment value, however, there is a non-grade reward (stationery items and a coffee voucher) and completion of the on-line tutorial element of the tour provides students with information required to successfully complete the first assessment item for the unit. The third item of assessment is a bibliography produced on the basis of attending either the on-campus Library session or completing the off-campus on-line tutorial. This bibliography

accounts for five percent of the unit grade, and is linked to the successful completion of the fourth assessment item, which is a topical report worth 15 percent of the unit grade. The aim here is not direct compulsion to complete the information literacy activities for unit marks, but to imply and demonstrate that the information literacy activities have an inherent and pervasive value in the completion of a wide range of learning and assessment activities.

It is planned to conduct a formal evaluation of the information literacy elements of SEB121 in 2003. Approval was sought and received from the Deakin University Human Research Ethics Committee (DUHREC) to conduct an evaluation exercise with the following elements:

1. a formative/qualitative evaluation of the self-guided Library tour – the on-campus session for on-campus students, and the on-line tour for off-campus students;
2. a formative/qualitative evaluation of the information literacy session – the on-campus session for on-campus students, and the Smart Searcher tutorial for off-campus students;
3. a pre-test/post-test evaluation of student knowledge/skills in basic information literacy in recognising common forms of referencing – before and after the information literacy session.

There are examples in the literature of the use of pre-test/post-test competency tests to evaluate the quantitative effectiveness of information literacy training, combined with questions seeking qualitative responses to assess student perceptions of information literacy exercises (Blakeslee et al., 2001; Churkovich & Oughtred, 2002).

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