This is the authors final peer reviewed version of the item published as:

Palmer, Stuart and Tucker, Barry 2004, Planning, delivery and evaluation of information literacy training for engineering and technology students, *Australian academic & research libraries*, vol. 35, no. 1, pp. 16-34.

Copyright: 2004, Australian Library and Information Association
Planning, Delivery and Evaluation of Information Literacy Training for Engineering and Technology Students

STUART PALMER and BARRY TUCKER

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, and the recognition that information literacy is an underpinning generic skill for effective learning in higher education. This paper describes a sequence of activities and technologies designed to help students learn and practice information literacy skills. These activities have been purposefully designed and integrated into a first-year engineering and technology study unit as a core syllabus element. A formal evaluation of aspects of these activities was planned and undertaken in semester 1 2003.

There are many conceptions of what is meant by ‘information literacy’¹, including, “…the ability to access, evaluate, and apply information effectively to situations requiring decision making, problem solving, or the acquisition of knowledge.”² 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 ‘recognize when information is needed and have the capacity to locate, evaluate, and use effectively the needed information’”³. There are a number of
factors that make information literacy an essential skill, particularly for students in higher education.

In many countries, including Australia, 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. Such a societal change requires that people be equipped to deal effectively with information as a valuable resource and commodity. While students, particularly engineering students, must learn to be proficient in the use of particular software packages and computer systems, and even become experienced at using the specific information retrieval systems offered to them by the institution at which they study, it is also important that they develop generic information seeking skills that they can apply in many different contexts\(^4\).

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.”\(^5\). Lifelong learning includes all formal, informal and occasional learning throughout life\(^6\). Advances in technology, knowledge and society require that engineers, as much as any professionals, must become lifelong learners to deal with these changes. 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\(^7\). 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, in Australia this is the Institution of Engineers, Australia (IEAust). Engineering accreditation bodies around the world are moving toward systems based on demonstrated graduate attributes and competencies, and away from systems based on rigidly prescribed course contents. 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."8.

Specific examples of the integration of information literacy elements into undergraduate engineering programs to explicitly address these course accreditation requirements can be found in the literature9, 10.

**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\textsuperscript{11}. If we accept that information literacy is a key element of professional preparation, then it needs to be considered systematically in curriculum design\textsuperscript{12}. 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\textsuperscript{13}. Information literacy is an essential graduate attribute, and libraries are the principal 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\textsuperscript{14, 15}. This collaboration may, in fact, extend beyond the library and academic teaching staff, if student support staff, information technology staff and academic professional development staff are also considered\textsuperscript{12}. Collaboration between the library and academic staff areas can also go beyond the immediate need of students’ information literacy skills, to partnerships to bid for funding to jointly develop both information and educational resources\textsuperscript{16}.

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. The collaboration in planning and development that takes place should be appropriate – if information literacy activities are to target a particular cohort of students, then library staff need to partner with those academic staff that have responsibility for study units which the target students will all complete. 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.

We have previously identified that information literacy is an important generic skill that underpins effective study as an undergraduate, effective lifelong learning for a productive career, and even effective participation as a citizen in the wider community. One approach to delivering such generic skills to undergraduate students is to develop a generic information literacy package that is presented to all students. However, generic approaches to information literacy have been reported by students as lacking relevance. 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. 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.

Information literacy training delivered when students have an immediate need for it in their studies is likely to find students highly motivated and/or be most effective in teaching these skills. If the training in, and/or use of, information
resources involves on-line elements, and the students’ study context also incorporates on-line elements, then it may be possible to directly link on-line information literacy training and/or links to access on-line information resources to study unit web sites. Where training focuses on the use of electronic information resources, such training should demonstrate database resources that are appropriate to the students’ discipline area. While the development of generic skills such as information literacy is encouraged 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. 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.

In many engineering programs, particularly at Deakin University, off-campus and mature age students are a large and important component of the undergraduate student body. Through twinning partnerships with overseas education providers, students studying ‘off-shore’ are a growing student segment in engineering at Deakin. 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. 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.

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’. 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. 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 of the students in a given class. In this circumstance, on-line information literacy training can help. One final aspect of ‘timeliness’ of information literacy training that relates to on-line delivery is the ability of on-line training materials to be updated promptly to reflect changes in the discipline of information literacy, the supporting technologies, or the student’s discipline requirements.

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. There exists guidance for the developers of such on-line information literacy resources to facilitate student usage and learning, such as navigation options for both new and experienced users, and the inclusion of interactivity to allow students to practice and self-assess their skills.

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. A student studying full time would normally be enrolled in four units of study per semester. Conventional (secondary school) entry students would normally undertake these programs on-campus, full-time; with some of these students taking part or all of their studies part-time and/or off-campus in later years to better suit their employment or other personal circumstances. Mature age students may study the programs on-campus, full-time, but most elect to study off-campus and/or part-time because of employment, family or other commitments.

Deakin aims to ensure that its graduates are information literate\textsuperscript{23}. 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. Experience elsewhere has shown that information literacy skills development is an important element of the transition into university for many students, and was ranked by students as the most valuable aspect of one ‘first year experience’ study unit\textsuperscript{21}. At Queensland University of Technology information literacy classes are now an official component of their student orientation program\textsuperscript{10}.

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 practice 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.

Figure 1 and the following section provide an outline of the information literacy elements of SEB121.

[Figure 1 about here]

Orientation week (or O-week) is the week prior to the commencement of the formal semester. As part of the engineering and technology activities in O-week for on-campus students, a series of presentations are run. In one of these presentations 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 this tour, on-campus students must book a time to attend, navigate themselves around the Library using a printed guide, and complete an on-line interactive tutorial on using the Library catalogue. Experience has shown that students prefer a self-guided tour in preference to a session led by a staff member. 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 elsewhere⁹. 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 second item of assessment, a topical written report, did not relate directly to information literacy, however, many students will have used the Library as a source of reference material for this report. At this point in the semester, 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 practice 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. It is also designed to be purposefully held physically inside the Library, in a small group situation, with hands-on practice of the theory presented in the session, requiring students to practice 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. The model adopted here is reported as the emerging trend for science librarians in the US, that is, “…for library instruction to be short (an hour or so), offered to first- and second year students…The classes should be tied as much as possible to specific courses, covering a resource or two that will be immediately relevant”\(^1\).

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\(^2\). 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 practice in the discipline area of the student. The Smart Searcher tutorial is available on-line to all students at any time, so on-campus students can also access any part of the tutorial that might be of value to them.

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.

The combination of O-week introductory sessions, Library workshops and links from a study unit homepage is also documented elsewhere⁹. 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 has been suggested that academic staff and students view assessment from opposing directions; academic staff consider first what is to be taught and then how learning can be assessed; while students first identify what is going to be assessed and then identify what they need to learn. If information literacy activities are not assessed, then there is a risk that students will give no or low priority to them. It is further 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.” Examples of assessment weightings for engineering information literacy activities can be found in the literature – five percent of a unit grade, and eight percent of a unit grade plus a further five percent for a project bibliography. 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.

Project Evaluation

The literature indicates that, while there are many examples of excellent information literacy programs documented, there is an on-going struggle to evaluate the effectiveness of such programs. Comprehensive evaluation of the effectiveness of information literacy instruction is complex and timeconsuming, and difficult to separate from the overall outcomes of undergraduate education. Evaluation can be conducted on at least four levels, “…within the library; in the classroom; on campus; and beyond the campus.” Forms of evaluation of student learning in information literacy programs include quantitative, qualitative, practice demonstrations and embedded assessment tasks that test learning in a discipline/class context. Any attempt to assess meaningful transfer of skills learnt in the library requires the design, jointly by library and academic staff, of assessment that seeks evidence of the use of information literacy skills in the context of the classroom. Such assessment can include production of bibliographies and student assignments requiring research.

A formal evaluation limited to the ‘in library’ elements of the information literacy elements of SEB121 was planned and conducted 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.

Item 1 and the pre-test were combined in a questionnaire delivered after the end of the availability of the self-guided tour and prior to the information literacy session; item 2 and the post-test were combined in a questionnaire delivered after the information literacy session – see Figure 1. With both questionnaires general demographic information was also collected to permit confirmation that sample groups were representative of the class population, comparison of responses between major demographic groups in the class, and comparison of responses between the two questionnaire respondent groups. As required by DUHREC, the questionnaires were voluntary and anonymous. 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.21, 24

At the time of the initial questionnaire the class enrolment was 134, and 66 completed questionnaires were returned, giving a response rate of 49.3 percent. Demographic information about the enrolled population was known, permitting a comparison to the respondent sample. 13.6 percent of respondents were female and 86.4 percent were male. This was not significantly different from the population
gender proportions of 9.7 percent female and 90.3 percent male ($\chi^2_1=0.699$, $p>0.4$). 84.8 percent of respondents were studying on-campus and 15.2 percent were studying off-campus. This was not significantly different from the population study mode proportions of 81.3 percent on-campus and 18.7 percent off-campus ($\chi^2_1=0.376$, $p>0.53$). 32.3 percent of respondents were studying a Bachelor of Technology (BTech) and 67.7 percent were studying a Bachelor of Engineering (BE). This was not significantly different from the population course proportions of 29.1 percent BTech, 67.9 percent BE and 3.0 percent ‘Other’ ($\chi^2_2=1.991$, $p>0.369$). This suggests that valid inferences about the initial population can be drawn from the initial respondent group.

For the initial questionnaire, the mean age of respondents was 20.2 years, with a standard deviation of 5.1 years and a range of 16 to 43 years. 93.9 percent of respondents participated in either the on-campus or on-line O-week self-guided Library orientation activity. These respondents were asked to rank the self-guided tour activity on a scale of 1 (not useful at all) to 5 (extremely useful). The mean ranking was 3.4 out of 5, with a standard deviation of 0.9. These respondents were also asked to indicate the most useful and least useful aspects of the self-guided tour activity. Table 1 gives the responses and frequency of occurrence obtained from both on- and off-campus students. The questionnaire included four different typical examples of reference types: a book, a chapter in a book, a journal article and an Internet page. For each example reference, respondents had to select the reference type from a list including a distracter reference type. The proportions of respondents who correctly identified the type of each example reference were: book = 91.0 percent; chapter in a book = 50.7 percent; journal article = 83.6 percent; and Internet page = 95.5 percent. There was no significant difference in any of these descriptive
statistics between the demographic groups (gender, mode of study and course of study) of the respondent sample.

[Table 1 about here]

The O-week self-guided Library tour was valued positively by students, and there was good agreement on this. On-campus students were more likely to comment positively on specific utilitarian aspects of the activity, such as ‘using the catalogue’, ‘knowing where to find resources’ and ‘getting the answer required for assignment 1’. Off-campus students were more likely to comment positively on general characteristics of the activity, such as ‘user-friendly and interactive’ and ‘how simple it was’. This difference is perhaps explained by the different nature of the on-campus and off-campus self-guided tour. On-campus students physically attended the Library and had to locate particular resources and complete particular activities. Off-campus students completed an on-line tutorial on using the Library catalogue. Off-campus students gave no negative comments. The principal negative comment from on-campus students related to the length of the computer-based tutorial on catalogue searching that they were asked to complete as part of the self-guided tour. The scope to vary this element of the self-guided tour is limited by the fact that this activity is open to all students as part of the on-campus University orientation activities, and any changes would have to be carefully considered for their impact on all students.

After the O-week self-guided Library tour, a majority of respondents were able to correctly identify example references for a book, a journal article and an Internet page. Only half of respondents were able to identify the more complex
reference type of a chapter in a book, although, of those who were incorrect, 66.7 percent identified it as a book reference.

At the time of the follow-up questionnaire the class enrolment was 127, and 45 completed questionnaires were returned, giving a response rate of 35.4 percent. 8.9 percent of respondents were female and 91.1 percent were male. This was not significantly different from the population gender proportions of 10.2 percent female and 89.8 percent male ($\chi^2_1=0.068$, p>0.79). 86.7 percent of respondents were studying on-campus and 13.3 percent were studying off-campus. This was not significantly different from the population study mode proportions of 81.1 percent on-campus and 18.9 percent off-campus ($\chi^2_1=0.714$, p>0.397). 33.3 percent of respondents were studying a BTech and 66.7 percent were studying a BE. This was not significantly different from the population course proportions of 29.1 percent BTech, 67.7 percent BE and 3.0 percent ‘Other’ ($\chi^2_2=1.512$, p>0.469). This suggests that valid inferences about the follow-up population can be drawn from the follow-up respondent group.

For the follow-up questionnaire, the mean age of respondents was 20.5 years, with a standard deviation of 5.3 years and a range of 18 to 43 years. 95.6 percent of respondents participated in either the on-campus or on-line information literacy skills session. These respondents were asked to rank the information literacy session on a scale of 1 (not useful at all) to 5 (extremely useful). The mean ranking was 3.5 out of 5, with a standard deviation of 1.0. These respondents were also asked to indicate the most useful and least useful aspects of the information literacy session. Table 2 gives the responses and frequency of occurrence obtained from both on- and off-campus students. The follow-up questionnaire included the same test of identification of common forms of references as the initial questionnaire, except that the presentation
of choices was re-ordered. The proportions of respondents who correctly identified the type of each example reference were: book = 84.8 percent; chapter in a book = 43.5 percent; journal article = 89.1 percent; and Internet page = 95.7 percent. There was no significant difference in any of these descriptive statistics between the demographic groups (gender, mode of study and course of study) of the respondent sample.

[Table 2 about here]

The information literacy session was valued positively by students, and there was good agreement on this. On-campus students were more likely to comment positively on learning how to search and access on-line and other information sources. The principal negative comment from on-campus students related to the session being too quick, that is, some students would have liked more explanation of certain aspects of searching and accessing information resources. There were no evident trends in the comments received from off-campus students. The concerns of some on-campus students could perhaps be addressed by the provision of information in printed form for them to ‘take away’, however, a deliberate strategy of ‘no handouts’ was employed to actively engage students in taking their own notes on relevant points, and the availability of on-line reference material on the topics covered was highlighted to students.

After the information literacy session, a majority of respondents were able to correctly identify example references for a book, a journal article and an Internet page. Less than half of respondents were able to identify the more complex reference
A comparison was made of the proportions of respondents in each of the
demographic groupings between the initial and follow-up respondent sample groups,
and no significant differences were found (gender: $\chi^2 = 0.583$, $p > 0.445$) (study mode:
$\chi^2 = 0.072$, $p > 0.788$) (course of study: $\chi^2 = 0.013$, $p > 0.908$). Additionally, no
significant difference was found in the mean respondent age of the initial and follow-
up respondent sample groups ($F = 0.107$, $p > 0.744$). This suggests that valid
comparisons can be made of the rates of correct identification of example reference
types between the initial and follow-up respondent groups. No significant differences
were found between the rates of correct identification of example reference types
between the initial and follow-up respondent groups (book: $\chi^2 = 1.051$, $p > 0.305$)
(chapter in a book: $\chi^2 = 0.577$, $p > 0.447$) (journal article: $\chi^2 = 0.691$, $p > 0.405$) (Internet
page: $\chi^2 = 0.001$, $p > 0.973$). However, the initial rates of correct identification of basic
reference types were already high.

Within the scope of the program evaluation presented here it was not possible
to consider the question of whether the information literacy activities documented
enhanced the students’ learning or contributed to the development of desired graduate
attributes. However, the results obtained from this specific action research case
suggest that future improvements to the information literacy training should focus on
more complex reference types, such as chapters in books, and the features that
distinguish these forms of references from the more basic types.

**Conclusion**
A sequence of purposefully designed activities to help students learn and practice information literacy skills was integrated into a first-year engineering and technology study unit as a core element of the unit syllabus. A formal evaluation of aspects of these activities was undertaken in semester 1 2003. Students valued the activities, and while no significant increase in the ability of the students to identify common types of references was observed, the rate of identification of basic types of references was high initially; students generally recognised three of the four reference types included in a pre-test. It was observed that approximately half of the students had difficulty in identifying the more complex reference type of a chapter in a book. As a result of the research, future development of these information literacy activities can be based on the assumption that a majority of commencing engineering and technology students is familiar with basic types of references such as books, journals and Internet pages. And, more time should be directed to developing the concepts of complex reference types, such as chapters in books, papers in conference proceedings, and other forms of academic monographs with multiple authors, that commencing students may not have encountered prior to university studies.

Notes

1. H Klaus 'Understanding scholarly and professional communication: Thesauri and database searching' in C Bruce and P Candy (eds) Information literacy around the world: Advances in programs and research Wagga Wagga Centre for Information Studies, Charles Sturt University 2000 pp209-222

2. R Young and S Harmony Working with Faculty to Design Undergraduate Information Literacy Programs New York Neal-Schuman Publishers, Inc. 1999


5. Higher Education Council (Australia) *Achieving quality: Higher education* Canberra Higher Education Council (Australia) 1992

6. P Candy R Crebert and J O'Leary *Developing Lifelong Learners Through Undergraduate Education* Canberra Australian Government Printing Service 1994


8. Institution of Engineers Australia *Manual for the Accreditation of Professional Engineering Programs* Canberra The Institution of Engineers Australia 1999


10. J McCarthy 'Integrating Library Services into the eLearning Environment at Queensland University of Technology' *Australian Academic & Research Libraries* vol 32 no 3 2001 pp222-238
11. C Bruce and P Candy 'Information literacy programs: People, politics and potential' in C Bruce and P Candy (eds) Information literacy around the world: Advances in programs and research Wagga Wagga Centre for Information Studies, Charles Sturt University 2000 pp3-10


13. C Asher 'Separate but Equal: Librarians, Academics and Information Literacy' Australian Academic & Research Libraries vol 34 no 1 2003 pp52-55

14. D Orr and M Wallin 'Information Literacy and Flexible Delivery: Are We Meeting Student Needs?' Australian Academic & Research Libraries vol 32 no 3 2001 pp192-203

15. R Ivey 'Information Literacy: How Do Librarians and Academics Work in Partnership to Deliver Effective Learning Programs?' Australian Academic & Research Libraries vol 34 no 2 2003 pp100-113


17. B Moran 'Planning a Program of Instruction in Information Management for Engineers' in P Howard G Swarbrick and A Churches (eds) 10th Annual Conference of the Australasian Association for Engineering Education Gladstone 1998 pp141-144

19. P Candy 'Mining in Cyberia: Researching information literacy for the digital age' in C Bruce and P Candy (eds) *Information literacy around the world: Advances in programs and research* Wagga Wagga Centre for Information Studies, Charles Sturt University 2000 pp139-151

20. N Fjallbränt 'The development of Web-based programs to support information literacy courses' in C Bruce and P Candy (eds) *Information literacy around the world: Advances in programs and research* Wagga Wagga Centre for Information Studies, Charles Sturt University 2000 pp25-36


22. J Hiscock and P Marriott 'A Happy Partnership - Using an Information Portal to Integrate Information Literacy Skills into an Undergraduate Foundation Course' *Australian Academic & Research Libraries* vol 34 no 1 2003 pp32-41


26. R Catts 'Some issues in assessing information literacy' in C Bruce and P Candy (eds) *Information literacy around the world: Advances in programs and research* Wagga Wagga Centre for Information Studies, Charles Sturt University 2000 pp271-283

27. P Iannuzzi 'We Are Teaching, But Are They Learning: Accountability, Productivity and Assessment' *Journal of Academic Librarianship* vol 25 no 4 1999 pp304-305


Figure 1

Outline of the information literacy elements of SEB121
Table 1

Student responses to self-guided Library tour activity

<table>
<thead>
<tr>
<th>Most useful aspect of self-guided tour activity</th>
<th>Frequency of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-campus students</strong></td>
<td></td>
</tr>
<tr>
<td>Finding/searching using the catalogue</td>
<td>12</td>
</tr>
<tr>
<td>Knowing where to find resources</td>
<td>9</td>
</tr>
<tr>
<td>The on-line tutorial</td>
<td>4</td>
</tr>
<tr>
<td>Answer to assignment 1 question</td>
<td>3</td>
</tr>
<tr>
<td>Chance to walk around the Library</td>
<td>3</td>
</tr>
<tr>
<td>Information about referencing</td>
<td>2</td>
</tr>
<tr>
<td>The fact that it was self-guided</td>
<td>2</td>
</tr>
<tr>
<td>Identify Library ID number and PIN</td>
<td>2</td>
</tr>
<tr>
<td>The checkpoints</td>
<td>1</td>
</tr>
<tr>
<td>How to borrow items</td>
<td>1</td>
</tr>
<tr>
<td>Information about on-line resources</td>
<td>1</td>
</tr>
<tr>
<td>The Library website</td>
<td>1</td>
</tr>
<tr>
<td>How to borrow books from other libraries</td>
<td>1</td>
</tr>
<tr>
<td>Find out about the Information desk</td>
<td>1</td>
</tr>
<tr>
<td>Understand call numbers for books</td>
<td>1</td>
</tr>
<tr>
<td>Understand different item types</td>
<td>1</td>
</tr>
<tr>
<td><strong>Off-campus students</strong></td>
<td></td>
</tr>
<tr>
<td>Links to on-line resources</td>
<td>3</td>
</tr>
<tr>
<td>User-friendly and interactive</td>
<td>3</td>
</tr>
</tbody>
</table>
How simple it was 1
Identifies resources for off-campus students 1

<table>
<thead>
<tr>
<th>Least useful aspect of self-guided tour activity</th>
<th>Frequency of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-campus students</strong></td>
<td></td>
</tr>
<tr>
<td>On-line quiz (too long)</td>
<td>6</td>
</tr>
<tr>
<td>No assistance (self-guided)</td>
<td>2</td>
</tr>
<tr>
<td>Tour too long</td>
<td>1</td>
</tr>
<tr>
<td>Had to book a time</td>
<td>1</td>
</tr>
<tr>
<td>To general, not tailored to course</td>
<td>1</td>
</tr>
<tr>
<td>Too much to remember</td>
<td>1</td>
</tr>
<tr>
<td>Getting lost</td>
<td>1</td>
</tr>
</tbody>
</table>
### Table 2

**Student responses to information literacy session**

<table>
<thead>
<tr>
<th>Most useful aspect of information literacy session</th>
<th>Frequency of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-campus students</strong></td>
<td></td>
</tr>
<tr>
<td>How to access on-line resources</td>
<td>7</td>
</tr>
<tr>
<td>Different types of Library resources</td>
<td>6</td>
</tr>
<tr>
<td>How to do searches of on-line material</td>
<td>6</td>
</tr>
<tr>
<td>Searching the Library catalogue</td>
<td>3</td>
</tr>
<tr>
<td>The computer session</td>
<td>2</td>
</tr>
<tr>
<td>Accessing on-line journals</td>
<td>2</td>
</tr>
<tr>
<td>How to reference different sources</td>
<td>1</td>
</tr>
<tr>
<td>How to locate information in the Library</td>
<td>1</td>
</tr>
<tr>
<td>Accessing on-line newspapers</td>
<td>1</td>
</tr>
<tr>
<td>Assistance selecting an assignment topic</td>
<td>1</td>
</tr>
</tbody>
</table>

| **Off-campus students**                           |                         |
| Lots of examples                                  | 1                       |
| Presented interestingly                           | 1                       |
| Relevant to student tasks                         | 1                       |
| Learnt to use the Library facilities              | 1                       |
| Being able to search for journals on-line         | 1                       |

<table>
<thead>
<tr>
<th>Least useful aspect of information literacy session</th>
<th>Frequency of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-campus students</strong></td>
<td></td>
</tr>
<tr>
<td>Too quick</td>
<td>4</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Issue</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too long</td>
<td>1</td>
</tr>
<tr>
<td>Sometimes repetitive</td>
<td>1</td>
</tr>
<tr>
<td>Too much detail</td>
<td>1</td>
</tr>
<tr>
<td>Too much talking</td>
<td>1</td>
</tr>
<tr>
<td><strong>Off-campus students</strong></td>
<td></td>
</tr>
<tr>
<td>Prefer to be able to print something off</td>
<td>1</td>
</tr>
<tr>
<td>Sometimes repetitive</td>
<td>1</td>
</tr>
<tr>
<td>Went off on tangents</td>
<td>1</td>
</tr>
</tbody>
</table>