



What do we teach them and what are they learning? Evaluation and assessment of the information literacy skills of science students

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Information literacy ‘enables learners to engage critically with content and extend their investigations, become more self-directed, and assume greater control over their own learning’ (Council of Australian University Librarians 2001). Such skills are, therefore, a key element of undergraduate learning, a foundation for research activities, and a basis for lifelong learning within the workplace. A number of key generic graduate attributes can collectively be described as information literacy skills (ILS). These include:

- a capacity to recognise the need for information and determine the nature and extent of the information needed;
- a capacity to access required information effectively and efficiently;
- the ability to evaluate information and its sources critically; and
- the ability to create new knowledge by integrating prior knowledge and new understandings.

The acquisition of such skills is an integral part of becoming a professional scientist, and there is an increasing impetus to include more overt teaching of such skills within the undergraduate degree (Parker 2003). It is acknowledged that the most effective learning outcomes occur when generic skills are an integral part of teaching within the discipline and taught to all students in a structured and progressive manner (Shapiro and Hughes 1996). Indeed, based on their own experiences of teaching ILS within the School of Zoology at the University of Tasmania (UTas), Dearden, Jones, Richardson and Barmuta (2004) have suggested that students’ acquisition of ILS should be incremental, iterative, embedded and assessed, as also proposed by Lupton (2002). Yet how can we determine what skills our students already possess, and at what level? And how can we best teach and assess their learning of information skills within the context of our own discipline?

In this project we aimed to address these questions. In collaboration with Queensland University of Technology (QUT) Library staff, the project team developed a multipart survey to test students’ current knowledge, skills and practice against the *Australian and New Zealand Information Literacy Framework (ANZIL) Framework* standards. We surveyed students in all three undergraduate years to see if their knowledge and skills improved from years one to three, as a result of transferring skills acquired at lower levels into higher undergraduate levels. Second, we wished to investigate whether there are discipline-specific differences in students’ ILS. We therefore focussed on three schools that we anticipated might have rather different expectations of their graduates regarding ILS: Computing, Engineering and Zoology. Students in the first two disciplines are highly likely to be enrolled in specialist degrees, while Zoology students are most likely to be enrolled in the more generic BSc.

However it is also relevant that learning occurs within different contexts within these disciplines. There was little information on what is being taught and how ILS are being assessed in schools of our Faculty of Science, Engineering and Technology (S. E. and T.). Our second aim was, therefore, to map current teaching of ILS across the Faculty through surveying the academic staff teaching undergraduate units at all year levels, in a systematic study of how ILS and associated assessment practices are incorporated into our Faculty’s programs.



Methodology

Both staff and student surveys were based on the Information Literacy core standards outlined in the *ANZIL Information Literacy Framework* (Bundy 2004), and all questions were linked to specific standards:

- *Standard One*: the information literate person recognises the need for information and determines the nature and extent of the information needed.
- *Standard Two*: the information literate person finds needed information effectively and efficiently.
- *Standard Three*: the information literate person critically evaluates information and the information-seeking process.
- *Standard Four*: the information literate person manages information collected or generated
- *Standard Five*: the information literate person applies prior and new information to construct new concepts or create new understandings.
- *Standard Six*: the information literate person uses information with understanding and acknowledges cultural, economic, legal and social issues regarding the use of information.

Staff survey

A survey questionnaire was mailed to every teaching academic staff member in the Faculty. The survey asked them to consider (yes/no answers) the following statements in regard to each of the six Information Literacy standards for each unit that they teach:

- An objective similar to this standard is explicitly included in the unit's learning objectives.
- Content matching this standard is explicitly included in this unit's content.
- Knowledge or skills similar to this standard are explicitly reflected in this unit's assessment.

They were also given the opportunity for providing additional information, either about specific units or about the structured teaching of ILS within their school or discipline.

Data analysis

The numerical data were collated in a spreadsheet, and for the yes/no answers, the data were summarised as a series of Venn diagrams that present the counts of 'yes' responses across all units. This was done separately for each standard, and for all standards combined.

Student surveys

The student surveys were adapted from surveys developed at QUT that were generously made available to our project by Judy Peacock and co-workers. There were three parts to the survey: to ensure that the questions were asked within a context familiar to the students, we adapted each survey slightly for the three disciplines by appropriately replacing discipline-specific terms only.

Part 1 (comprising Questions 1-7) tests the students' acquisition of ILS through questions presented as specific scenarios with multiple choice answers. A sample question from the Zoology survey is:

- Which search strategy would retrieve the most citations in an electronic database?**
- a. conservation OR environment
 - b. conservation AND environment
 - c. conservation NOT environment
 - d. conservation
 - e. environment

In the survey for the Computing students, the words 'conservation' and 'environment' are replaced by 'polymorphism' and 'overloading', while the engineering students are asked to consider the search terms 'hydropower' and 'environment'.

Part 2 (comprising Questions 8-15) aims to tease out students' knowledge from their actual behaviours when presented with a problem requiring them to apply their ILS. It presents the students

with scenarios and then asked them to choose what they should do and what they would do from a series of multiple choice answers. A sample question from the Zoology survey is:

<p>You have found the following book in the UTAS Library collection: Gul, S. <u>Enzyme assays : essential data</u> New York : Wiley, 1998. You feel that most of the information contained in the book is relevant and you want to consult it frequently. How much of the book may you photocopy legally?</p>	<p><i><u>I should</u></i></p> <p>a.</p> <p>b.</p> <p>c.</p> <p>d.</p> <p>e.</p>	<p><i><u>I would</u></i></p> <p>a.</p> <p>b.</p> <p>c.</p> <p>d.</p> <p>e.</p>	<p>a. Photocopy none of it</p> <p>b. Photocopy no more than 10% or one chapter</p> <p>c. Photocopy no more than 20% of the book</p> <p>d. Photocopy all of it provided it is for your own use only</p> <p>e. I don't know</p>
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Part 3 asks for some demographic information about the student, including whether they are a mature entry student and whether they have attended a workshop on information literacy within the last year.

The surveys were anonymous and participation was voluntary. The surveys were administered during class times by Chris Evans the Science Librarian, and the academic staff teaching the units were not present. Within the disciplines of Computing, Engineering, and Zoology, we surveyed undergraduate students in years one, two and three. Where possible, we selected compulsory core undergraduate units for surveying, as these would best reflect the demographic for that year cohort within each school.

Data analysis

For Parts 1 and 2, each question was matched with a Standard, and the ‘correct’, or most appropriate, answer as previously identified by the survey team. Data were analysed using logistic regression (G-tests), to test the effect of subject (Computing, Engineering, Zoology) and year (one, two or three) on the proportion of correct answers for that class for each question. We then took a second approach, combining those questions that all addressed specific Standards, and carried out similar analyses that related to each Standard. The Computing data presented some issues because one class was a mix of second and third year students: surveys were deleted from the data base if the student had not indicated their year group. Data were analysed both with the year groups separated, and with them combined, but this had little effect on the results. For all tests, the level of significance set at 0.05. For Part 3 (demographic information), data were collated and summarised, but no statistical analyses were performed.

Results

Staff survey

The returned surveys provided information on 62 individual units from ten of the twelve schools within the Faculty. The data indicate that current teaching across the faculty appears to be addressing all six standards: however, the distribution of units represented by the surveys suggests that teaching of ILS is primarily concentrated at years 1 and 2. Furthermore, some schools, particularly Psychology and Zoology, appear to be putting more effort into overt inclusion of ILS across their undergraduate curriculum. However information is, of course, limited to those units described in returned surveys.

A substantial number of units include explicit statements about information literacy in all three of their unit learning objectives, content and assessment; another group include information literacy in their content and assessment but do not include it in the unit’s learning objectives, while another group assess ILS without explicitly including them in the unit’s learning objectives or content (Figure1).

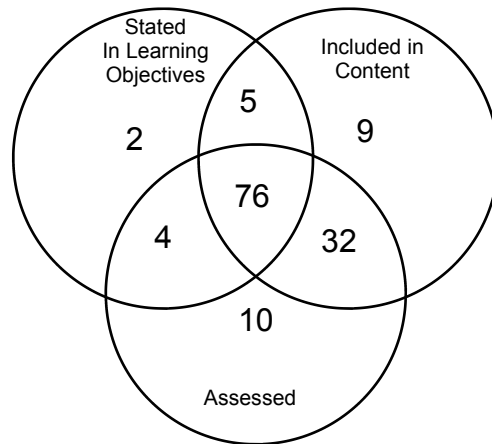


Figure 1. Staff survey results: combined data across all six Information Literacy standards. Numbers in each segment represent the numbers of units that include these standards in unit learning objectives, assessment tasks, and/or content.

The data for each individual standard showed that in the majority of cases the standard was included in all of the learning objectives, unit content and assessment tasks. However, despite current emphasis on enhancing understanding of academic integrity issues, only 21 units considered Standard Six, which considers the ethical use of information, and only seven of those incorporated the standard into all of the unit’s learning objectives, content and assessment (Figure 2).

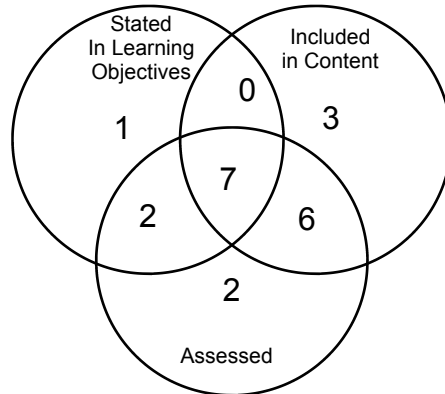


Figure 2. Staff survey results for Information Literacy Standard Six. Numbers in each segment represent number of units that include this standard in unit learning objectives, assessment tasks, and/or content.

Student survey

In the key areas of *finding information* (Standard Two), *critical evaluation of information* (Standard Three), and *plagiarism* (Standard 6), the survey results demonstrated some differences between the disciplines, but these were not all significant. Unexpectedly, there also appeared to be little difference between the year groups, as demonstrated by the responses to the following selected questions:

- Standard 2: Q2. The proportion of students that answered correctly did not vary significantly between subjects ($p = 0.3643$) nor between years ($p = 0.6482$).
- Standard 3: Q9. The proportion of students that answered correctly did not vary significantly between subjects ($p = 0.0782$) and years ($p = 0.7632$).
- Standard 6: Q7. The proportion of students that answered correctly varied significantly between subjects ($p = 0.0175$) but not between years ($p = 0.4652$).

The results were not consistent within standards because of a lack of statistical power due to the low numbers in some student groups (specifically Computing years 2 and 3). However, as a general observation, where a statistically significant difference was detected, this was always due to a greater proportion of correct responses by Zoology students. Where there was a significant interaction between year and discipline, this reflected a general trend for Zoology and Computing students to improve with year, but for Engineering students to show no change or a decline in the proportion of correct answers. This is illustrated by the following example (Figure 3) that presents compiled data (as a score out of a maximum of 12) for all questions referring to Standard 2:

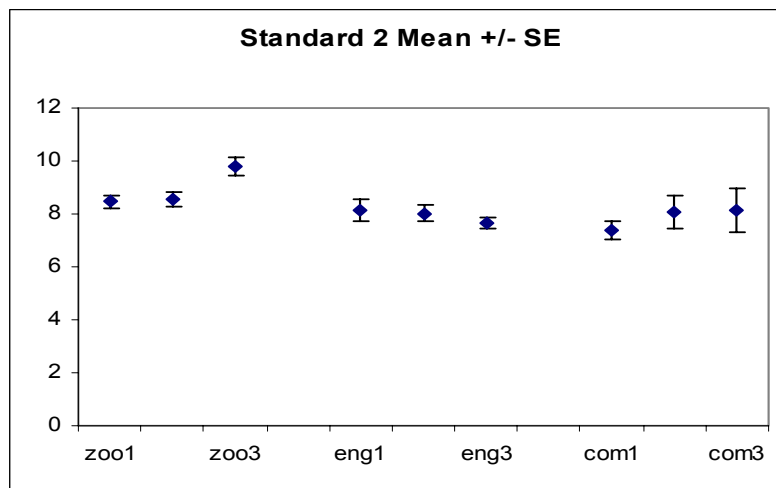


Figure 3. Mean scores for compiled questions relating to Standard 2, for first, second and third year students in Zoology (zoo), Engineering (eng) and Computing (com).

The final part of the survey demonstrated that there were marked differences in the percentage of students within each subject discipline and within year groups who had attended an ILS workshop during the past year (Table 2).

Table 1. Percentage of undergraduate students in each discipline who had attended an ILS workshop during the past year (Survey Part 3)

	Year 1	Year 2	Year 3
Computing	6	16	0
Engineering	75	7	10
Zoology	60.5	58.5	14

Discussion

Overall, the results indicate that the student surveys described in this paper are an effective means of testing students' acquisition of ILS in the context of the ANZIL Standards. The students' responses suggest that some questions may be somewhat ambiguous, and may need to be slightly re-worded in future iterations. However, the surveys do appear to be an effective tool for mapping how students improve their ILS as they progress through a degree, and will therefore provide academics with important information about the effectiveness of their teaching programs.

Comparisons between the disciplines showed that, in our study, Zoology students tend to perform better. This may reflect the programmed approach to teaching information literacy within that school: at both first and second year levels, a large proportion of Zoology students indicated that they had attended a relevant workshop within the past year. The school has a policy of embedding the teaching of ILS within the curriculum, as recommended by Parker (2003), and while the workshops are usually run by library staff, they relate specifically to assessment items for the relevant unit. Indeed, it has been suggested previously that strategic partnerships between academics and library staff can greatly increase the effectiveness of teaching ILS and thereby enhance students' lifelong learning skills (Rockman 2002): this approach is being strongly encouraged at UTas.



It is not clear, however, whether the differences we saw between disciplines most reflect discipline-specific differences in attitudes towards ILS or the effort put into overt teaching of ILS in those schools. It was also evident from discussions within the project team that academics from different schools may have different expectations of their students, especially in their degree of engagement with the primary literature. In the next iteration of these surveys, it would be instructive to compare cognate disciplines (e.g., Zoology and Plant Science), so that this issue could be better resolved.

The results also show that there is certainly no room for complacency here. It was particularly concerning that a significant number of students were unable to respond correctly to questions relating to Standard Six, which addresses academic integrity, and that this standard was also least addressed in teaching, even by those staff motivated to complete the survey. Thus the staff survey will provide a useful mechanism for current and future coordination of ILS - related teaching across programs. At a local level, then, our results will inform current work within the Faculty on developing a generic attributes curriculum. At a broader level, the student survey instruments provide a tool to facilitate comparisons of students' ILS across year cohorts within institutions, or, indeed, between institutions.

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References

- Bundy, A. (ed.) (2004) Australian and New Zealand Information Literacy Framework: principles, standards and practice. Australian and New Zealand Institute of Information Literacy, Adelaide.
- Council of Australian University Librarians (2001) *Information Literacy Standards*. 1st ed., Canberra: Council of Australian University Librarians.
- Dearden, R.L., Jones, S., Richardson, A. and Barmuta, L. (2004) Shared vision, shared responsibility: the vertical integration of information literacy across the Zoology curriculum. In *Lifelong learning: whose responsibility and what is your contribution? Proceedings of the 3rd International Conference*, Yeppoon, Queensland.
- Lupton, M. (2002) The getting of wisdom: reflections of a teaching librarian. *Australian Academic Research Libraries*, June 2002, 75-85.
- Parker, J. (2003) Putting together the pieces: information literacy at the Open University. *Library Management*, **24**, 223-228.
- Rockman, I.F. (2002) Strengthening connections between information literacy, general education and assessment efforts. *Library Trends*, **51**, 185-198.
- Shapiro, J. and Hughes, S.K. (1996) Information literacy as a liberal art: enlightenment proposals for a new curriculum. *Educom Review*, **31**(2), <http://www.educause.edu/pub/er/review/reviewArticles/31231.html>

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