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Integrating information literacy as a habit of learning - assessing the impact of a thread of IL through the curriculum

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Abstract

This paper describes integration of IL as a thread running through the environmental sciences curriculum at Newcastle University. A variety of IL activities, including skills development, reflection and assessment, were piloted within existing modules between 2005 and 2008. Discussion groups and learning logs were used to draw out student perceptions of their experiences and to investigate the students' concept of IL as a graduate attribute for life. Student self assessments were considered in the light of independent analysis of their IL abilities. Students' responses show that embedding the assessment of information literacy can play a crucial role in engaging students with the concepts involved, so that as well as learning specific skills, they have the opportunity to develop a wider awareness of the information environment. Continuing assessment of the value and effectiveness of these interventions has also supported the learning processes for staff involved in the implementation.

Keywords
Learning for life, habits of learning, information literacy impact, information literacy assessment

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1. Introduction

Learning for life requires individuals to develop appropriate underpinning personal habits of learning which can continually evolve to meet new needs and adapt to new circumstances. Information literacy (IL) is an essential component of this individualised approach when it is built on a foundation of up-to-date skills. It is becoming recognised more widely that IL is essential in today's workplace; Martin and Williamson (2003, p.145) highlight that all information users need to become "critical consumers of information in order to avoid overload and to develop new intellectual skills in order to manage information effectively and transform it into usable knowledge". These skills are also critical for effective learning while at university and ideally during academic study IL should be embedded as one learning habit or disposition (Claxton and Carr 2004) which supports effective interaction with information and lasts for life. A university education is not purely about gaining specific subject knowledge; it must challenge students to view their learning as something which isn't bounded by their time at university but is part of their everyday world.

Perkins, Jay and Tishman's (1992) descriptions of thinking dispositions correlate well with this approach and allow us to situate IL within a broader educational context. They define seven dispositions, with traits such as a tendency to explore alternative views, the tendency to wonder and probe, to seek connections and explanations, to exercise control of mental processes and be reflective, all of which have parallels in definitions of information literacy. It is also helpful to distinguish between learning styles, attitudes and habits. Learning styles, which are a reflection of an individual's personality and are usually an unconscious trait, are difficult to influence or change.

They can be thought of as the way in which a learner receives, sorts, interacts and processes information. Learning attitudes are frequently a conscious trait and often depend on motivations. A person's attitude to their learning, their views on the value of learning and why they are learning is also often influenced by factors beyond the classroom. In contrast, a learning habit describes the way in which a person has learned to learn. Development of study skills and information literacy targets students' learning habits i.e. the ways in which we learn, the methods we employ and the routines we often follow unconsciously. A key aim of this project was to encourage students to embed IL practice as a learning habit and to personalise this practice within their attitudes to finding and using information for learning.

Recently some authors (Keen 2007; Brabazon 2007; Rowlands and Fieldhouse 2007) have raised concerns about the information explosion and the ways in which 'digital natives' approach their need for information. Keen (2007, p. 15) warns us of "Digital Darwinism, the survival of the loudest and most opinionated", referring to the indiscriminate way people use, contribute to and believe information on the Internet. Brabazon (2007, p.16) argues passionately that the "'clicking replacing thinking' habit has been profoundly damaging to our learning institutions and to the ambitions of our students and educators" and champions information literacy as a priority for "transforming a fetish for information into a desire for argument, debate and knowledge" (Brabazon 2007, p.12).

Teaching and immersion of the student in the scientific method and culture has long been recognised as an important part of education for those entering scientific professions. Separately but contemporaneously to IL, the term science literacy has gained currency (Yore et al 2003), and overlaps with the conception of information literacy are noticeable. Hurd (1998) includes many characteristics, which relate directly to an individual's ability to evaluate and use information in his definition of a scientifically literate person. An important recurring aspect of scientific research is the critical review of literature to position one's work in the field. However, neither IL nor scientific literacy is effectively taught by exposure to practice, neither can they be absorbed from an academic community by osmosis. Although it may not be recognised and labelled as such, there is a general agreement amongst academic staff that a student-centred pedagogical approach implicitly involves effective habits of information management and use. IL is essential to allow students to develop their individual knowledge base beyond materials presented in lectures by drawing on both subject-specific and more general information. Following concerns raised by teaching staff about students' limited information skills, close collaboration between academic and library staff between 2005 and 2008 has resulted in the development of a whole curriculum perspective which integrates IL more purposively. This paper describes the process of integration of IL activities and assessments into the Environmental Science curriculum at Newcastle University, and presents the preliminary results of research undertaken to assess the impact on student attitudes to IL and learning habits.

2. Teaching information literacy

A frequently cited definition of information literacy is that developed by the American Library Association (1989): "To be information literate, a person must be able to recognise when information is needed and have the ability to locate, evaluate and use effectively the needed information". In the UK, a distinct model "The seven pillars of information literacy" (Task Force on Information Skills 1999) was developed by the Standing Conference of National and University Libraries (SCONUL) and focuses on defining personal characteristics and a progression of skills that are associated with the development of information literacy for an individual (Johnston and Webber 2003). Both of these definitions provide useful benchmarks but they focus mainly on skills development, rather than on influencing attitudes and habits. We have therefore used the definition by Bent et al (2007, p.84) as a basis for our approach in this project, considering IL to be a recursive learning process rather than a simple ladder of skills to be attained:

IL can be thought of as" an individual's attitude to their learning and research such that they are explicitly thinking about how they "use, manage, synthesise and create information, in a wise and ethical manner, to the benefit of society", as part of their learning life. In this view, information literacy is central to learning and research and is about changing people's learning attitudes and habits so that they understand how information fits into their learning lives (Bent et al, 2007, p.84).

Differences in conception and definition of IL are not inconsequential when considering the integration of IL into the curriculum. If IL consists of a set of skills then the emphasis can be confined to training; however if IL is viewed as a personal and individualised corpus of knowledge and an attitude to or habit of learning, then a broader educative approach is needed (Town 2003). Education, as opposed to training, engages the learner in reflective practice, learning specific skills alongside the development of a wider awareness of their learning. We consider that the overall aim of integration of IL into the curriculum is to allow students to develop a continually evolving personal learning process underpinned by up-to-date skills; consequently a variety of pedagogical approaches were used in this project.

3. Integration and evaluation of IL in the Environmental Science Curriculum

The programme specification for BSc Environmental Science in 2003 listed "information skills" within the cognitive skills section: "critically appraise data, information and viewpoints and produce a reasoned argument" and also as a key (transferable) skill: "summarise and communicate in writing and orally in a manner appropriate to the target audience; use information sources effectively". However the linked description of the teaching strategy was much less explicit, merely stating that: "library workshops develop information searching skills". In 2003/04, first year students had an introductory library tour in induction week and second year students attended an advanced skills library workshop as part of a compulsory module. This workshop was organised and run by the Science Liaison Librarian, but this was in no way integrated into the content of the module.

During the programme review in 2004, the Environmental Science teaching group expressed concern about the weak skills of students in finding and using scientific literature in assignments, more advanced information evaluation and synthesis and the potential ability of the students to effectively undertake their final year Environmental Science Project. Some of their most common concerns are demonstrated by the following comments:

> *Even in 2nd year assignments you still mostly get websites quoted as references.*
>
> *I think that we have probably failed to encourage the students to find and make sense of scientific, rather than popular literature.*
>
> *I do think that most of the intake is woefully trained in dealing with writing reports and undertaking original work. This spans the full gamut from design (which one might expect to be a little naive) through to execution and write up. … The students are not given any time to learn really useful skills for the outside world (like thinking, for one).*

Reviewing the previous information literacy workshops delivered mostly by library staff, the authors noted that a coincidence of timing had led to a particularly effective workshop. The students had just been set the task of finding information about the possible impacts of airport expansion for an assessment when they attended the workshop. As a result the students had been keen and obviously interested in the content of the session and as a consequence the library staff commented:

> *It was nice to run a workshop where it felt integrated into the real study of the students, rather than an optional add-on where even those who turn up aren't that interested.*

Against this background, a more wide ranging review of the curriculum and module structure of the degree programme allowed academic staff to identify three compulsory modules, one in each year of the degree programme, where information "skills" were mentioned explicitly as Intended Skills Outcomes. The development of the students' awareness of IL and its associated skills was planned as a golden thread, starting at the beginning of the first year and linking through the curriculum to the final year project, integrating information literacy learning objectives into the Environmental Science programme. Each module was then developed to include the introduction, consolidation and explicit assessment of information skills but within a subject-specific frame (more details are given in Appendix 1). The authors used generic information literacy material provided by library staff and adapted it where appropriate to fit the scientific context. New material devised by academic staff specifically for the environmental sciences programme has also been developed, leading to a blend of integrated and stand alone teaching and learning approaches, delivered to the students by academic and library staff acting both together and independently in collaboration. The Environmental Science programme specification was consequently amended so that the teaching strategy for key skills formulated in 2004 stated:

> *Information literacy is developed with the support of the library and information centre support staff with a golden thread running from Environmental Science Issues through Environmental Practice to the Environmental Science Research Project. … Varied requirements for literature searches and production of word-processed documents reinforce this and give the opportunity to practice information literacy skills in a range of contexts.*

The IL development within the Environmental Sciences programme took place in the context of other information literacy work initiated by library staff in the University Library. The integration and assessment of IL activities is also being piloted in a University Teaching Fellowship project in Chemistry and this has allowed refinement of the criteria to the benefit of the Environmental Sciences course. The student self assessment activity was adapted from work on perceptions of IL by secondary school pupils and teachers (Bent 2008); this study also influenced the design of some discussion groups which took place with second year environmental science students and informed some of the approaches taken in the individual IL activities. The Newcastle Information Literacy Project (Bent and Brettell 2006) has developed a toolkit [http://www.ncl.ac.uk/library/staff/infolit/toolkit/] of learning objects, links and ideas which can be adapted by teachers to integrate into their curricula and this provided a rich source of accessible material for both teaching and library staff. Materials developed for the Environmental Sciences programme, such as the self assessment activity, have also been deposited into the Toolkit so that they can be used by others.

In the past, in spite of the huge investment of time and effort expended by library staff in delivering information literacy related activities at Newcastle University, there has been little hard evidence to demonstrate how effective the activities have been in the real development of students as information literate learners. Competency based tests which assess specific skills, such as citation and other assessment approaches can indicate whether students can describe an appropriate search strategy and use specific resources effectively. On the whole, however, before this project there was little evidence on whether any of the interventions led to permanent changes to the students' attitudes and habits with respect to information. The techniques developed in this research to assess impact should be easily transferable to other courses and modules in future and it is hoped they will allow a much clearer assessment of the value of IL development.

Evaluation of the IL activities in the Environmental Science programme, including skills development, reflection and assessment, individual interventions and the overall thread through the curriculum took place between 2005 and 2008. Given that our approach in embedding IL into the Environmental Science curriculum encapsulates both a skill (training) element and an attitude (education) element, the assessment of the success of the Environmental Sciences programme has included both qualitative and quantitative techniques. A range of different IL activities and assessments was piloted across the programme; they included specific practical training such as

developing a search strategy by defining keywords and using mindmaps, learning how to use appropriate tools and resources and selecting suitable references. These were augmented by activities aimed at fostering an IL learning habit, such as reflective learning logs, seminar discussions and formative IL feedback on assessed coursework. Due to the variety of teaching approaches employed, a range of techniques had to be useded to capture a sense of their impact on the students' learning and development of IL habits. At this stage, emphasis was mainly on testing and refining the activities and evaluations, rather than a providing a full structured assessment of their impact.

The learning logs and search strategies submitted by the students as part of their assessments provided relevant information on both the use of the practical skills introduced and students' understanding of information literacy concepts, as students had been directed to reflect on both the processes they had gone through and their own reactions to them. From the perspective of the library staff, this was an invaluable opportunity to engage in a dialogue with students about the concepts of information literacy as well as assess their practical skills. Informal feedback was also obtained through conversations with staff and students. From 2007, all first year students were also asked to self-assess their information literacy skills using a simple framework [Appendix 2] developed from the SCONUL 7 pillars model as part of their paperchase exercise in the Library [see Appendix 1 for programme details]. The additional IL self assessment exercise was used as a starting point for discussion in seminars, where the aim was to raise the students' awareness of what information literacy is about and to engage them in thinking about their own IL development as part of learning for life. From 2007, general academic marking of students' assignments in 4 modules was supplemented with independent evaluation of their work, using criteria devised to identify evidence of IL in assessed work [Appendix 3]. The analysis of the findings generated by independent assessment of work using IL criteria go beyond the scope of this article and will be reported on in a later publication. In 2008 discussion groups were also used to draw out student perceptions of their experiences during the first year of the degree and to investigate their conceptions of IL as a graduate attribute for life. Although all students participated in the IL activities, only volunteers joined the discussion group exercises. As volunteers tend to be motivated, higher achieving students, this has inevitably lent some bias to any conclusions. However, the work has served as a basis for a more structured evaluative framework which is being implemented from the 2009/10 academic year.

4. Impacts of the IL activities and assessment

Student self-assessments [Appendix 2] indicated their own perceptions of their current information literacy level using a scale from poor [1] to excellent [5]. For first year students at the beginning of the year, mean scores for each skill area were mainly between 2.4 and 3.6, with students rating their ability to "interpret information retrieved from different sources" the best and ability to "gather brand new data" the worst. Interestingly, the broadest range of ratings was given for "recognising the legal and ethical implications of using other people's work". Using a self assessment tool at the start of the programme allowed staff to assess the variation in students' IL understanding and experience when first entering the university so that the first IL workshop could be tailored to students' perceived weaknesses, such as those mentioned above. The early use of self-assessment also introduced the students to the focus of the IL thread on reflection alongside the learning of a corpus of skills.

The first learning logs submitted highlighted the importance of integrating the library induction into students' programmes of study by providing practical and relevant exercises, rather than relying on the central university library inductions.

> *The self-guided tour as part of central induction wasn't overly successful. This could have been due to lack of concentration due to lack of sleep or the lack of the tour's relevance to my course (or so I believed at the time).*

Although the initial library induction was useful I didn't find as much information on how to use the library as I did with the paperchase exercise which was part of the course.

Learning logs submitted later in the first year of study, even after attendance at a library workshop, showed that many of the students' first port of call in their search for information was the Internet.

The majority of the research I carried out was at home on the internet.

I did search for relevant information myself, mostly using Google as this was more convenient for me. This is because the library is quite a distance away …

Nonetheless, some students were able to show that they were using the Internet appropriately with some clear strategy, planning and assessment of reliability.

I went onto the Internet where I used a variety of search engines and key words to find information that may have been of some use to me. The main search engine I used was Google. The key words I used were hedgerow, removal, farm, agriculture, amalgamation, environment(al) impacts. Each time I searched I came across many of the same web sites, which I had already used or had already found were no use to me. So I tried putting inverted commas around some words and different combinations of the key words I had already thought of. This often came up with the same websites again, however, it did sometimes come up with new sites which were useful. This was often a long process as each search would come up with hundreds and sometimes thousand of links to web sites that the search engine thought were relevant (which as I have said above, was often not the case)

I learnt successful ways to gather specific information from the internet by refining my words when using search engines within websites. I also realised how important it was to look at the information carefully and relate its relevance back to the question.

Many of the statistics in the presentation were taken from websites – government departments and agencies. The use of these websites means that my information and figures were reliable and more current. I also used portals and gateways on the Internet following the library exercise and a very good book on sources of information on sources of information in environmental science in the library reference section.

The final IL tutorial session in the first year of the course was focused explicitly on searching for journal papers and, in particular, the skills needed to read them and extract relevant information, using a recent journal article on a topic of general environmental interest. In the last learning log submitted that year, some of the first year students were able to demonstrate development in their skills and attitudes to IL, demonstrating that the approach of fostering an IL learning habit as well as developing specific skills was having some success.

I felt that I have achieved quite a lot. I actively used journals in my research for the first time in a project, and indeed used a range of journals. I also reduced my dependence on books quite a lot.

Reviewing my learning logs through the course, I can see that I have begun to use journals and the internet to find different kinds of information more effectively and I have used the library much more. I achieved my learning aims for handling information quite well.

The general end of year module questionnaires indicated that all the first year students found the Environmental Issues module had been very helpful in supporting them to learn to use the library facilities, as well as encouraging them to reflect on their learning in a way which was new to them. All the students indicated that their information search skills, even where they had considered them

good initially, had been improved. Overall the module was judged to have helped in developing the skills needed to assess information and use it to evaluate environmental issues.

The information search and evaluation strategy submitted as part of the assessment with a second year assignment showed that students were applying the skills learned in the first year and transferring them to their second year study in order to find relevant materials. This was felt to be an indication of the development of an IL learning habit.

> *My first search was a broad search on the CSA database through the library. A search using the words "waste incinerator" threw up papers on the technical aspects. A scan of the abstracts showed reference to municipal waste as the correct terminology. A search using the words "municipal waste incineration produced a number of papers which also covered environmental impacts.*

Students were also aware of wider range of sources and were making some attempt to distinguish them in terms of reliability and bias, though not always very systematically. One student seems to have used books and journals because they were overwhelmed with information from an Internet search, although they did recognise that books and journals could be more reliable too.

> *I started by looking on the internet but found that the vast amount of information was too much to look through, so I started using books and journals for relevant information. I also feel better about using them as they are more reliable.*

More detailed logs from other students also showed a greater awareness of the need to assess sources for appropriateness and the relevance of different sources for different questions.

> *The two main sources of information used were scientific journals and the internet. These sources provide the most recent information including the latest facts and figures, as well as providing a range of public opinion (internet in particular). … To refine the articles produced by a general search I performed a search within the search results using more specific terms. This enabled me to rapidly locate the most relevant publications.*
>
> *Internet searching was much less efficient as the number of irrelevant hits was much greater than the scientific article database. The reliability of websites was judged by the organization. Usefulness was decided by the degree of relevance to the topic, avoiding highly opinionated or biased articles. Papers written to inform rather than persuade were used.*
>
> *I also visited a site for the Parliamentary Office for Science and Technology this is intended not to be politically biased and simply provide information. The Office for National Statistics was also felt to be reliable and unbiased site.*
>
> *There is a large amount of information available on this subject, but a lot of it is very subjective to the views of the campaign groups and not all is based on actual fact. For example the facts I found on the Environment Agency's website were quite different to the information that I found on the website for the local campaign groups. The sites from the pressure groups were often a selective reworking of the information provided from other sources.*
>
> *I used LexusNexus to find newspaper stories about incinerators and chose the Guardian as a suitable source. Given more time it would have been interesting to see how papers with different readership bases covered the stories.*

Second year students were also able to show the skills needed to read scientific literature appropriately.

> *Journal articles were very specific, so I primarily read the abstracts first to determine whether the paper was relevant, only if this was true did I read the whole article and note the key points.*

In 2005, final year students had not experienced the full programme of IL activities and assessments and revealed the weaknesses, which staff had reported and which had stimulated the development of the IL thread.

> *I found the workshops with Moira very helpful. Before attending the workshops I had no idea about the vast information that we could get from databases and electronic journals. It's handy to know that we can get information from lots of different sources, as it is sometimes to easy just to rely on the internet, and usually most relevant books are out on loan.*
> *The workshops also helped with explaining how references should be set out for different sources of information, as I was always confused about how we should cite a web resource.*

Generally in their final year students are focused on the academic use of information as part of their research project. Almost all of the final year students were able to demonstrate the use of a broad range of sources to support the introduction (context setting) and the literature review in their research projects. In the discussion groups, the students said that they had found the integration of information literacy activities into the curriculum of benefit, as this made the IL sessions directly relevant to the context in which they were learning.

> *It was good having the sessions integrated into modules throughout the year, we paid much more attention and they seemed much more relevant. The sessions this year really set us on the right track. After them we were better equipped to search for the most appropriate journals, to identify other sources of information and to reference the range of sources of material we have found. Without those sessions I would have really struggled with my research project.*

The submission of learning logs, which required reflection on information searching, evaluation and use alongside essays and other reports was a key part of the project. Learning logs provide a reflective tool for enabling students to think about IL as an integrated approach to learning, rather than purely as a set of skills and they raise the profile of IL as an integral part of the learning experience. They also provide very useful feedback to support teaching development and allow the adaptation of teaching activity to address any weaknesses revealed. A valuable by-product of the integrated approach is that it allows library staff to enter into dialogue with students about their learning and the value of IL. Often when library staff are asked to run an IL workshop within a programme they are confined to teaching specific skills and do not have sufficient control of the programme to enable them to develop a reflective activity. This project demonstrates how much value library staff can contribute to the learning experiences of the students.

As with the comments in the learning logs, the students who contributed to the discussion groups demonstrated a mixed range of IL abilities. Most students were able to engage in an abstract discussion of their information use and it was apparent that some had definitely moved on in their approach to dealing with information. When talking about approaches to finding information, for example, one student explained how thinking about the problem in advance of her search activity had helped in her searching strategy, demonstrating to her the value of planning beforehand:

> *When we were in a group we discussed what to do and decided how to do it and so that was easier when we started looking because we had already thought about what we wanted and it helped me to think about where I should look.*

Others commented on why they prefer to start with internet sources, but also showed a clear awareness of how to use them to familiarise themselves with a topic:

> *I think it's more difficult to know if a book's useful until you've got it and you have to read quite a lot before you know if it's useful but you can get a feel for the whole website quickly.*

When reflecting on their personal IL journey over their first year the students were able to identify ways in which they felt they had progressed, for example when talking about their improved understanding of citation:

> *Learning how to reference properly has influenced every piece of work we're going to do, because of plagiarism and all that and it's become second nature to write it down when you look at a source. That was something I didn't used to do and I spent ages going back and sometimes I couldn't find things again.*

Some students explained how they felt their skills had improved in using both basic and more advanced features of the library service:

> *just using a library properly, I never really used one before so finding things is new.*

> *Last year we didn't use it as much but now I use it every day….I learned about electronic journals when I came here…. and I think more about how I use web sites.*

Thinking back to their original self assessment of their information literacy, all the students felt that they were now more information literate, basing their assessment, it seemed, on the fact that they knew about more sources of information. The quotes above also illustrate the way in which their attitudes and approaches to information were developing, and show evidence of emerging IL habits of learning, at least in academic life. However, there was also evidence that whilst several students had absorbed some of the messages relating to choice of sources, in the main they only applied this thought process to their study activities and did not carry over the concepts into their everyday life. When talking about their approach to looking for information one student said:

> *I think everyone's initial approach is Google, but there are obviously other places to find information for like essays and stuff and I'd probably think about using them now.*

When the rest of the group was asked whether they agreed that Google was the starting point, there was some dissention:

> *It depends if you want academic information or just general information like about how much it would cost to buy something.*

The first results from the self assessment of IL skills at the start of the first year [Appendix 2] showed that students consistently gave themselves a higher IL 'score' than the independent evaluation of their submitted essays [Appendix 3]. Over the next 2-3 years the continued combination of the evaluation of submitted essays and reports for evidence of skills in use, together with student reflection on skills development, will allow us to build up a picture of the progress of several cohorts of students through the process as a whole and provide a more rigorous assessment of whether the IL thread has permanently changed students' attitudes and habits with respect to information.

5. Discussion

There are few well documented examples of IL teaching in the context of a programme or module; by contrast, library websites often hold a wide variety of materials on IL skills including access to

self-taught training packages (e.g. http://www.ncl.ac.uk/library/staff/infolit/). This work suggests that embedding IL into the specific method and culture of the academic discipline can provide the bridge needed to bring even library-neutral academics into active engagement with IL concepts.

Surveys of students as information users (e.g. Peters et al. 2003; Smith and Oliver 2005) tend to confirm the initial feelings of the Newcastle academic and library staff with regard to the environmental science students and the descriptions that students make of their own search behaviours described above. Peters et al (2003) showed that most information skills teaching to date has been focused on how to search for, locate and retrieve information and present a properly formatted bibliography. Martin and Williamson (2003) give evidence that even after preliminary information skills training, students make poor use of the wide range of subscription and other higher-education funded electronic information sources and gateways. The preliminary evaluation of these students also indicates that they are very difficult to wean off a Google habit.

It is clear that many students have only rarely been challenged to consider how they are finding and using information; hence they can find reflection on these aspects difficult. However, in terms of students' understanding of IL issues and concepts, Bent (2008), working with both school and university students, discovered that many students have a much more sophisticated understanding than their teachers predict. These students also indicated that they would be receptive to more explicit engagement on how they can develop as information literate learners. The self reflective approaches used in this project were designed to encourage this willingness to think about personal learning and development and the results obtained demonstrate the importance of the golden thread approach, which combines both education and training in a consistently supported way throughout the whole learning experience. The preliminary evaluation of the golden thread approach to IL integration confirms that if information skills are recognised as key skills within the subject benchmarks (using subject benchmark terminology) and in programme specifications, a planned and recursive approach to teaching and learning information literacy is required. Best practice guidance for student learning recognises that it is essential that if students are to develop new or enhanced strategies for learning these must be fostered, supported and encouraged through the structure of the teaching and learning environment (Crosling and Webb 2002).

This project demonstrates that the integration of self-reflective activity alongside skills development is particularly important to support the development of IL as a habit of learning. Previous work with university students has shown that information literacy is a highly individual and situated practice (Rossi and Hinton 2002; Johnston and Webber 2003; Smith and Oliver 2005). The preliminary evaluations carried out to date confirm this and suggest that assessment of IL should be focused both on supporting student reflection on processes and assessing the final outcomes. Integrating the teaching and assessment of IL also enables the use of reflective activities in assessment which support students in integrating good IL practice within their attitudes to finding and using information for learning.

For academic and library staff, one of the benefits of drawing a thread of information literacy through the whole environmental sciences programme is the ability to map the IL development of students from the very start of their university experience right through to graduation. Once the programme integration is fully established, this will enable evidence of the potential contribution the programme has made to IL as a graduate attribute to be more easily recognised. The interventions, techniques and methodology used in the programme to date will be extended and developed during academic years 2008-9 and 2009-10, resulting, we hope, in more comprehensive evidence of the value of the approaches taken. This should be demonstrated by an improvement in the assessment of submitted work using the criteria in Appendix 3. Piloting the IL activities together with the evaluation and reflective feedback activities in the programme enabled the students to become aware of IL within the context of their subject and as part of their wider learning experience. In addition teaching staff were able to refine and adapt the activities on an ongoing basis, so that lessons learned from teaching the current second year students, for example, can quickly be reflected in the teaching of the new first year students. Building this kind of

flexibility into the programme is essential if it is to continue to be relevant and to meet the changing needs of the students.

6. Conclusions

Some aspects of IL can clearly be taught to all students in the same way, thereby allowing the development of generic supporting resources. Other aspects may be better learned in a specific disciplinary context. Considering the development of IL throughout the degree programme has led to a blend of teaching and learning approaches, using both generic and subject specific material as appropriate. Integration of the development of IL throughout the programme means that while there are library-based skills sessions, these sessions cannot be identified as the sole, or even the main points where IL teaching and learning takes place. It is clear that the development of IL needs to be valued through direct credit-bearing assessment whenever possible to further highlight its importance to the students. If 'marks' or even self assessed rankings are attributed to IL abilities, this serves to challenge and motivate students towards improving their ranking in a later assessment exercise. It is evident that embedding the reflective assessment of IL can play a crucial role in engaging students with the concepts involved, so that as well as learning specific skills, they have the opportunity to develop a wider awareness of the information environment. Measuring the impact of this approach also needs to be embedded alongside the activity.

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Appendix 1: Summary of the Environmental Science IL strategy.

	1st year – Environmental Issues	2nd year – Environmental Practice	Final year – Research Project
Aim:	To develop students' study and communication skills to enable independent learning at HE level and to develop confidence in debate.	To give students an enhanced understanding of environmental science in a work context.	To give students the opportunity to undertake a research investigation, analyse data, critically review the literature, and prepare a report of the investigation.
Structure:	Lectures or visits to introduce topical environmental issues followed by small group tutorials for which students need to prepare discussion material.	Presentations from current environmental practitioners linked with skills development workshops, CV writing, project management etc.	Mainly self-directed research support by individual supervisor. Tutorials held in Semester 1 to consolidate writing and project management skills.
Assessment:	Group presentations (2) drawing together observations and literature to discuss an environmental issue. Individual research topic submitted as i) a search strategy and mind map. ii) an essay outline with full bibliography.	A job description and person specification for a post suited to an Environmental Science graduate. A briefing document on a current topic (e.g. airport expansion) including a record of the search strategy used and an assessment of strengths and weaknesses of the information sources.	Literature search strategy; précis of key literature in the form of an introduction to a scientific paper. Main report in extended journal paper format and supervisor's assessment of process.
IL aspects:	First session highlights importance of making use of library resources; students complete library paperchase and IL self assessment exercise. Main library workshop in Week 5 after assessment of paper chase results and targeted to weak areas. Focusing on how to find known information sources and how to search for resources on any topic – development of an appropriate search strategy. Correct citation skills and awareness of copyright and plagiarism. Mind mapping.	Importance of understanding priorities and interests of a range of stakeholders highlighted throughout. Main library workshop in Week 3 refreshing on search strategy techniques and introducing a wider variety of information sources as well as routes to access them, methods to support critical evaluation of sources.	Tutorials include tips and hints on managing information from sources and the key elements of literature review. Main library workshop in Week 2 – overview of key sources of academic information especially databases and introduction to EndNote. Reminder of key ethical issues – plagiarism and need for correct citation.

Appendix 2 : IL Self Assessment Activity

How Information Literate are you?

Read the behaviour and associated example and then give yourself an honest rating between 1 and 5.

Score : 1= Poor 2= Fair 3= Good 4= Very Good 5= Excellent

Behaviour	Example	Rating
I analyse my information needs before I start looking for information	Defining keywords and phrases, using mind mapping techniques, talking to friends, finding background information	
I choose sources appropriately	Don't just use Google, but try different types of information such as books, newspapers, government reports, people, websites	
I can search for information effectively and efficiently	Using advanced features of search engines, combining words, limiting searches	
I know how to ask questions to help me get information	Using appropriate language, saying things in a different way, listening skills	
I can gather brand new data when required	Designing and creating surveys, gathering data, carrying out interviews	
I know how to keep up to date with new information	Knowledge of the main information sources for your job/subject area	
I understand how to interpret information retrieved from different sources	Understand how search engines rank results, being able to sort results sensibly	
I evaluate the quality of the information I find	Using appropriate criteria such as currency, bias, authority to assess information	
I can understand the information I find, analysing and synthesising appropriately	Able to summarise, reword information, collate material from several sources. Know not to cut and paste!	
I recognise the legal and ethical implications of using other people's work	Understanding of copyright and plagiarism. Able to reference material correctly	
I think about what I am doing and make changes as a result	Reflect on what works and change habits as a result	

Adapted (with permission) from an idea by Helen Conroy, Netskills, Newcastle University.

Appendix 3 IL Assessment Criteria

Student: Module:

Information Literacy Assessment

Score 1 (low) – 5 (high)

Criteria	Description	Score	Comments
C1: Independent Research	The work shows evidence of some independent research i.e. sources other than course textbook/ lecture notes have been used		
C2: Relevance	The sources used are appropriate to the **topic** and **level** of study i.e. the kind of sources you would expect		
C3: Validity	The sources used have **academic credibility** i.e. books, journals, quality websites		
C4: Critical thinking	The student has incorporated the information into the essay in a way which demonstrates understanding of the topic and critical thinking		
C5: Citation	a. References are cited correctly b. All sources are cited in the text and bibliography		
C6: Plagiarism	There is no evidence that any material has been plagiarised		
C7: Information literacy ability	Total score, indicating the general information literacy of the student (35=100%)		