

Embedding Core Information Skills At The Point Of Need In First Year Science

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Abstract

Online information literacy modules have been integrated into semester 1 units of study so that every commencing first year science student is now engaged in developing information skills as part of their disciplinary learning (Kift, 2004). A certificate of completion system has enabled these activities to be easily introduced by staff from a range of disciplines. This methodology has enabled skill development to be introduced with no duplication or overlap in the workload for students despite the range of course choices available and without core units.

Introduction

Students commencing their first semester of University study come from a wide variety of educational and cultural backgrounds, and their preparedness for academic-level study can vary significantly. To flourish in a research-intensive Australian university, students need the ability to conduct self-directed, independent study in large classes, often whilst juggling university and part-time employment (Crisp et al., 2009; Nelson, Kift, Humphreys, & Harper, 2006; and Krause, Hartley, James, & McInnis, 2005). In generalist degrees such as the Bachelor of Science (BSc), these issues may be aggravated by the flexibility of the degree. The wide variety of course choices means that students shift between subjects and move around the campus throughout the day, with highly individual timetables. These circumstances can make it difficult for students to feel part of a cohort and it is a struggle for staff to present a consistent experience.

Kift (2004; 2008; 2009) and Kift, Nelson, and Clarke (2010) have outlined and demonstrated the efficacy of a 'transition pedagogy' for ensuring the cross-institutional integration, coordination and coherence of the first year experience policy and practice. To engage commencing students in learning and, particularly, to design activities which develop academic skills, it is important to avoid 'piecemeal' approaches (Krause et al., 2005) and to provide activities that mesh curricular and co-curricular support. These activities need to minimise overlap and workload for students and staff, and be sustainable and flexible. A consistent approach, across multiple units of study, ensures that all students are included without duplication, regardless of their subject choices. In employing such an institutional approach to skill development (Kift et al., 2010), it is crucial that the activities are still valuable to each discipline to ensure on-going engagement by students and staff.

With these challenges in mind, it is perhaps not surprising that attempts to embed information skills in undergraduate programs have been described as 'an aspiration rather than a fully realized ideal' (McGuinness, 2006). Many commencing students feel confident using technology and electronic information. They often do not acknowledge that they have anything to learn in this area. Similarly, staff may assume that commencing students have already developed information literacy at school or in their pre-university experiences, or may think that it is 'someone else's business' (Arndell, Bridgeman, Goldsworthy, Taylor, & Tzioumis, 2012a). Engaging both sides with developing information skills requires 'a complete culture change' (Chen & Lin, 2011).

Traditionally, University information skills programs have been run by librarians, either during events in orientation week, or via online tutorials and face-to-face classes. Engagement with such activities is often uneven with evidence suggesting that those attending tend to be high achieving students (Wingate, 2006). Many librarians recognise that involvement with faculty is key to successful information skills programs (Given & Julien, 2005). 'Point of need' or 'just in time' development of these skills and cognitive abilities through integration with the curriculum across the 'whole of first semester' (Kift, 2004) is now seen as more effective than isolated events (Scales, Matthews, & Johnson, 2005).

The challenges described above require involvement by all relevant parties and a shift towards viewing information literacy development as part of the first year experience and as 'everybody's business' (Kift, 2008). Examples of successes at the institutional level include the development of a virtual learning environment at the University of Southern Queensland (Stagg & Kimmins, 2012) and the embedding of an information skills tutorial for all students at the University of New South Wales (Tantiongeo & Evison, 2008). The 'ARTS1000: eSearch to Research' collaboration between the Library and the Faculty of Arts (University of Sydney, 2011) embeds information literacy as a compulsory component of units of study.

As noted above, commencing students in the Faculty of Science at the University of Sydney have a wide range of choices in their courses. In addition, there is no foundation unit at the institutional or faculty level, so there is no scope to embed information skills development in either of these contexts. Students could thus participate in multiple information skills development activities or none at all. This paper describes a creative solution developed through collaboration between the Faculty of Science and the Library to systematically engage with the entire cohort so that information skills are embedded across first year science units. Through the work described in this paper and the development of a First Year Roadmap (Arndell, Bridgeman, Goldsworthy, Taylor, & Tzioumis, 2012b), we are seeking to encourage a sense of community amongst the students through their development as scientists, and their perception of the cohesiveness and shared skill development.

The authors comprise the 'Sydney Scientist' project team, a partnership between the University of Sydney Library and the Faculty of Science. There are five Science faculty liaison librarians whose activities are coordinated by the Science Library Services Team Leader (Arndell). The team also comprised the Associate Dean for Learning and Teaching (Taylor, in 2011 and Bridgeman, in 2012) and the Directors of First Year Studies in Biological Sciences (Taylor) and Chemistry (Bridgeman) together with a project officer (Tzioumis). This project was the first example of such collaboration, and its success directly resulted from the blend of expertise from the two parts of the institution.

Commencing First Year Science Students In The Faculty Of Science At Sydney

The Faculty of Science at the University of Sydney is comprised of eight Schools and a number of research institutions. It enrolls a large number of students (usually around 1200) into its 5 degrees. Students in a wide range of professional and generalist degree programs offered by other faculties also enrol in our units. The Schools are large, semi-independent institutions whose approaches to teaching and learning can vary considerably, even at a first year level. The focus of each unit has traditionally been very much on delivering the scientific content, knowledge and skills central to each discipline area rather than on developing program level attributes. Curriculum renewal at The University of Sydney is driven by the development of graduate attributes, which include information literacy, and by the concept of *engaged enquiry* for which research-enriched learning and teaching is central.

Students have varying degrees of information skills and proficiencies when they begin university but there is presently a reluctance to introduce a separate ‘study skills’ unit into the already crowded first year of the BSc degree, despite a growing appreciation of the variability of the standard of skills amongst incoming students (Pyke, 2011). In some units, Faculty Liaison Librarians actively participate in aspects of course delivery to enhance information skills. In others, discipline-based initiatives have been introduced. Whilst these strategies are individually effective, the improvements in students’ outcomes are naturally restricted to a subset of the cohort. At best, duplication and overlap results, leading to increased workload and frustration for students. At worst, the approaches are contradictory.

Research And Information Skills: Background To The iResearch Project

Two key information skills were identified for the first semester of our degree programs: plagiarism and academic honesty and the ability to evaluate resources for scholarly merit. These skills are needed from the first day of semester and in early assessments but are poorly understood and developed in our commencing students. Being able to choose and evaluate information sources is a core skill from which other attributes can be built. Recognition of the nature and importance of academic honesty is perhaps even more vital for commencing students if they are to avoid ‘negligent plagiarism’ early in their studies.

Both of these information skills have previously been addressed by the Library’s ‘iResearch: information skills for life’ project (iResearch Project, 2011). The outcome of this internally funded project was a series of short, fun, reusable online modules in core areas of research and information skills. These modules are designed to be stand-alone tools to be re-used in multiple educational contexts. The modules can be accessed ‘just in time’ at a time or place that suits students via the Library’s website, and can be easily embedded in information literacy programs or into units of study. Each module was designed by a team of Library staff using eLearning and interactive design principles, such as the use of scenarios (Mayer, Fennell, Farmer, & Campbell, 2004), and have been rigorously and continually evaluated by staff and students (Hanfling, Goldsworthy, & Bader, 2011). They use straight-forward language and situations which first year students will understand and identify with.

Briefly, in the ‘Plagiarism and Academic Honesty’ module, students work through scenarios and answer questions which cover the difference between referencing and copying, and the concept of academic honesty. Completion takes 5-10 minutes and the module thus forms an introduction to this topic which can then be built on using discipline specific information and resources. Similarly, in the ‘Scholarly versus Non-Scholarly’ module, students work through situations which define what scholarly resources are and how to identify such resources. Students then use these criteria to evaluate resources such as Wikipedia entries, books, magazine articles and peer reviewed journal articles. Figure 1 shows screenshots from both of these modules representing a typical scenario.

Research And Information Skills: Embedding In The Curriculum

The ‘Plagiarism and Academic Honesty’ and ‘Scholarly versus Non-Scholarly’ modules (iResearch Project, 2011) were chosen to be embedded into the curriculum in a range of first year Science units. 20 units of study were chosen from four Schools within the Faculty of Science with large enrolments: Biological Sciences, Chemistry, Physics and Psychology. Completion of these modules was made compulsory in the assessment programs. The choice of these units means that *every* student in *each* of our degree programs completes these modules during semester 1. Every student completes the ‘Plagiarism and Academic Honesty’

module before the end of week 2. Depending on their choice of units, students may complete the ‘Scholarly versus Non-Scholarly Resources’ module at different points of the semester.

In Chemistry and Physics, the ‘Plagiarism and Academic Honesty’ module forms part of the laboratory program. It is used as an introduction to the importance placed in science research on reporting results which are your own and which are genuine. Discussion about recent cases of fraud in scientific and medical research is used to illustrate how central honesty and ethics are to the scientific method. The module is used to supplement the requirement for students to sign a declaration. No marks are awarded for completion of the module but students must do so in order to receive marks for their log books. In scientific research, the log book represents the official and legal record of results and observations. In Biological Sciences and Psychology, completion of the ‘Plagiarism and Academic Honesty’ module is required for the first written assessment. In both disciplines, the module forms the introduction to more extensive work in class. A more detailed description of the embedding of the skills modules in first year chemistry is detailed in the case study below.

Alongside ensuring that all first year science students complete these modules, it is also important that students need not complete them multiple times across many units: it is perfectly possible for students to enrol in units from all four of the Schools involved in the project. To ensure student engagement and ongoing staff buy-in, a ‘Certificate of Completion’ function was added to the modules, providing proof of completion certificates for each module. These certificates can be attached to a student’s log book or assignment. At the end of each module, students are asked to authenticate using their university login information. The certificate generated contains their name, the resource they have completed and the date of completion. An example is shown in Figure 2.

Students are strongly encouraged to upload their certificate as an asset to their ePortfolio available through our First Year Science eCommunity (Arndell, 2012b), or at least to keep an electronic copy on their own device. The ePortfolio on this site is designed to encourage students to collect evidence as they develop graduate attributes (Hallam & Creagh, 2010). By keeping the certificates as evidence of information literacy development, the same certificate can be used for multiple units of study. This system is akin to the recognition system of badges being developed for online skill development (Young, 2012).

The ‘Certificate of Completion’ function is database driven. The authentication aspect calls on limited details contained in the Student Records database. These details are fed into a database created by the Library to store ‘Certificate of Completion’ data. Unit of study coordinators and teaching staff who request access through the Library can then access the ‘Certificate of Completion’ database. Once access has been granted, an academic can log on to the database and download a record of student completions as a ‘comma separated values’ (.csv) text file which can be opened in a spreadsheet program on any platform. This makes tracking completion very simple and enables, for example, a coordinator to easily check whether a student who has mislaid a certificate has genuinely completed the resource.

The .csv file is also formatted to enable it to be used to create a gradebook column in a learning management system. This makes marking or checking completions extremely easy for coordinators. Although it is not necessary for coordinators or teaching assistants to view the certificates, we still recommend requiring students to submit them to show the importance attached to completion of the modules. The availability of a list of completions as a gradebook column enables coordinators and teaching assistants to make use of additional facilities such as selective release of additional resources or warning mechanisms.

Alongside use in first year science units, certificates have also been incorporated into the compulsory first year engineering and information technology units, as well as some units in health sciences. By the end of 2012, around 10500 people had obtained a 'Certificate of Completion' for the 'Plagiarism and Academic Honesty' module and around 3500 people had obtained a certificate for the 'Scholarly versus Non-Scholarly Resources' module. Although obtaining a certificate requires authentication with a University of Sydney username, the modules can be accessed and used by anyone. A full list of the modules with links is available from the University Library website (sydney.edu.au/library/).

Case Study: Global Warming Assignment In First Year Chemistry

This assignment was introduced in 2011 and is taken by around 1500 first year chemistry students each year. It was developed as a direct result of the Faculty – Library partnership,. It introduces students to primary literature concerning the detailed chemistry of climate change. Students use research databases to locate, download and analyse papers. Although aspects of atmospheric chemistry have been part of our first semester units for around 10 years, this assignment requires students to develop inquiry and problem solving attributes and to develop an understanding of how scientific research reports its findings in peer reviewed journals. The assignment seeks to develop students' abilities in the 'Understanding Science' and 'Inquiry Problem Solving' threshold learning outcomes, detailed in the Science Learning and Teaching Academic Standards (Jones & Yates, 2011) as well as our graduate attributes. It is fully online and uses a blend of resources and tools. It aims to provide students with an authentic experience of how researchers undertake a literature review.

In Part 1 of the assignment, students complete three of the Library's information skills modules ('Scholarly Versus Non-Scholarly Resources', 'Finding Journal Articles Using Databases' and 'Search Smarter, Search Faster') and a short course in using the professional 'Web of Science' database. Students then search for the top 10 most cited articles on global warming for the decade 2000–2010. They use the database tools to find information on the papers and their authors. To do this, the students must use the Library's authentication system for each publisher – they cannot use a search engine like Google Scholar. In Part 2, the students complete a short module on the nature of peer reviewed research. They are then tested on their understanding of three papers, which contain detailed results and concepts.

Encouraging Participation And Institution Uptake

As detailed above, commencing science students' engagement with these information skills modules is assured by embedding them as requirements across units of study in semester 1. Completion of other modules is also encouraged through the roadmaps on the First Year Science eCommunity (Arndell *et al.*, 2012b) and University of Sydney Library websites (2012). These roadmaps are embedded in our transition and mentoring activities.

Engagement of staff was also a key factor in ensuring the success of this initiative. The authors held a number of workshops with first year coordinators, and School and Faculty Learning and Teaching Committees in 2011. Ongoing assistance is provided for coordinators to embed the modules and the certificate system in their unit websites. The Science Library Services Team Leader also briefed the Science faculty liaison librarians on this work so that it and future developments, such as integration of additional modules, are built into routine liaison activities. Presentations at the University 'First Year Experience' group in 2011 and at the Teaching Colloquium in 2012 have led to the widening of the initiative into units of study outside Science as well as into the core Engineering and Information Technology programs.

Evaluation

Mechanisms for module evaluation were built into the development and assessment activities of the Library's iResearch Project (Hanfling et al., 2011). Each module underwent formal and informal modes of evaluation to ensure that they were appropriate, engaging, and enhanced the students' learning experience. Ongoing evaluation of the modules has been facilitated through the development of a feedback form attached to each module, and a database to gather and analyse submitted data. Completion of the feedback form is voluntary and provides users with the ability to rate the modules out of 5 for usefulness, and provide additional comments. The Library has used this data since 2009 to ensure that the resources remain relevant and accurate over time (Hanfling et al., 2011).

The availability of the feedback forms to track user opinion has been used to good effect by the Sydney Scientist project team. When additional versions of the iResearch modules were created to include the 'Certificate of Completion' mechanism, the original modules without the 'Certificate of Completion' mechanism were maintained. This provided the team with the ability to track student feedback specific to the 'Certificate of Completion' versions of the modules, and to compare datasets. Data gathered on the two versions revealed that user opinion on their usefulness remained consistent irrespective of the version they viewed (see Table 1 and Figure 3). This was an important finding as it provided the team with some assurance that feedback submitted about the 'Certificate of Completion' versions was reliable. Further data analysis revealed that approximately 86% of users rated the 'Certificate of Completion' versions of the 'Plagiarism and Academic Honesty' and 'Scholarly versus Non-Scholarly Resources' modules as being useful, very useful or extremely useful (Table 1 and Figure 3). Comments provided by students and staff have further assured the team that the modules are useful to the development of core information skills:

(i) Plagiarism and academic honesty feedback:

- 'It was a useful learning tool that taught me some valuable concepts regarding the need for academic honesty' – 1st year student, May 2012
- 'Excellent tool to be more focused in our assignments' – 1st year student, August 2012
- 'Well organised. Covering some of those very common questions. How to present details to support your argument but not impinge on an author's intellectual property rights and thus avoid plagiarism' – staff member, August 2012

(ii) Scholarly vs non-scholarly resources feedback

- 'I think this is a fantastic resource and will be recommending it to students. The only thing I would add is a reminder of what the 'assignment' question is. When analysing whether the sources were (*sic*) suitable, I had forgotten the original assignment question' – Staff member, May 2012
- 'This resource definitely helped me assess whether resources are scholarly or non-scholarly' – 1st year student, May 2012
- 'The tutorial provided me with essential guidelines which help when selecting appropriate academic resources for studying and for research' – 1st year student, May 2012

Summary

The development of academic skills, such as those needed for information literacy, is a challenge in a large and generalist degree program lacking core units of study. By integrating the online modules into semester 1 units of study, every commencing first year science student is now required to develop information skills in academic honesty and plagiarism,

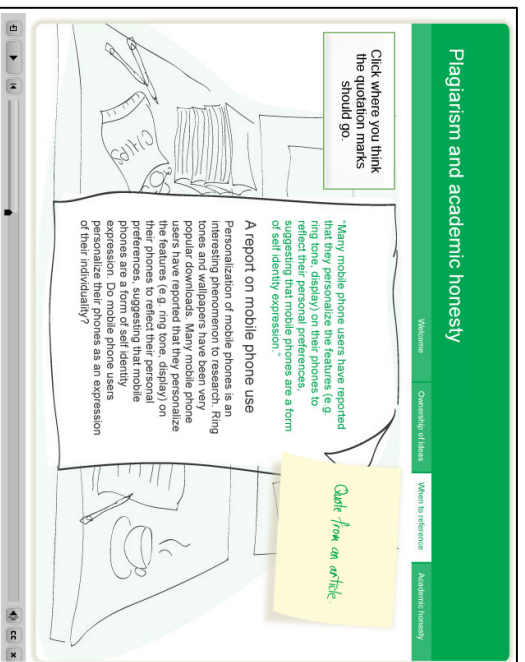
and in the evaluation and identification of scholarly resources. These online modules have enabled changes in assessments and in curriculum. The ability to record completions of the relevant modules using a database has enabled these activities to be easily introduced and integrated by staff from a range of disciplines. This methodology has also enabled skill development to be introduced with no duplication or overlap in the workload for students despite the range of course choices available. These sustainable, low-cost academic skills modules form a useful exemplar for how such program level support can be integrated in a research intensive university, and how it can enhance rather than dilute the curriculum.

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(a)



(b)

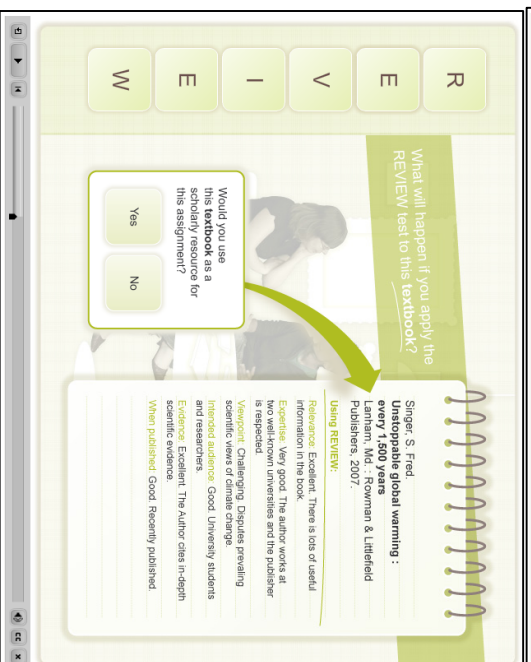


Figure 1: Screenshots showing scenarios from (a) the 'Plagiarism and Academic Honesty' and (b) the 'Scholarly Versus Non-Scholarly Resources' iResearch Modules.

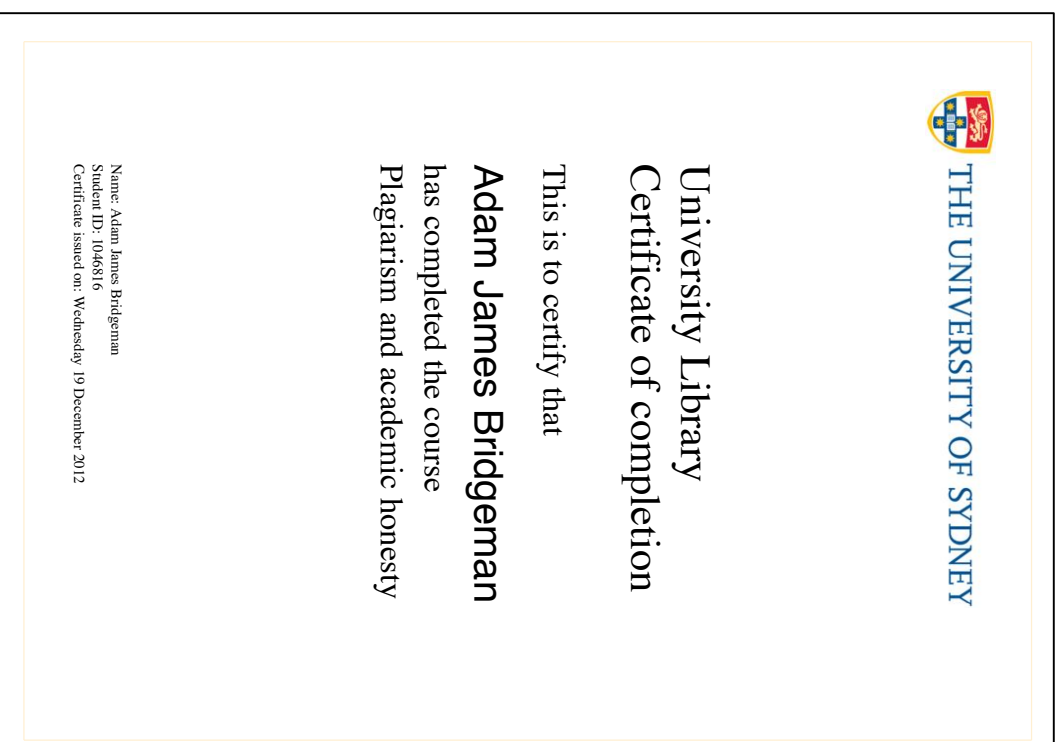


Figure 2: Certificate of completion for the 'Plagiarism and Academic Honesty' iResearch Module.

Table 1: Evaluation of iResearch Modules associated with Sydney Scientist using the scale: 1 = Not useful, 2 = Somewhat useful, 3 = Useful, 4 = Very useful, 5 = Extremely useful

module	Ratings and number of responses					Average rating	Number of responses
	1	2	3	4	5		
Plagiarism & academic honesty	51 (4%)	126 (10%)	418 (32%)	434 (34%)	261 (20%)	1113 (86%)	1290 (20%)
Plagiarism and academic honesty - certificate version	15 (4%)	40 (10%)	133 (34%)	122 (31%)	82 (21%)	337 (86%)	392 (7%)
Scholarly vs non-scholarly resources	13 (5%)	28 (10%)	80 (29%)	102 (37%)	50 (18%)	232 (85%)	273 (5%)
Scholarly vs non-scholarly resources - certificate version	9 (3%)	29 (11%)	82 (30%)	98 (36%)	57 (29%)	237 (86%)	275 (5%)
All learning modules	435 (7%)	733 (12%)	1695 (28%)	1836 (31%)	1297 (22%)	4828 (81%)	5996 (100%)

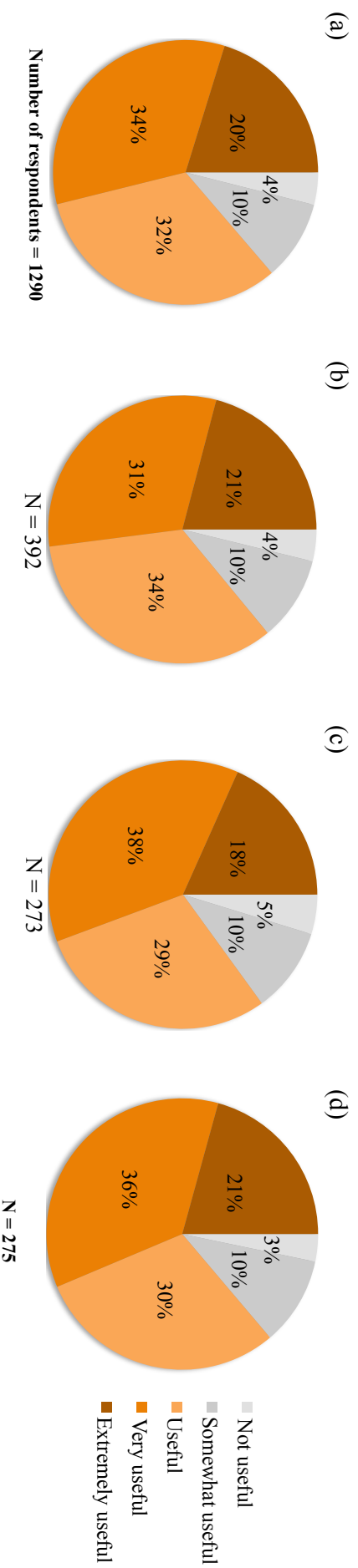


Figure 3: Evaluation of (a) plagiarism and academic honesty [(b) certificate version] and (c) scholarly versus non-scholarly resources [(d) certificate version] iResearch Modules associated with Sydney Scientist