

First-year Human Biology students in the ivory tower.

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University academics have frequently been characterised as having esoteric, blue-sky research agendas that are unconnected with the real world. Moreover, these same agendas are said to frequently clash with and impede quality teaching, impacting negatively on undergraduate students' learning of science content and skills. But what happens when the skills associated with research in a science academic's discipline are explicitly identified, fostered and assessed in large first-year science courses? And what are students' long-term, well-considered perspectives of the benefits and downsides of these research-skill-building experiences?

This paper presents findings from interviews with 3 cohorts of students that were conducted 1 year after completion of 2 consecutive first-year human biology courses that were designed to explicitly develop student research skill. Students from 2005 and 2006, interviewed in 2006 and 2007 respectively, provided a perspective that the academics coordinating the courses needed to make the purpose and process of developing student research skills more obvious to students. The changes to the curriculum were then gauged through the interviews with the 2007 cohort of students, conducted in 2008. Findings include that the majority of students perceived that the research skills they developed in first year human biology were very useful for their subsequent study, but also in their proposed or realised employment. These findings have been fed back into the course, to motivate present students about the benefits of a focus on their research skill development.

Introduction

University academics have frequently been characterised as having esoteric, blue-sky research agendas that are unconnected with the real world. Moreover, these same agendas are said to frequently clash with and impede quality teaching, impacting negatively on undergraduate students' learning of science content and skills. But what happens when the skills associated with research in a science academic's discipline are explicitly identified, fostered and assessed in large first-year science courses? And what are students' long-term, well-considered perspectives of the benefits and downsides of these research-skill-building experiences?

Academics coordinating 2 consecutive first-year human biology courses have been explicitly and incrementally developing and assessing students' research skills throughout 2 consecutive courses over the past 10 years. From 2005, they have used the Research Skill Development (Willison & O'Regan, 2006) framework as a conceptual model to construct assessment rubrics for literature, laboratory and field research tasks¹. This framework specifies 6 general facets of research that academics adapt to make discipline-, course- and task-specific. These facets are elaborated into a continuum described by 5 levels of autonomy, from highly prescribed 'closed' tasks (Level 1) to open-ended tasks (Level 5) (Willison & O'Regan, 2007).

In the Human Biology Semester 1 course, the focus has been on closed laboratory research tasks which require some guidance (Level 2 of the RSD) and especially on closed literature research tasks that require a higher degree of independence (Level 3 of the RSD). The two Semester 2 tasks are open inquiries, with some guidelines (Level 4 of RSD) requiring increased student autonomy, and involve a group inquiry culminating in a poster presentation, and field research culminating in a report. The latter requires students to develop their own research hypothesis, settle on appropriate data sampling techniques, evaluate their data (considering limitations and biases), find information from literature relevant to the data, synthesise information with the data, analyse the data using appropriate techniques, organise their report and communicate with ethical and social awareness.

Over the two semesters students therefore receive multiple rubrics with specific feedback on each research-related assessment, yet all framed in the familiar format of the RSD framework (6 facets, specified levels of autonomy). One benefit of this has been the trend over the years towards a closer match between students' literature research skills, and the skills associated with open ended research in the field (Willison, Pierce & Ricci, 2009), a finding similar to a literature and laboratory-based study (Chaplin, 2003).

This paper explores students' understandings of the benefits and downsides of explicitly and incrementally developing the skills associated with research in Human Biology. It firstly presents the structuring of assessment tasks that substantially shaped the research skill development of students during the year. Next it specifies a rationale for the interview strategy employed, followed by the analysis of the interview data. This analysis focuses on the 2007 cohort that benefited from the curriculum improvement arising from evaluation of interview data provided by the previous 2 cohorts; the data is analysed to determine the benefits and detriments of explicit research skill development. The paper ends with considerations of just how explicit the research skill development process needs to be, from the students' perspective.

Making the research skill development process explicit

Over the 3 years from 2005 to 2007, numerous changes were made to the first-year Human Biology curriculum so that the whole process of developing student research skills would be increasingly explicit. Firstly, these changes included, in 2005, that some assessments used previously in 2004 were specifically reframed according to the Research Skill Development framework. These were two literature research tasks, and 1 open-ended field-based inquiry. In 2006, another literature research task was framed by the RSD, and in 2007 two standard laboratory tasks were reframed according to the RSD. Another change was that, in 2005 and 2006, tasks involving literature were called Competency Exercises, whereas in 2007, they were titled Research Skill Development tasks. And from 2007, students were informed that the course was explicitly designed to develop their research skills. This increasing explicitness was directly informed by the interview data from the 2005 cohort, which typically suggested that the whole process was not at all obvious to the students, with one student responding to an interview question about how we could improve students' research skill development: 'Was this the assignment to increase research skills?' The student could not even recognise if an assignment may have had this as an intention. What we had thought was clear and apparent was not evident to the students.

All 3 cohorts had a lot to say about the usefulness of the assessments for further study. But only the 2007 cohort spoke clearly and frequently about the usefulness of the assessments for employment. One reason for this is that the topic of employment emerged from the early interviews with the 2007 cohort, resulting in the addition of a question in the interview protocol around employment, and so usefulness of research skills in employment was elicited in subsequent interviews if it did not arise spontaneously. Another contributing factor that helped improve the ready applicability of skills was likely to be the direction and correction that the 2005 and 2006 students gave in interviews, providing a certain clarity for the 2007 cohort's experience. This resulted, for example in the changes noted above, including the simple but profound action of calling all the assessments in Semester 1 Literature Research Task or Laboratory Research Task. So, in this paper, the 2005 and 2006 cohort interviews can be treated as informing a curriculum improvement cycle, with the 2007 cohort interview data providing evidence of the effects of the improvements enacted. Therefore the data below on the benefits and downsides of explicit research skill development draws on the perceptions of the 2007 students. The rationale for the interview strategy is discussed next, before proceeding to an analysis of the interview data.

Rationale for Interviews conducted 1 year after completion

Year-after-completion interviews were utilised so that students would have a year's worth of opportunity to apply skills that they had developed, in order that their perspective may have a well-considered retrospective component that is lacking from end-of-course evaluations. For example, a student from the 2005 cohort, interviewed in 2006 stated that he had treated one of the tasks designed to develop research skills '... as a joke 'cause it was sort of so straight forward.' One year later he reflected that '... it's actually quite good 'cause it got us thinking about what's right and what's wrong' and part of a bigger-picture process to 'develop these particular skills to enable you to be able to undertake the bigger research project at the end'. In other words, he did not see at the time what each assessment was achieving, but his longer term retrospective allowed a greater appreciation that his skills were being appropriately developed. The long term outlook therefore provided an opportunity to consider each assessment more broadly as part of a bigger picture, in keeping with other long-term follow up of students' perceptions of benefits (Bauer & Bennett, 2003).

Three cohorts of students have been interviewed one year after completing their First Year Human Biology studies; those from 2005, 2006 and 2007. Interview invitations to the 2005 cohort were issued to 4 different groupings of students, as determined by their degree of success and improvement with tasks that were devised to develop their research skill:

1. those who performed very well initially, but whose performance showed less improvement during the year than average
2. those who began poor to medium, but ended up with the most improvement during the year. These students tended to gain the highest marks in the final RSD assessment.
3. those who started the year as the weakest according to the diagnostic assessment. This group tended to finish the year with marks close to the cohort mean.
4. and those who started off around average, but showed low improvement compared to the average for the whole cohort. Some in this group finished with the lowest marks in the final RSD task.

In keeping with the ethics-approved protocol², compensation was offered to students for their time spent in interview, with a value of approximately \$20 with students choosing a meal voucher, photocopy card, movie voucher or i-Pod recharge card. Of the 32 invitations to attend interviews that were made to the 2005 cohort in 2006, 9 students came for interview (out of a finishing cohort of 79), and these were mainly from the big improving group (6 from # 2), with two from the group that started weakest (#3), and one from those who improved minimally (#4). Not one student came from the group that started strongly, but had subsequent disappointing improvement (#1). A more random sampling was adopted for the 2006 cohort, however the number who came for interview (10 students out of a finishing cohort of 97) and their profile of success with RSD assessments was very similar to the 2005 cohort. Research interview data from 2005 and 2006 cohorts was therefore strongly skewed towards those who had improved substantially under the strategies employed, both those who started amongst the weakest as measured, and those who finished with the highest measures.

Therefore, for interviews conducted in 2008, the selection of students from the 2007 cohort was intended to redress the imbalance of previously interviewing strongly improving students by targeting only students whose improvement was substantially less than average. 13 students came for interviews out of 18 so-targeted requests (out of a finishing cohort of 95). The 32 student interviews in total across the 3 years therefore together represent a broad cross-section of measured student research skill development. All students interviewed were enrolled in the Bachelor of Health Science program which requires some core courses but allows different pathways of study ranging from public health and psychology to medical science. Hence the contexts that students were applying their research skills to in their second year of study varied substantially. As far as the authors are aware, there is no second year course that explicitly develops student research skill. All the students from the 2005 and 2006 cohorts were studying at university, and 2 students from the 2007 cohort had

left university and working, with most references to employment below being of the part-time variety.

For all 3 cohorts a semi-structured interview protocol was adopted, where pre-determined questions were asked explicitly if ideas that the questions were intended to illicit did not emerge in the course of the interview. Transcripts of interviews were subjected to category analysis, culminating in frequency of categories and epitomising comments for each. Category analysis was conducted initially by the interviewer and independently by another team member. Items in categories were then compared and contrasted before being collaboratively discussed with a third team member. Transcripts were then analysed once more by the second team member to determine final categorisation.

Effects on the curriculum of interviews with the 2005 and 2006 cohorts

As stated above, the 2005 and 2006 cohort interviews provided 2 key ideas: the first was that students perceived in hindsight that the process was valuable in that it developed their research skills; and the second was that they had not appreciated that this development was happening at the time, and that it should have been explicitly explained in advance. A 2006 student's comments crystallises the ideas of being surprised by what useful things were being accomplished, but in a manner not obvious at the time of doing the assessments.

... when I was doing the assignments I didn't really take into account that all these levels were increasing. I didn't honestly when I was actually doing them but looking at them now and then thinking about what we were actually asked to do it becomes a lot more obvious to me... but these levels didn't really occur to me at the time. But, yes, definitely I can see now though what they were getting at and trying to improve on... I think maybe it was a good idea doing it progressively and going into it, especially in first year that was a pretty good way to do it, like easing people into it.

Therefore, the changes in the curriculum for 2007 were, as noted previously, to make the process of student research skill development even more explicit than had been the case up till that time; this is a culmination of benefit from analysis and application of learning from the 2005 interviews (with the 2006 cohort interviews influencing the 2008 curriculum). The 13 students from the 2007 cohort, selected from amongst those who benefited least from RSD approaches in terms of academic marks, were interviewed in November 2008. The resulting data, then, provides a realistic sense of what is achievable when a medium sized course explicitly develops student research skills. The focus of the analysis was on what themes emerged about the usefulness of research skills developed in the first-year Human Biology context for subsequent study, and for employment.

Usefulness of explicit research skill development

12 of the 13 students interviewed from the 2007 cohort commented on the usefulness of research skills in the context of university study. Some students stated that an ability to research was in some vague way useful to further study:

Yes, well especially since next year we're going into harder subjects and stuff like that, so we'll definitely need to be able to research further and stuff like that.

Others expanded on how their research skills may be utilised.

It definitely allows you to get out there and compare all different experiments and investigations and analyse materials and make up your own mind based upon them. I think it is a very important part for university, even if your course isn't – like the one I'm in now – isn't real research-based, it is still elements of research where I have to complete assignments based upon previous studies and

things like that. So I feel like definitely last year helped a lot in developing how important research skills are. I think it is really crucial for all your university years.

And one student was explicit that the skills were suited to university only:

I don't think I'll use my research skills beyond further study. Like, I'm not going to use it as a teacher, but it will help when I have to do the science next year.³

These findings are consistent with other studies that have found longer term academic benefits for student engaged in research processes (Bauer & Bennett, 2003; Crowe & Brakke, 2008).

Usefulness of research skills outside of the university context

Of the 12 students noted above, 9 students stated that the research skills they developed in First Year Human Biology had proven to be useful, in addition to within-university study, outside of university, especially employment. One student cited inspiration to find out as a major benefit of developed research skills for employment.

I suppose when you get that skill of being able to research, I think it sort of inspires something in you that makes you want to find out things or learn more. If I follow my Public Health strain, then I probably see myself getting a job in some sort of NGO or department, and then collecting data and doing surveys and researching things and finding things that other people have done, and then either being able to support that or prove it wrong.

The skill set itself was seen to enhance the content acquisition skills needed to stay current, to be set for an 'auto-upgrade' of information when this was necessary:

With your job, you need to keep updating yourself. If I was to go into nursing, I could keep going on getting different certificates for it and depending on what you needed for those certificates, if you have got these skills, then you wouldn't have a problem being able to achieve them and getting good marks from doing it.

Some students emphasised specific skills that had proven to be useful, such as the following account of the skill surrounding evaluation of sources:

I don't think I've ever had so much emphasis placed on credible sourcing before. Like we would just use a random website, really, and not think about who had actually put that up there. This subject really helped me think like that, even at my own workplace. Nothing to do with Biology, so that was really good. I'm glad I did this subject because it is the scientific information to back everything. Like, I've never really wanted to be a wishy-washy naturopath that is a bit of a hippie that people – I can't say why this works, I've always wanted to be able to say this works because of....[left unstated by student]. I suppose that research could be important to me, really.

Evident in the above quote is that the student was surprised about finding something as apparently mundane as credible sourcing to be ultimately very beneficial. Some students emphasised the effect of the process in entirety. One student reflected that, as over time the Human Biology research tasks had decreasing amounts of lecturer prescription, and increasing amounts of student autonomy required:

I suppose you want to motivate students to be more independent, because once you get out in the workforce you need to have the research skills and also the group skills.

10 of the 13 students were clear that the skills associated with research in Human Biology were useful for both further studies and employment:

Obviously if you take your degree further like and do Honours or whatever, obviously you're going to need it but even with going out and finding employment depending on what you do I think you are always going to use this, if you got out and do something like a government sector then you are going to have to do reports. That's useful as well. I think this sort of framework is used without people realising it everywhere throughout the rest of whatever they do

This is an enticing notion, whereby students would internalise the whole process to the extent that they did not realise their thought processes may have changed to reflect an orderly approach to research. In the main, students connected the one set of skills to the two domains of study and employment, as the following 3 students indicated in various ways:

...whether it's academic things like doing assignments and papers and writing whatever on academic stuff, or whether it's just even simple things like that are in your job... there's still stuff you have to research.

...you do have to have research, even when you go to Honours or your Masters, and even in your workplace, you do assessments, you do surveys, you do social research, all these things matter.

A lot of Occupational Therapists end up completing their own articles and investigations, I suppose, and you still use it now when you are looking up and doing assignments. I still have to be researching, whether it be databases for articles or journals. I am always using it. Even though I am not doing laboratory-based work which requires a different sort of research perhaps, I'm still doing foundation research to find out different information.

And one student spoke of the usefulness of research skills in the broadest terms possible:

I think uni research in every aspect when you're in uni, because you need to learn and with learning you need to research, so I guess it's pretty broad, research, and it applies to every course you do. Everything you do, actually. Even if you need to learn how to assemble the TV, you need to research that as well.

It is difficult to find empirical studies that reveal the usefulness- or otherwise- of research skill development at university for subsequent employment in non-academic environments.

Explicit RSD for the 2007 cohort?

From the students' longer-term, considered perspective, the processes used in Human Biology developed a set of research skills valuable to subsequent study, and for many it was valuable for their working lives and broader. But how obvious was the degree of explicitness to the 2007 students at the time?

It wasn't that I didn't understand the assignment, it was that I sort of missed the point at the time which seems silly now; it makes sense now.

A large proportion of students interviewed, 8 out of 13, indicated something like the above, that they missed the point of the assessments at the time. This doesn't negate their comments about the usefulness of the skills, just that they couldn't see them developing. They were often unaware, even though they had heard the right words:

I just knew – you know when you're in class, you know that you want to achieve level 3, but you're not – from my point of view you're not so aware why you are doing it. I think they need to clarify that in a sense these assignments are to better our skills rather than getting a good grade... I don't think a lot of people really understood that it was to increase your level. Don't get me

wrong, they did say that. They did say that this is about, but maybe re-emphasise it and let the kids know that this is really about improving your skills in terms of research.

As for the 2005 and 2006 cohorts, there is the urging by students to make the process even more explicit, even clearer. Following their advice, 2008 saw the first time that the RSD framework itself was introduced, to show how all assessments map onto the same skill set. In 2009 we used student quotes from the 2007 cohort interviews saying that research skills were developed in Human Biology, and these were very useful. The 2008 cohort will be interviewed in October 2009. It is surprising that it was the 2007 cohort that had the most to say about the usefulness of skills, as we targeted the students who showed smallest amounts of improvements, as measured using the RSD-generated marking rubrics, over the course of the year. Ironically, this may have led to a stronger sense of immediate usefulness, especially in employment; maybe these students were less inclined or able to follow an academic pathway to Higher Degree by Research, yet were still interested and willing to utilize the skill set associated with researching.

Conclusion

One student interviewed from the 2007 cohort didn't make statements about the usefulness of research skills developed, and another student believed that they were relevant only to university study. For these students, maybe such skills were perceived to be esoteric, belonging in the ivory tower. However, the majority of students interviewed signalled that their research skills had been enhanced substantially, and that these skills would serve them in good stead, both in subsequent university studies, and in their employment. Having engaged in 'ivory tower' practices, they were continuing to storm that tower, as well as beginning to move out to broader society and applying research skills in practical and insightful ways.

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Notes

¹ These assessments, and those from other disciplines are available at www.adelaide.edu.au/clpd/rsd

² Ethics Approval number H-024-2006, University of Adelaide.

³ Ironically, South Australia has adopted a mandatory Year 12 High school course starting in 2011 called 'Research Project', when the skills to develop student research skills will be in demand in S.A.

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