Engaging from a distance and on-campus with an introductory biology unit

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Abstract

This paper examines the engagement of on- and off-campus students in a topic of study in a first year introductory biology unit. Aspects of engagement considered include the students’ perceptions of the subject matter and the teaching, as well as the learning approaches adopted. Information on students’ perceptions was derived from focus group interviews and responses to the Course Experience Questionnaire. Students’ learning approaches were investigated by individual interview and by students’ responses to a version of the Study Process Questionnaire. The learning contexts of both cohorts were characterised by a great deal of content, illustrative practicals and a substantial proportion of assessment by examination. Off-campus students’ formal interaction with lecturing staff and other students was limited to a five-day residential school. Many on-campus students found the topic irrelevant and did not engage fully in the practical component, which they saw as boring. The off-campus cohort, which was considerably older, found the topic personally interesting and relevant, and rated the teaching, especially the practicals, more highly than the on-campus cohort. These perceptions related in a theoretically coherent way with students’ approaches to learning, with on-campus students reporting more use of surface approaches and less use of deep approaches than their older, off-campus peers. In general, the older, off-campus students found their learning context more engaging, and engaged with it in a more meaningful way, than the on-campus, younger cohort.

Introduction

Engaging students in meaningful learning in introductory science units is known to be a difficult task. For the purposes of this paper ‘engagement’ is defined by students being interested in the subject area, enjoying the teaching, and perceiving the subject matter as relevant. Engagement also involves the students’ approaches to learning, that is, whether they adopt deep approaches to learning intending to understand, or more surface approaches aimed at reproducing the content (Biggs, 1993).

One of the challenges to student engagement in large introductory science units is content overload (see e.g., Hegarty-Hazel, 1990), where a wide range of basic concepts is presented in order to equip students for later more complex or specialised units of study. This relates in part to the hierarchical nature of scientific knowledge. Attempts at reducing excessive content in first year introductory biology curricula have achieved variable success: as a headline in Science has put it, “information overload hampers biology reforms” (Stokstad, 2001). A further challenge to student engagement which is related to content overload is teaching methods. It has been argued by Ramsden (1992, p. 137) that excessive content in the curriculum is a consequence of the...
limiting theory of teaching-as-transmission. An example of this transmission view of science teaching was expressed by Dunbar (1995, p. 181): “in the sciences you need an information pack before you can start to discuss anything, and those tools may have to be acquired by rote-learning before we can do anything with them”. Many introductory science units based on this traditional teacher-centred, information-transmission model are perceived as irrelevant by students (Lowe, 1994) and therefore not as engaging as they could be.

Although aspects of engaging students in first year science units have been subject to considerable previous research (see e.g., Laws, 1996; Matthews, 1998), few if any studies have examined the engagement of on- and off-campus students enrolled in the same introductory science unit. An understanding of the ways these two groups engage with their different learning contexts within a single unit is of potential benefit for a number of reasons. These include the increasing demand for distance study and the burgeoning range of study arrangements which blur the boundaries between on-and off-campus study modes.

The overall purpose of this paper, therefore, is to examine the engagement of on-and off-campus students in a first year introductory biology unit, by addressing two major aims:

- to describe the characteristics of the on and off-campus learning contexts, and
- to compare the engagement of on and off-campus students with these learning contexts.

**Methods**

This paper is part of a broader study, examining learning approaches and outcomes of students in a first year introductory biology unit over two consecutive years. Students enrol in this unit in two modes; either on- or off-campus. In the on-campus mode students attended three lectures and one practical per week, while in the off-campus mode students studied at home from printed materials covering equivalent lecture content, and attended a compulsory intensive five-day residential school where they attended lectures and practical sessions. There was no ICT-based learning management system available to either group of students at the time.

The specific context for the study was a particular topic in the unit, which was chosen for a number of reasons. Pertinent to this paper is that this finer scale two-week ‘block’ was associated with a single lecturer per year in each mode rather than several, and because previous studies in a first year science context have shown that students adopt different learning approaches at different stages of a course (Millar, Prosser, & Sefton, 1989). The total sample of volunteer participants was 302 students, 225 on-campus and 77 off-campus. The median age of the on-campus sample (19 years) was considerably younger than the off-campus median of 27.

The research design of this study triangulated both quantitative and qualitative methods in investigating aspects of student engagement. Quantitative data were collected using a modified, topic-specific version of Biggs (1987) Study Process Questionnaire (SPQ), a Likert instrument which has been used extremely widely in investigating students’ approaches to learning. The modified version used (MSPQ) contained items relating to deep and surface approaches only. It had been piloted and used in several previous studies at the topic level in Australian first year science contexts (e.g., Prosser, Trigwell, Hazel, & Gallagher, 1994, p. 308) where its reliability and validity were established. In the first year, students also responded to items from the Course Experience Questionnaire (Ramsden, 1991), again in relation to the particular topic. Qualitative data were collected from observations of teaching materials, laboratory and lecture sessions; eight focus group interviews with students; sixteen one-to-one interviews with students, and interviews.
Quantitative data were analysed using a combination of standard parametric and non-parametric techniques. Interview analysis followed in many respects the data reduction, coding and display procedures advocated by Miles and Huberman (1994). The scale was small enough and the interview data structured enough so that analysis was carried out using the functions of a word-processor/spreadsheet rather than specific code-and-retrieve software. Reliability of coding learning approaches from individual interviews was established, with interjudge agreement on thirteen out of fifteen cases.

**Results**

**Learning context**

Some commonalities in the learning context were apparent across on and off-campus contexts. Human examples were used in lectures and printed materials for both groups. The practicals in the topic, as in the rest of the unit, were illustrative and explanatory in focus, and no project or problem-based activities occurred. Both on- and off-campus students sat the same end-of-semester examination worth 50% of their unit mark.

The breadth of content in both the unit and the specific topic was recognised as a problem by one lecturer: “I think there’s an awful lot in a lot of this material. Look at the text book – it’s vast, huge, enormous amount of detail…there’s a huge amount of content, a lot of jargon”. Lectures for on-campus and off-campus students were based around teacher-centred PowerPoint presentations, with very little student interaction. One of the lecturers described the institutional constraints of the unit that led him to adopt this teaching style:

> …we’ve got a sort of syllabus which has been agreed on by a vast committee to try and satisfy the needs of the whole faculty…and we even have committed into print what’s actually going to be in all those lectures, so I’m basically teaching to a formula…even within the lectures I do all the first year lectures on PowerPoint and that’s a very rigid and inflexible way of doing things…

*(Lecturer 1)*

This lecturer said that in third year lectures he was “much happier with just…few notes on a scrap of paper because...students want to go in different directions, you can and you’re not quite so constrained”. Both lecturers taught in a very different way in first and third year units.

Despite these similarities, the students enrolled in the on and off-campus modes clearly experienced quite different learning contexts. Off-campus students received printed resources outlining and explaining weekly study topics in line with the on-campus teaching schedule. The off-campus students studied at home with no formal, regular contact with other students or staff, other than during the residential period. The residential period was very intense for both staff and students, with a typical daily schedule of 2 lectures and two practical sessions. The content in the topic at the focus of this study was condensed to one lecture during the residential school, but the same practical was conducted. Some differences in assessment of the topic also were present. The on-campus students sat a short practical test which covered the relevant topic together with material from other topics. This did not occur with off-campus students, who had alternative assessment arrangements for their practical work.

In summary, the face-to-face teaching and learning context of this study for both modes comprised a content-heavy curriculum, traditional teacher-centred lectures combined with predominantly illustrative practicals, and substantial component of assessment by examination.
Differences between on-and off-campus modes were that off-campus students had much less contact with teaching staff which in a sense imposed a less teacher-focussed, and more autonomous aspect to their study. The off-campus students also had much less social engagement with other students, a more intensive face-to-face learning environment during the residential school, and slightly different assessment of the topic at the focus of this study.

Engagement of students: perceptions of learning context

The extent to which students engaged with these learning contexts is described in terms of two major aspects of engagement. First of these is the students’ perceptions of the amount of content, teaching, and relevance and interest of content.

On-campus students expressed different accounts of their engagement with the learning context. When asked about the amount of content in the unit and topic, many of the students thought it was “OK” with some students commenting that it was too much and some of those assuming that that is just the way it is at university:

S1: It is a lot to remember but you kind of get that, so um sort of expect that being at university.  
(On-campus focus group 3)

Many of the recent school leavers in the on-campus cohort complained about the content being a repetition of what they had studied at school and in the first semester biology unit, but acknowledged that the content had to be covered for other students who did not have the same background.

S1: Because these are sort of like catch-up units…so some people haven’t done Bio in Yr 12 and some people have, so some people are going “yep, done this before, its boring, yep, basically got most of this anyway” and other people haven’t done it and its all new to them so you’ve got the two extremes…its not sort of really specific to the degree you want to do at the end so –
S2:…Yeah but like you’ve got to take into consideration the people who haven’t already done it, so it’s hard from the University’s perspective.  
(On-campus focus group 3)

The on-campus focus groups expressed a diversity of opinions about the teaching methods of the lectures and practicals. Several students particularly valued the lectures:

S1: The lecturers cover a lot more and give you the full idea so you can understand step by step processes and things
S2: The lectures give you the full scope of what you really need to know for the subject outline sort of thing like, goes through everything you need to know whereas the prac it might not be all in there…
S3: Lectures give you basic info and if you’re having trouble the prac’s are where you get it under control sort of thing
S4: The prac’s are a shocker if you didn’t understand the lectures  
(On-campus focus group 6)

S1: I guess in all science subjects they reckon it’s better to have this hands on experience and get right into it but I think that I sort of learn better when I’m sitting down and just absorbing information and writing notes down and stuff like that and…then just take people’s word for it that it actually happens, because that’s why they’re teaching you, instead of having to do it sort of thing …I find the lectures heaps more useful.  
(On-campus focus group 1)

Several others, though, found the lectures boring:

But um, I think how its taught, like because this dude he just puts it up on the screen and goes, “blah blah, blah blah”, it goes right over your head and it makes an interesting thing, like its amazing really, it makes an interesting thing quite boring…

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An extremely strong repeated theme from the on-campus focus groups was that the practical session in the relevant topic was very boring, unengaging, and at the end of the day they “just want to get out”.

S1: I think it’s bad when you’re like playing with pipe-cleaners and paperclips and you’re going ‘Oh this is just taking up my time I’m going to leave’
S3: Its Thursday afternoon everyone just wants to get out
S1: Yeah you just want to get out

Although an activity in the practical using pipe-cleaners (as concrete referents for chromosomes) was viewed by many students as boring and removed from the real world, several students acknowledged that the exercise did help to clarify their understanding:

S1: I might be a bit stupid, and it was very boring, but I was sort of half glad because I was a little bit sketchy on it the first time we went round...
S3: Well I think the pipe-cleaner bit, despite what everyone has said, has reinforced it for me…
S1: Yeah I’d agree it was very useful but still you do feel like a bit of a kid with your play dough and [laughter] squiggles and stuff.

When on-campus groups were asked about the relevance of the topic to them, some recent school leavers could see immediate relevance to their lives or studies. Many, though, did not express this view, rather perceiving that they were collecting the basics which they took on trust as being relevant to future units.

S1: I think as I said before it gives you the basics of what we’ll need for further studies and without that there’s no point in trying to attempt your further studies.

S1: I think eventually when we do something else in 2nd/3rd year and then we’ll see how it works – that’s the thing, like you’re just learning this thing at the moment and its not really fitting into anything as of yet.

One focus group (dominated by Rural Science students) expressed the strong desire for the content to be more directly related to their degree program:

S1: Um, its kind of hard. I’d like it, because I’m doing rural science, I’d like it to be a little bit more rural outlook and stuff because I’ve done all this in Yr 11 and 12 so I’m just sort of sitting here going “OK, we’ll just look over this again”. I’d like to start getting in to what I’m going to be going in to.
S2: It’s all just, it’s nothing to do with what we thought we were doing…
S1: [interrupt] so far we’ve hardly even looked at…we’ve looked at a bit of soil and some plants and that’s about it we haven’t looked at a lot of stuff.
S3:…First year stuff’s so boring it’s just, it’s got nothing to do with rural science at all, really.
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materials at home. Some were studying under extreme time constraints, so engaged more during the residential school, and some felt the opposite:

S3: I’m sort of a person, where this is where I get most of my study done – here at the res school. Because I’ve got such a big workload at home with my occupation. I do 60 hrs a week and I’m on a full study load as well.
SI: I don’t know how it is for other people but I find as an external student I do learn mostly in a fairly self-determining sort of way, like I regulate my study, I learn principally from the material that is sent out to me. The residential school tends to be like a bit of a rush from one thing to another and you’re bombarded by material

The off-campus students overwhelmingly endorsed the residential schools. Face-to-face lectures were valued for simplifying the complex textbook material, and fleshing out some aspects of the content.

S2: Well I’d like to say I operate on a different, practically almost the total opposite study regime to what these guys do… I find that the lectures are good for reinforcing your knowledge, but also as a secondary learning tool…It reinforces the stuff you’ve already got in your head and make sure you’ve got it right…a lot of them discuss new material and discuss the material in a wider sense so they’re fleshing it out so you get more information in a lecture sometimes than you do just off your textbook.
S3: …Coming up here and actually going to the lecture and reinforcing the minimal notes that I’ve actually done at home and…when I get here…its just really helpful because you’re not just reading out of the book, where I admit I get distracted, and sort of pack it in half the time…that particular lecture I found was just so helpful because I just got a real good grasp of the concepts.
S5: I probably agree with the first two – I do most of my reading and stuff at home so when I come here the lectures are just really repetition of what I’ve already read.
I: Is that a waste of time ?
S5: It’s not really a waste of time – like I find it good just to go over it.
S1: I wouldn’t have said that lectures are a waste of time – at all – like sometimes they’re really good at kind of putting things into context and clarifying but I don’t think it’s a primary mode of learning for off-campus study

In the context of the study topic and more generally in the unit, the high point of the residential school was the practical component. No-one in the off-campus focus groups expressed dissatisfaction about the practicals:

S1: The pracs is the best part of the school, and after all these are supposed to be experimental subjects.
S2: I’d agree because it just completely reinforces everything – you’re applying what you’ve learned and it just sort of brings everything together and is really helpful especially in that prac.
S3: You can see it happening – I mean most of the time its happening on the sort of level that we just can’t see but that was good because we could.
S2: Yeah like you said it just totally reinforces everything that you’ve just learned.
S1: You can see it in the book but there’s nothing like seeing it under the microscope … you can see a beautiful picture a thousand times but there’s nothing like looking under the microscope.
I: Somebody must hate pracs? People do you know!
S1: I don’t hate them, I really like them. It’s a real reality check about what you’re doing like it’s putting everything into context
S2: It connects it to real life.

It seemed, though, that some of the younger off-campus students may not have been engaging with their practical sessions to quite this extent:

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S1: ...15 in our group 3 or 4 of them were fairly young and they do, they finish half an hour earlier than we do and I’m still struggling with the 3rd or 4th page not halfway through, still madly drawing. They seem to ignore the demonstrator half the time but that’s what happens  

(off-campus focus group 1)

One student offered the following suggestion for improvement to the practical:

S1: Maybe some more problem-based way of looking at that specific problem might be more beneficial. I’m not quite sure how you would do that with that particular topic. Like it would be nice to maybe see a blend of some more problem-based approaches and some of these things where you know you’ve got it: “I’ve got to find this, I’ve got to do that”.

But others were not keen on this idea

S1: we might get stuck-  
S2: students will be confused-  
S1: like its only first year level-  
S2: yeah-  
S3: Yeah, you’re not really sure what you’re doing, and that’s the whole point why you’re doing the subject & that could get a little bit out of hand maybe.  
S4: I think it’s a bit risky because it’s supposed to be that at undergrad level we have the benefit of past wisdoms…. I know what they’re trying to get at, but I think that without the knowledge, I suspect the effectiveness would be somewhat limited.

(off-campus focus group 2)

When the question of relevance was raised with the off-campus focus groups, the same perception that the material was relevant in some, as yet unclear, way to later units was expressed, but there was also a strong view among many of the students of more immediate personal relevance and interest:

S1: relevance – well I guess, its relevant to life; whether its relevant to vocations – it depends what you end up doing, doesn’t it, but um certainly its relevant to me in that it’s part of life so its very interesting.

S2:....to know that every single cell in our entire body every single cell in every other thing in the world undergoes the same process is really kind of profound.

(off-campus focus group 2)

In summary, many students from both off-campus and on-campus student focus groups expressed overall satisfaction with the lectures, alongside some perceptions of being bored or “spoon-fed”. While off-campus students held extremely positive perceptions about the practical, many of the on-campus students found the practical session boring, but some aspects of it useful as well. The students were generally accepting and non-critical about the amount of content in the unit and its difficulty. In general, many on-campus students found the topic to be largely irrelevant to their immediate concerns, while many off-campus students in the focus groups found the topic personally relevant and interesting. The differences between the perceptions of on- and off-campus students on the quality of teaching were corroborated by their responses to the CEQ. Off-campus students rated the teaching significantly more highly than the on-campus cohort ($Z=-2.5, p = 0.01$)

Engagement of students: learning approaches

The second aspect of engagement investigated here is the approaches to learning that the students adopted with respect to their study context. As defined by Prosser & Trigwell (1999), approaches to learning are a context-specific interaction between the students and their learning environment.
Students may interact with their learning environment and adopt a deep approach with the intention to understand, a surface approach with the intention to reproduce, or a mix of these two approaches. The following quotations from individual interviews are indicative of students’ expressions of surface and deep approaches from this study context:

S: this is the foundation work - it doesn’t start to get specific to what I want the degree to be until next year. And so pretty much, most of it is pointless information, so just pass an exam and move on…
I: And when you’re reading through that what are you aiming to do?
S: Just reading it.
I: Why?
S: Because it’s that way I know what I missed in the lectures.
I: So what are you trying to do with the stuff you missed?
S: So read it once, it sticks in your head … then you’ve got the answers you need to do the test.

On-campus student aged 18: surface approach

S: That in particular isn’t necessarily interesting to me but the whole unit, and that’s part of it, is very interesting. It’s just part of a whole to me…It is fascinating stuff. It’s just mind-boggling…
I: When you were studying…were you aiming to remember the material or to understand it?
S: Uh, understand it really. I have great difficulty memorising anything unless I understand it first so I look for understanding first and then hopefully I’ll remember it….when I come to the lecture I don’t necessarily believe what they say. I like to think about it and compare it with what other opinions I’ve heard…What I have struggled with is the concept that inanimate matter can do that without guidance…yet the stuff happens by itself inside the cells every day… I keep a notebook & I write down things that I think are important or interesting and worth noting and also I do diagrams

Off-campus student aged 33: deep approach

Of the student interviews, four out of five off-campus students reported a deep approach to their study, compared to only two of the eleven on-campus students.

Quantitative data corroborated the findings from the interviews. The comparison of mean deep and surface approach measures between on-campus and off-campus students indicated significant differences between means for both deep and surface learning approach scales. For the deep scale, the mean for on-campus students (-0.22) was significantly lower than for off-campus students [0.55, \( t (296) = -6.9, p < .001 \)]. For the surface scale, in contrast, the mean for on-campus students (0.23) was significantly higher than for off-campus students [-0.12, \( t (296) = 5.70, p < .001 \)]. There was, however, a significant main effect for age on both deep \( [F(2, 282 =19.7, p < .001] \) and surface \( [F(2, 282 =12.6, p < .001] \) approach measures. It was not possible to separate the age and enrolment effects because of grossly unequal and sometimes very small group sizes, so the differences in learning approach detected between the on- and off-campus cohorts may well be related to the age differences in the samples. In summary, though, both qualitative and quantitative data on learning approaches suggest that the off-campus students engaged with their learning context in a more meaningful way than the on-campus cohort did with theirs.

Discussion

Many of the characteristics of the learning contexts in this study are consistent with teacher-focussed, information-transmission pedagogy so common in introductory units. Likewise, the comments of many of the students who were bored and unengaged with the topic, especially the practicals, are theoretically consistent with this pedagogical environment. Although accepted by many students as ‘normal at uni’, the content in this unit which was recognised as excessive by
the lecturers is theoretically likely to encourage surface approaches to learning (Ramsden, 1992, p. 81) and therefore dis-engagement with content meaning.

There was therefore clearly scope to promote student engagement in the topic. A reduced focus on transmission of information would be more in line with more student-centred conceptual change models of teaching advocated in tertiary teaching and learning research (e.g., Prosser & Trigwell, 1999, pp. 137-163). Some more specific possibilities for promoting engagement could include incorporating some “exploratory” (Hegarty-Hazel, 1990) problem-based practical work, and some choice of practical and assessment activities with particular relevance to specific degree programs. Engagement in practical sessions seems particularly important for on-campus students, who in a typical degree program have three or four resource-intensive afternoon practical sessions per week.

The difference in engagement between on-and off-campus students is of interest given changes in use of information communication technologies (ICTs) in distance education. The model of distance education in the unit at the focus of this study is largely by correspondence, supported by some use of virtual learning environment such as email. This contrasts with models using ICTs more heavily to engage isolated off-campus students via more constructivist virtual learning environments and interactive learning communities (see e.g., Bernard et al., 2004). From the results of this study, off-campus students showed greater engagement than their on-campus counterparts without heavy reliance on ICTs. This suggests that while off-campus students could well benefit from more ICT-supported learning, their engagement with the content was not compromised, relative to the on-campus cohort, by its absence. In fact, it may be that on-campus students have as much or more to gain from appropriately designed computer-aided learning activities. It has been argued by Hounsell and McCune (2002) that computer aided learning can be a useful alternative to practical work in undergraduate biology, especially given the cost of laboratory work and the scale of equipment needed for some authentic learning experiences. It could also have value in injecting some more variety and relevance into the learning environment, given the boredom of the younger on-campus cohort with the status quo.

In this study the students’ perceptions of their learning context, at a broad scale, seemed to be consistent with the pattern of difference found in their learning approaches. The perceived irrelevance and lack of interest in the content, which featured strongly in on-campus students’ accounts of their learning experiences, related in a coherent way to their more surface approaches, in line with previous research (for reviews see Prosser & Trigwell, 1999). In the case of many off-campus students, conversely, the perceived relevance and interest they expressed, and their greater satisfaction with teaching, were associated with deeper approaches to learning. The enrolment effect on learning approaches could not be separated from the age effect, because off-campus students were much older. Students’ approaches to learning are not totally labile and context-dependent, and deep learning approaches are more common in mature-aged students (Richardson, 1994).

Regardless of the undoubted influence of age on their learning approaches, it is of interest that the off-campus cohort reported more use of deep and less use of surface approaches to learning than the on-campus group. The off-campus students in one sense had least opportunity for social construction of knowledge, because of their relative isolation from peers and teaching staff, yet the off-campus mode accorded them and perhaps relied on a relative independence of study. A multitude of variables such as age, prior knowledge and other commitments doubtless contributed to the way that individuals within the off-campus cohort engaged with their learning.
Nonetheless, the interactions of the off-campus students with their learning context seems to have resulted in deeper learning approaches, which have been found in a number of studies (e.g., Hazel, Prosser, & Trigwell, 2002; Prosser, Hazel, Trigwell, & Lyons, 1996; Trigwell & Prosser, 1991) to be related to higher quality learning outcomes in first year science. The combination of the residential school and self-paced study of appropriate materials was effective in engaging first year off-campus students with their learning, relative to the context and engagement of their on-campus counterparts.

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References


