[O29] Using debates to develop and assess critical reasoning abilities in first year bioscience students

Catherine Sanderson
Faculty of Health, Leeds Metropolitan University
c.sanderson@leedsmet.ac.uk

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Introduction

The knowledge base of the Biosciences is no longer the domain of professionals in the field but has invaded contemporary culture with discourse around issues such as the implications of developments in reproductive technologies, genetic engineering and the genome project aired routinely in the mass media. Arguably the wider dissemination of this continually and rapidly developing knowledge base and the popularisation of science drives a greater not lesser need for professionals in the Biosciences, particularly in Biomedicine and Health, to have an in depth grasp of core concepts. They also need to have the competency to use those core concepts to counteract media spin around issues in science and health. Presenting such an argument also requires them to be able to critically evaluate the manner in which the knowledge base was acquired and therefore the extent to which it can be a valid explanation of phenomena.

Although there seems to be little disagreement about the importance of critical thinking and reasoning in Bioscience education, and in other science subjects (Garrett, J. *et al*.1999 and 2000), the use of critical reasoning abilities is usual only stated as a learning outcome for final year undergraduate or postgraduate modules and courses (Pearce, R. S. 2006). Debates are used as a learning tool for the development of critical reasoning but they are rarely summatively assessed. In addition the development of those abilities progressively throughout a three year degree course is often implicitly rather than explicitly addressed. (Fisher, A. 2001 pg1). We often assume that our students understand that this is what we expect them to do when we direct them to the evidence base and this isn't really good enough in a student centred ethos. Students have to know what they are meant to be learning from each task and need to be able to evaluate the extent of their learning. Learning outcomes need to be both explicit and transparent especially when linked to the assessment process. (Race, P. 1999, Biggs, J. B. 2003).

This article describes and evaluates the use of a summatively assessed debate as an assessment and learning strategy to develop critical reasoning skills and stimulate learning through assessment in first year Biomedical Science and Public Health students.

Engaging first year students in verbal debate is a challenge. Their conceptual thinking about the nature of science itself is an important factor to consider here (Eflin, J. T. *et al*.1999), as there is evidence that Bioscience students view new knowledge uncritically as an addition to a body of factual information rather than the outcome of a particular methodological approach to enquiry. Consequently their response to conflicting information was generally to ask the lecturer 'which is right' rather than making any attempt to understand why differing information might be presented. (Watters, D. J. and Watters, J. J. 2007)

Moving students away from an epistemological view of science as factual knowledge passively received to one that centralizes critical thinking about the nature of that knowledge, the quality of the evidence base for believing it and the implications of that knowledge, is a complex task (Edmondson, K. M. and Novak, J. D. 1993). Watters and Watters (2007), emphasize the need to understand students' beliefs and approaches to learning in addition to their view of science in order to develop appropriate strategies that facilitate change.

Deconstructing what is meant by critical reasoning is a much debated issue with its roots in a philosophical tradition dating back to John Dewey (1909) Edward Glaser (1941) and continued by Ennis (1989, 1996) amongst others, but for me it is relatively straight forward; I want my students to observe the world around them, ask questions about what might be going on, consider possible answers and explanations (that may be self generated through the research process) and determine which ones, on the evidence available, seem most plausible. In other words I want them to think things through before they express opinions.

Critical reasoning is also central to reflective practice – it is about holding self beliefs up for scrutiny in the light of new evidence and experience. Constructing a reasoned argument either verbally or in writing also necessitates 'the ability to use language with clarity and discrimination' (Thomson, 2002 p2).

Additionally, a fundamental requirement of assessment, learning and teaching (ALT) strategies in H.E. should be to empower adult learners to take responsibility for their own learning and to become self directed and reflective so that they develop the skills and competencies needed to continue their learning after graduating according to the demands of novel situations they are confronted with.

Undoubtedly the ALT methodologies and strategies that could be effective for empowering our students to be self directed learners are as diverse as the student population but all include the need to affect concepts of self efficacy (Bandura 1977, 1997). They would also have to involve a major shift in power relationships in learning towards increasing levels of student involvement in the process, culminating in students taking full ownership of some learning situations. This approach is exemplified by Finkel (2000) in his book on 'Teaching with your mouth shut' where he challenges didactic transmission models of teaching of the sort that predominate in Bioscience degrees (Hughes and Wood 2003) and where he instead suggests that 'the teachers task is to set up conditions that promote thinking'.

Opportunities abound on Science and Health courses to think about radically opposite viewpoints as ethical dilemmas present themselves almost daily in the popular media. Further examples here include end of life decisions; where the 'blame' lies for lifestyle induced illnesses; ecological ethics and the nature of doctor/patient relationships.

Many of these dilemmas are played out in TV medical and courtroom dramas and in novels (e.g. see Jodi Picoult, *My Sisters Keeper* and *Mercy*). Molecular biology techniques are utilised routinely in forensic investigation in crime thrillers such as CSI, and are therefore increasingly familiar territory to our students. This may be a double edged sword as students may expect the same 'content' in lectures and become dismayed when engagement at way more depth is expected! Alternatively, familiarity with the application of the knowledge base from popular culture may help to overcome barriers to learning that potentially arise when confronted with new and conceptually difficult subject material in a lecture theatre setting. It is this familiarity with contemporary culture that is exploited to stimulate learning by National Teaching Fellow Kirsten Hardie of the Arts Institute at

Bournemouth in her 'On Trial : Teaching without talking' role play work with students – developing Finkel's ideas. (Hardie, 2007)

Consideration of issues in medical, scientific and health care ethics often begin with 'should we because we can'. They can therefore provide a valuable learning opportunity for students to engage in critical examination of both sides of the argument whilst raising their awareness of the social responsibility of scientists and the impact of scientific developments. Because of its currency, debating ethics in Bioscience also has the potential for motivating students to engage in the possibility that science can be transformative as a philosophical approach to making sense of the world and their experience of it.

Teaching Strategy

In the Faculty of Health here at Leeds Met University, on our Health Sciences and Public Health courses, we deliver a first year, first semester module, Concepts of Science and Health, that was designed to explore definitions and views of both of those terms and to discuss moral and ethical frameworks such as utilitarianism, deontology and the medical ethics of Beauchamp and Childress that may help to evaluate and construct reasoned arguments around contested issues. Principles of critical reasoning are also introduced.

The module was also designed as an action research case study to evaluate qualitatively the tutor and student experience of stimulating learning by debating contemporary issues. The bioscience knowledge base needed to do this is only partially delivered in lectures. It is the students themselves who work out the information they need in order to argue their case, so it is a problem based learning methodology. For example in order to present arguments either for or against designer babies they need to find out what stem cells are, why they have the properties they do and they need to research and describe the methodology of IVF treatment. Understanding of this knowledge base is consolidated during the planning process for the summative assessment within small group tutorials.

60% of the module assessment is for the production of a group report that sets out the arguments that either support or refute an ethical standpoint followed by a debate with their opposing group based on the written reports. The remaining 40% is for an individual assignment that profiles a famous scientist, describes what they are famous for, reflects on the quality of the science and evaluates the impact of their work on our present thinking about science and health.

Module structure

- The first year cohort is large and includes over 140 students studying Biomedical Sciences, Public Health and Complementary Therapies.

- Because of logistical and resource constraints some teaching sessions (2hrs per week for 10 weeks) are lecture theatre based but are planned to be very interactive using moral and ethical dilemmas as scenarios for debate.

- My teaching style in these large group situations is to be controversial, play devils advocate and occasionally to be confrontational with an aim to stimulate discussion.

I often find myself able to stand back for extended periods of time as students converse with each other throughout the room, learning from each other. However, whilst it is not just

the usual suspects that take part here, some students, for a variety of reasons may not feel comfortable enough to able to contribute in this arena.

- These large group sessions are therefore supported by course cohort group tutorials. In these smaller sessions the quality of the arguments I hear in the larger sessions is evaluated drawing out the principles of critical reasoning and further ethical problems are considered as formative work.

- For the summative assessment students are divided randomly – by alphabetically order of surnames - into groups typically of 5 students. Topics for debate are determined by the whole student cohort based on their current interests, though each group are randomly allocated both the topic and whether they have either the 'for' or the 'against' argument to prepare. They may therefore find themselves having to uphold a position that they themselves do not presently support. The intention here is that they will then take a more systematic approach to the construction of a reasoned argument.

- Assessment criteria for the report and the debate, are developed by the students, with minimal tutor guidance in tutorials. The criteria for the report typically focus on the integrated quality of the arguments and the evidence used to support them and the ability to demonstrate familiarity with the relevant underlying ethical theories.

- Completed reports are swapped between opposing groups and they are asked to prepare a series of questions, usually four, that they wish to pose based on issues arising from their reading and interpretation of the arguments in the report.

This year (2006-2007) topics were:

- Reproductive Technologies/designer babies

- End of life decisions/Euthanasia

- The treatment of lifestyle induced illnesses

- Drug companies

- Ecological ethics

- Animal Rights

The Debate

- The assessment criteria typically include the necessity for everyone to contribute, though not necessarily equally and for debates to be reasoned and evidence based rather than purely emotive! Clarity and quality of both the questions and the primary answers are also assessed.

- Each criterion is marked on a scale of 1 – 5 (which correspond to degree classification scales), to allow for mark allocation, but additionally has space for feedforward comment.

- The role of the tutor is to direct proceedings, time keep and retain order! The module tutor is present for all debates with a second tutor for moderation.

- Opposing groups come together and ask their predetermined questions in order. After each question the opposing group completes their reply (approx 1min) and there is then the opportunity for open debate (approx 3 mins).

- When all questions have been asked, each group self evaluates their performance against each of the criteria and the tutors give instant formative feedback based on their observations. In addition each group is asked to share their reflections on the whole assessment process, particularly on the extent to which their research impacted on their own views of the topic. This ensured that all students were engaged in feedback and evaluation.

- Marks are allocated within 24hrs after tutor consultation.

Student evaluation of both the module and the assessment is extremely positive with many specifically commenting that their views were changed as a result.

- 'At first I thought I was never going to able to argue for it (euthanasia) but reading up about the people who have asked for permission to do it made me think about how I would feel in that position'.

- 'Doing the research for the report made me realise that I didn't really know anything about how drug companies worked. I had always thought they were just money mad but some of them do lots of good things'.

- 'I have always thought that there was no problem with testing things on animals and although I do still think that, it should only be allowed if they can prove it can't be done any other way'.

They also commented mainly favourably on the process as a stimulus to learning.

- 'There was loads of information on it on the net so we really had to work out which bits were the best to use by looking at where the info came from'.

- 'The other team were really difficult to argue against because they had really good reasons for everything – we just hadn't done enough to cover everything'.

- 'I wasn't looking forward to the debate but when they were speaking I just thought but that's not right and had to say something – and what I said floored them! I didn't know I could do that!'

- 'Our topic (global warming) was really interesting. Because we wanted to win I did loads of reading about it and I never read up about a topic after a lecture'.

Group self evaluation was routinely 1 grade less overall than the tutor grade. The main drawback commented on by students is that which is inherent in any largely self directed group work, namely how to manage dysfunctional groups and the extent to which any allocated marks reflect an equitable contribution by all group members. The students themselves decided on a strategy to deal with this but it still impacted negatively on their experience. They felt that the debate assessment criteria developed by themselves were valid and robust but needed to allow for a wider range of individual differences in mark allocation.

Conclusion

The aim of the ALT strategy described here was to help to develop critical reasoning skills in Bioscience and Health first year student using a summatively assessed debate on an ethical dilemma in science and health. Student evaluation of both the module and the assessment provides evidence that they rated the learning opportunities provided by this module as both highly effective and enjoyable confirming the experiences of other educators (Bond, 2005).

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