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E+S=DM: Using Science to Teach Social Science and Build Critical Thinking Skills

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Developing critical thinking skills is a core part of ensuring graduates are able to perform effectively once in the workplace, a generic attribute ranked highly by employers. For those working in the field of marine resource management, critical thinking and problem solving skills are vital when trying to manage and reconcile contesting cultural paradigms and competing economic, social, and political imperatives. It is these skills, not content knowledge *per se* that are ultimately tested and mediate outcomes in the workplace overall. However, when attempting to teach a course called *Marine Environment and Society*, a course moreover that specifically aims to build such skills, I found that students, in not being familiar with a social science approach to learning, either discounted or were not able to undertake the critical thinking needed. A learning environment must enable student learning of goals and ensure activities are consonant with disciplinary practices. This paper outlines my journey to create an effective interdisciplinary learning environment for students, within what is essentially a mono-cultural teaching and learning context. This was done by applying familiar paradigms and practices within teaching to convey unfamiliar concepts and thus enable students to accept new forms of learning and stimulate their critical thinking facilities.

Introduction

> "When I was undertaking a Masters of Environmental Studies, I was required to take a bridging course in mathematics in order to successfully complete all my coursework. I was allocated a tutor and he and I spent at least four weeks trying to bring me up to scratch in relation to mathematics. However, we consistently got nowhere as I just could not comprehend the concepts he was trying to teach me. Finally, in despair, my tutor asked me what my original degree major had been, and I answered 'Ancient Classics and History'. The next week, he started our session by talking to me about the history of mathematics, beginning with that ancient favourite – Pythagoras. It was a memorable moment, for from that time on, my interest was triggered, my brain unlocked, and henceforth I was able to not only do the mathematics required but went on to successfully complete the course and all the required environmental statistics."

What this story tells us is not that the student in this case was any good at mathematics, but that the tutor was an inspired and creative teacher. He was able to facilitate the student's foray into a different disciplinary world by helping her apply her existing skills base to the problem at hand. This paper presents the results of an action research project, undertaken over a three year period that attempted to resolve similar challenges in teaching a social science course called *Marine Environments and*

Society (MES). The key problem in the course was that students, in not being familiar with a social science approach to learning, either discounted or were not able to undertake the critical thinking needed to understand the issues related to the complexity of the relationship between societies and marine environmental systems. This paper outlines the results of the journey taken by the author to create an effective interdisciplinary learning environment for students, within what was essentially a mono-cultural teaching and learning context. The paper describes two dimensions of this challenge: building students' understanding and skills base through the implementation of authentic learning tasks, and creating a learning environment that built student inquiry and interest overall. Together these dimensions helped facilitate critical thinking skills of the students.

Developing critical thinking skills is an essential tenet of effective teaching and learning practice (Kreber & Cranton, 2000). For those working in the field of marine resource management, critical thinking and problem solving skills are vital when trying to manage and reconcile contesting cultural paradigms and competing economic, social, and political imperatives. It is these skills, not content knowledge *per se* that are ultimately tested and mediate outcomes in the workplace overall. Ladyshewsky (2006, p. 73), argues that critical thinking can be broken down into five categories; knowledge expansion, perspective sharing, verification of knowledge, cognitive conflict and alternative perspectives. Critical thinking skills are generalist skills (Moore, 2004) that can be applied in specific genres when navigating inter or cross disciplinary teaching and learning environments (Davies, 2006; Ikuenobe, 2001; Reed & Kromrey, 2001). Different techniques were implemented during this project, in an attempt to enhance student ability to critically assess subject matter, both across and within disciplines, and apply meaning derived from that process to real life contexts and tasks.

Methodology

MES is a one semester unit, and offered to second and third years. It is offered by the Australian Maritime College (AMC), now an Institute of the University of Tasmania. Students from the Bachelor of Fisheries, Bachelor of Administration, and Bachelor of Education take this course.

This paper used action research principles to structure a three year evaluation (2003-2007) of the implementation of the course Marine Environment and Society (MES). The cyclical and participatory nature of action research is well suited to an undertaking such as this (Wadsworth, 1998). Action research, first explored by Lewin (1946, 1947), offers a way of bridging the gap between practice and theory and an opportunity to study change processes in social contexts (Blichfeldt & Andersen, 2006, p. 2). Action research has four characteristics which made it relevant to the evaluation over time of the implementation of teaching innovations in MES. It is cyclic, thus suiting the ongoing delivery of the course over time, where similar steps and sequences were repeated. Secondly it was participative, both students and staff were involved in the evaluation over time, and they were active participants in the review process. Third, the review was qualitative, in that it focused on language rather than numbers and finally it was a reflective process incorporating student and staff critical feedback on the process and outcomes of course changes (Dick, 2000).

In each year of delivery, Student Evaluation of Teaching and Learning (SETL) forms were analysed to evaluate the success/failure of different teaching strategies over time. In addition, based on the SETLS of the first year, face to face evaluations were held at strategic points during semester in order to gauge student response to innovations. While enrolled in a Graduate Certificate in University Learning and Teaching, the author also used MES as a template to trail new teaching and learning strategies as part of her assessment. Results from a Student Representative Committee, (chaired by a student) whose role was to report back bi-monthly to teachers on each course were also used. In this way, it was possible to both gauge student difficulties with the course, but also monitor the success (or not) of various innovations.

History of Course Development

The course itself is designed to enable students to understand the social and human dimensions of the relationship between society and the marine environments, particularly the notion that there are different worldviews, perspectives and approaches within this relationship. It is a social science rather than science course. Topics include property rights theory, Indigenous resource management and co-management, environmental theory including economic rationalism, Gaia, deep ecology, ecofeminism and social ecology, the social dimensions of environmental issues such as climate change, and the role of different sectors such as industry, non-government organisations (NGOs) and Indigenous groups in the context of the relationship between the marine environment and society.

During the delivery of the course, a number of obstacles presented themselves. In this context Bradbeer (1999, p. 382) notes that there are three ways in which symptoms of problems in achieving interdisciplinarity are: (i) problems in working across disciplines, (ii) problems of working in different disciplines and (iii) problems in synthesising different disciplines. As Ylijoki (2000, p. 339) adds, disciplines differ not only cognitively but socially, with the core of a discipline conceptualized as a moral order "that defines the basic beliefs, values and norms of the local culture". Llamas (2006) also argues that disciplinary technologies have a major influence on how students perceive a 'good student'. As such, adhering to specific disciplinary boundaries is 'good' practice and the politics of resistance are mobilized if these criteria are confronted. This stance part explains the resistance experienced from the students in this case; they become reticent to cross boundaries, fearing that they will be punished for this by lower marks.

Student of MES faced difficulties in relation to working across and in synthesising different disciplines. For example, during delivery climate change is used as a case study to focus attention on the relationship between people and place. In this context, students were required to synthesis information from scientific tradition, as well as social science fields ranging from anthropology, geography, history and collective rights theory. Thus in attempting to tackle the issue of climate change, students also had to scope and then synthesise information across a wide range of fields and paradigms.

Disciplinary differences were crucial roadblocks facilitating student understanding in this context; for example, the unit outline for MES is underpinned by the expectation that what students are essentially exploring is the contest between competing value systems and world views. In delivering the course it became evident that students did

not understand what a value was, let alone a world view, as highlighted by this excerpt from one student who questioned, in regard to an assessment piece requiring him to document two different world views on an environmental issue: “How can I sum up their world view, when they only live in one place?” The most immediate implication was that the student, and others offering similar views, did not understand teacher expectations of them nor the differing requirements between science and social science. This is again consistent with Bradbeer’s (1999) assessment that there are a number of symptoms of problems in interdisciplinary courses; in this case, it was a problem of synthesizing different disciplinary understandings. Face to face student feedback from the student liaison committee demonstrated that this factor also ‘delayed’ student understanding (Scheja, 2006, p. 437), and meant their negotiation of the teaching-learning environment, and engagement with their individual topics and the course overall was constrained. Feedback for instance highlighted in early meetings students were unsure of what the course expectations were, but towards the end of the course were more confident in applying and using terminology outside of their original ‘comfort’ zone. As Dysthe (2002) notes, textual feedback and expectations feed into and reflect disciplinary orientation and theories of learning. In this case, lecturer feedback was also not fully understood. Thus, with each subsequent delivery of MES, time was invested by the lecturer much earlier on to explaining and developing understanding of key terms that would be used throughout the course.

By and large students were also used to a surface and rote learning approach, and found the requirement to think critically and deeply about what they were learning, cognitively difficult. This is not to say the students were not capable, but they were not familiar with the paradigmatic approaches required to produce the assessment outputs that were expected.

Finally, given this course was structurally located within a science degree, where scientific approaches are prioritized, students did not rank social science knowledge bases highly. Student’s whose disciplinary orientation was towards science constructed lecturer orientation towards the arts in the context of the ‘other’. As such, feedback from many students highlighted that they simply switched off from the course.

In this context, this paper focuses on the role of the lecturer in developing an effective teaching strategy to overcome this problem. Strategies focused on building the felicity the students had in relation to their application of scientific knowledge, and applying that ability to develop their understanding of the role of social issues.

Responding to the Challenge; E+S= DM

The challenges inherent in teaching MES were met in many ways. In the second year of delivery, all basic terms were explained, based on the assumption that the students would not be aware of them. Terms such as ‘value’, ‘world view’, ‘actor’, ‘paradigm’, ‘social’ and ‘discourse’, were explained in the first two weeks. To complement this, assessment tasks were created that were more directly related to the topic. For example, students were asked to write an assessable media release on a social problem. Students were also required to give a presentation each on the most pressing *social* issues facing the marine environment, when previously they had to give a presentation on the most pressing *environmental* issue. Lectures were redeveloped so that they were simpler, yet covered the syllabus.

Overall however, in the second year of delivery, the quality of assessed work was still poor, with the numbers of high performing students still well below the average. Importantly, most students, in their individual ranking, scored badly in this course in comparison to their (much higher) scores in other courses within the same degree. It was obvious that the right pitch for delivery had not been gauged. While students completed more authentic assessment tasks, that is, writing a Ministerial Brief, a media release, or minutes of a meeting, all of which students would be conceivably be asked to do later on in the workplace, the delivery of the content was still problematic. Feedback on SETLs indicted students felt they had not been intellectually challenged in the course, some going so far as to indicate they thought some of the teaching techniques were 'childish'. It appeared that in the effort to illuminate basic social science concepts that the teaching effort had gone too far to simplify the course. Accordingly, students still had difficulty seeing the relevance of the course or the applicability of the underpinning ideas in the real world. Student evaluation forms reflected this, indicating the course had been well taught and the lecturer was well informed from their perspective, but that the content *per se* had not interested them. One student noted it was "the most boring course apart from operational planning".

However, during the last two weeks of delivering the course for the second time, there was a significant shift or 'teaching moment'. After 10 weeks together, the lecturer was trying to explain to students how to present the most pressing *social* issue in their verbal presentations. She discovered that students were having major difficulties in understanding *why* social issues needed to be considered, and how to get to social issues from an environmental problem. Importantly after all this time, they still did not understand what was meant by the term 'social' or 'social context'. Their mind set was so constructed towards a scientific approach they were having a real issue with socially constructed views. In explaining the relevance and meaning of the social dimension in environmental decision making, the lecturer framed the relevant point within the discourse of the whole course, by 'speaking' to them in the language they knew best – scientific, formulaic terminology. On a white board she summarised the entire course into a simple mathematical equation: E (Environment) + S (Social contexts) = DM (Decision Making). E+S = DM. All students 'got' this formula. This was demonstrated by a number of factors most immediately by a clear improvement in assessed presentations, and later on in the depth of understanding and critical thinking (according to the five elements described earlier and based on Ladyshewsky, 2006) reflected in the final assignment, and in the number of peer reviewed social science resources used to back written work up.

In framing the context of the course in such a way, the students went from being passive to active learners, and were more 'aware of the how rather than the what in learning' (Bradbeer, 1999, p. 382). In meeting the students half way in relation to their own disciplinary paradigms it had been possible for the lecturer to share her own discipline in effective ways. It was on the basis of this understanding that MES was delivered for the third time.

In delivering the course for the third time, the lecturer made a conscious decision to guide the students from the science to the social science in every part of the course. The aim was to not only help them move in between disciplinary paradigms, but also

enable them to see the links and relevance between the two disciplines for environmental decision making. As such, the course started with the formula E+S=DM, and an exposition of the environmental science, before the social dimensions of that issue were introduced. In this context, the lecturer engaged in what Kreber and Cranton (2000) call *process reflection*, where the adequacy of the instructional knowledge is questioned leading to a re-focusing on the strategies that led to them.

In this iteration of the course, activities were designed to further build critical thinking skills and cross disciplinary understandings, through the implementation of further authentic assessments. Students were required to participate in problem solving activities, which required them to explore issues related to real life contexts. For example, one task asked students to take on the role of a member nation of the International Whaling Commission, and to then role play a meeting wherein students had to decide whether or not to approve the lifting of a moratorium on whaling. In this instance, role plays helped students make the journey between science and social science in a critically reflective way. The task required them to go beyond disciplinary boundaries to reflect on how the application of different information sets can conspire to create –and resolve, difficult real life problems. This process enabled students to see how different world views and also different political representations affect decision making processes, and that an understanding of science alone, in fact, is not enough. Using a topic such as whaling was very popular, as it engaged student interest while enabling them to focus on the issues at hand. Most importantly it helped students make the cognitive jump from science to social science, from scientific paradigms to social contexts.

Similarly, another task called on students to convene a meeting as members of the United Nations High Commission for Refugees, where they were required to try to develop a policy for environmental refugees. This topic was in turn linked to the scientific problem of climate change. Again, in this way, the aim was to guide students through a process that began with the science and ended with the social issues around that science.

Similarly, reading tasks were set, where students had to engage with many peer reviewed articles of social science literature that related to an environmental issue they were familiar with, such as water quality. As they were able to use their own general and scientific knowledge about the issue to bear on the articles, it was possible for them to build on their current understandings, but in a social context.

Over time then, through the ongoing delivery of MES, a conscious attempt was made to try and create a learning environment that would stimulate and enhance the critical thinking skills of the students, in a social science context. There is still a long way to go but it is now a much better course. Feedback from students, through SETLs, the committee and face to face has demonstrated that these innovations have worked.

Student attendance averaged 95% for the entire duration, and the quality of assessment was much higher overall, indicating higher levels of learning and understanding. The role play exercises backed up with literature stimulated critical thinking skills, evidenced by the unusual solutions to problems students produced in

class. Student feedback has also been very positive with active rather than passive engagement with course content shown throughout:

> I really enjoyed the time we spent on getting into other people's heads, and learning things, like taking minutes we would have to do in the workplace
>
> I liked finding out about other countries and their views, the social stuff

Critical Thinking and Interdisciplinarity

Getting students to engage with the subject and think critically starts a process that will help build the blocks necessary to enhance student higher learning and higher order cognitive skill and builds interdisciplinary understanding. In the context of marine or environmental management, this capacity to bridge disciplines, and mine the advantages of each to resolve 'sticky' issues is a necessity for environmental management professionals.

Studies have also shown that teaching within different disciplinary contexts is not a simple matter of relaying different content but also is about working within an understanding of the knowledge and beliefs about the purposes of teaching, knowledge of students conceptions and misconception about the topic, the curricula knowledge available, and the instructional strategies available (Grossman, 1991; Fernandez-Balboa & Stiehl, 1995). Unless all components are addressed, the teaching can be prejudicial to the students by in effect reinforcing the disciplinary boundaries they operate within and are blinkered by, hence precluding their access to wider knowledge and understandings of how to resolve complex real life issues.

Conclusion

Interdisciplinary study is a challenge (Bradbeer, 1999), yet studies show students do not only see higher education as a means of getting work but are motivated by intellectual interest in disciplines (Solbrekke & Karseth, 2006). In the case of competing disciplinary paradigms it is not enough for teachers to abscond responsibility and blame student difficulties and apathy on a lack of motivation or deficient disciplinary understanding. A learning environment must enable student learning of goals and ensure activities are consonant with disciplinary practices. Teachers must do their best to create that environment.

This evaluation shows that it is important for teachers to acknowledge that universities "both reflect and reconstitute classifications of knowledge and in so doing establish categories of expertise and knowledge worth knowing" (Gumport & Snydman, 2002, p. 375). Essential to obtaining a shift in student perceptions within MES was the effort put into creating a shift in student understanding of disciplinary knowledge bases, such that 'social' knowledge became 'worth knowing'. Once acceptance of the classification of knowledge occurred, students were then able to open their mind to attain higher level skills in thinking, reflecting and learning.

The key lesson from this evaluation therefore is that it is important to focus as much on self regulated processes in teacher learning as it is on self regulated student learning (Eekelen Boshuizen & Vermunt, 2005). Being a reflective practitioner is a

core element of creating the conditions that enable critical thinking in students (Schon, 1983).

Ultimately, in this case, the ongoing iteration of course development for Marine Environment and Society helped create an effective interdisciplinary learning environment for students, within what was essentially a mono-cultural teaching and learning context for both staff and students. Working on courses such as MES should encourage the social, interactive, and collaborative aspects of both student *and* teacher learning in ways that facilitate the establishment of effective learning communities, overall (Smith & Bath, 2006).

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References

Bradbeer, J. (1999). Barriers to interdisciplinarity: disciplinary discourses and student learning. *Journal of Geography in Higher Education*, *23*(3), 381-396.

Blichfeldt, B. S., & Andersen, J. R. (2006). Creating a wider audience for action research: learning from a case study research. *Journal of Research Practice, 2*, 1-12.

Davies, W. M. (2006). An 'infusion' approach to critical thinking: Moore on the critical thinking debate. *Higher Education Research and Development, 25*(2), 179-193.

Dick, B. (2000). *A beginner's guide to action research* [On line]. Available at http://www.scu.edu.au/schools/gcm/ar/arp/guide.html.

Dysthe, O. (2002). Professors as mediators of academic text cultures: An interview study with advisors and master's degree students in three disciplines in a Norwegian university. *Written Communication*, *19*(4), 493-544.

Eekelen, I., Boshuizen, H., & Vermunt, J. (2005). Self regulation in higher education teacher learning, *Higher Education*, *50*, 447 - 471.

Fernandez-Balboa, J., & Stiehl, J. (1995). The generic nature of pedagogical content knowledge among college professors. *Teaching and Teacher Education*, 11(3), 293-306.

Grossman, P. (1990). *The making of a teacher: Teacher knowledge and teacher education.* New York: Teachers College Press.

Gumport, P., & Snydman, S. (2002). The formal organization of knowledge: an analysis of academic structure. *The Journal of Higher Education, 73* (2), 375-408.

Ikuenobe, P. (2001). Teaching and assessing critical thinking abilities as outcomes in an informal logic course. *Teaching in Higher Education*, *6*(1), 19-35.

Kreber, C., & Cranton, P. (2000). Exploring the scholarship of teaching. *The Journal of Higher Education*, 71 (4), 476 – 495.

Ladyshewsky, R. K. (2006). Peer coaching: A constructivist methodology for enhancing critical thinking in post graduate business education. *Higher Education Research and Development*, 25(1), 67-84.

Llamas, J. M. (2006). Technologies of disciplinary power in action: The norm of the 'good student. *Higher Education*, *52*, 665-686.

Lewin, K. (1946). Action research and minority problems. *Journal of Social Issues, 2*(4), 34-46.

Lewin, K. (1947). Frontiers in group dynamics II: channels of group life, social planning, and action research. *Human Relations*, *1*, 143-153.

Major, C., & Palmer, B. (2006). Reshaping teaching and learning: The transformation of faculty pedagogical content knowledge'. *Higher Education*, *51*, 619-647.

Moore, T. (2004). The critical thinking debate: How general are general thinking skills?
Higher Education Research and Development, *23*, 3-18.

Reed, J. H., & Kromrey, J. D. (2001). Teaching critical thinking as a community college history course: Empirical evidence from infusing Paul's model. *College Student Journal*, *35*(2), 201-215.

Scheja, M. (2006). Delayed understanding and staying in phase: Students perceptions of their study situation. *Higher Education*, *52*, 421-445.

Schon, D. (1983). *The reflective practitioner: How professionals think in action.* London: Temple Smith Press.

Smith, C., & Bath, D. (2006). The role of the learning community in the development of discipline knowledge and generic graduate outcomes. *Higher Education, 51,* 259- 286.

Solbrekke, T., & Karseth, B. (2006). Professional responsibility – An issue for higher education? *Higher Education, 52,* 92-119.

Tsui, L. (2002). Fostering critical thinking through effective pedagogy: evidence from four institutional case studies. *Higher Education, 72,* 740-784.

Ylijoki, O. (2000). Disciplinary culture and the moral order of studying –a case-study of four Finnish university departments. *Higher Education, 39,* 339-362.

Wadsworth, Y. (1998). What is participatory action research? *Action Research International* (online journal). Retrieved from http://www.scu.edu.au/schools/gcm/ar/ari/p-ywadsworth98.html