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Implementing a new interdisciplinary module: the challenges and the benefits of working across disciplines

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Abstract

A new interdisciplinary module in Science Ethics has recently been introduced at the University of St Andrews. The staff teaching on the module come from a variety of disciplines, ranging from the physical and natural sciences, through to philosophy and economics; a diversity mirrored in the students themselves. As this module seeks not just to be multidisciplinary but rather interdisciplinary, the tutorials, readings, desired learning outcomes, small group work, case studies and modes of assessment are all tailored in such a way as to promote cross-discipline dialogue, and so to develop and nurture interdisciplinary learning. This article seeks to outline many of the issues that have been raised, the solutions that have been proposed, and the challenges and benefits for the staff and students involved.

Keywords: interdisciplinarity, interdisciplinary learning, science ethics

Introduction

The Science Ethics module at the University of St Andrews was initially proposed in order to address the lack of explicit ethical teaching within the scientific disciplines.

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Nissani (1997, p209) clearly illustrates the situation that can develop if a scientist remains blinkered within their own discipline, unaware of the impact their research can have, by retelling the following story from Lifton and Markusen (1990, p273-274) about a nuclear weapons scientist:

> *"the experience he had in the mid-1980s when visiting the Soviet Union for the first time: Walking in Red Square… [seeing] so many young people… he began to weep uncontrollably…. Before that, Moscow had been no more that a set of lines at various levels of rads and pressures and calories per square centimetre that one had to match with the bombs." Nissani then clearly underlines the problem that can often therefore exist whereby "a highly educated person can be unaware of the social and moral dimensions of her actions. … one may know much about a subject and yet know little of its ramifications".*

As science ethics is an area which by its very nature affects not just an individual but society as a whole, there are many disciplines or areas of knowledge that ought to be involved in addressing issues raised in order to truly give a balanced and informed view. It was thought best to teach this module not simply by using scientists informed and interested in the ethical dimensions of their work, but rather to draw together staff from other disciplines relevant to science ethics such as philosophy, theology, economics and statistics (Berk, 2001; Lesser and Nordenhaug, 2004; Graber and Pionke 2006). It was at this juncture that the module moved beyond its original mission of simply teaching scientists to think ethically. It was decided to open up the module to students from all faculties and to have a multidisciplinary student base as well as a multidisciplinary teaching staff and to thus provide an environment for interdisciplinary learning.

The Scottish Higher Education system is such that the first two years, the "Pre-Honours" years, have a degree of flexibility in terms of the modules in which a student can enrol. It was decided that the Science Ethics module would be placed at a second year level, and that there would be no prerequisites for entry into the class. By doing this the module would be open to any interested party, including those outwith the science faculty.

It became clear relatively early on that the organiser's (the author's) belief, that by simply bringing together staff and students from different disciplines the module would somehow

metamorphosize from being multidisciplinary with disparate forms of knowledge brought together under one umbrella to being an integrated, interconnected and cognate unit, was somewhat naïve. It was not going to be quite as easy as that.

The divide between the humanities and the sciences, the two cultures described so famously by C.P. Snow in his Rede lecture of 1959 (Snow, 1998), could still be said to exist today. Below is a light-hearted narrative based on a conversation the author had with a current undergraduate science student as the student tried to illustrate quite how disparate she had found the teaching and intellectual environments of two of her modules (one in metaphysics, the other in science):

> *"You have a scientist and philosopher (especially a philosopher inclined to metaphysics) in a room and you present them with a metal spoon. The scientist (typically in my view) would pick up the spoon, tap it on the desk, measure its weight, perhaps calculate its volume, test to see that it was metal by passing an electric current through it and observing its melting properties upon heating. He/she would then conclude that it was a metal spoon and put it back in the drawer and then maybe go and investigate a knife.*
>
> *The philosopher (again just a stereotype) would stand staring at the spoon and ask whether it truly exists or whether it is merely a projection of our mind, whether it is in fact a fork, but we merely call it a spoon, whether it is proof of an omnipotent spoon-making deity, whether it symbolises humanity's hidden sexual desires, whether it is evidence for life after death and then in turn start pondering whether we ourselves are alive and how we can verify that. The philosopher would be unlikely to put the spoon back in the drawer until a very long time after, and would probably still be unsatisfied with any answers proposed for his/her questions."*

This is a humorous account, but one which nonetheless rings true. We have two cultures, replete with differences in epistemologies, vocabularies, mechanisms of connection, codes of conduct and standards of validation required (Frost and Jean, 2003; Nikitina, 2006) but how do we bring them together within the lecture theatre, seminar room or minds of ourselves and our students? And when should we?

Interdisciplinarity: What is it?

Before progressing on to look at how interdisciplinarity can be created, and its subsequent benefits, we have to first of all find a working definition of what we mean by interdisciplinarity.

A quick straw poll amongst staff members involved in interdisciplinary teaching brought up definitions such as “the creation of new knowledge”, “knowledge which falls between disciplinary boundaries” and “trying to find common themes”.

The literature itself is full of different definitions of interdisciplinarity and what it means, each with its own nuance or tailored in a specific way for the context in which it is used (see Lattuca, 2001a for a review). Fortunately however there are two clear themes that emerge from papers on interdisciplinary teaching and research:

1. Connections: - interactions, dialogues, integration, synthesis and exchange.
For example Rhoten and Pfirman (2006, p3) talk of “the **integration** or **synthesis** of two or more disparate disciplines, bodies of knowledge, or modes of thinking to produce a meaning, explanation, or product that is more extensive than the sum of its parts”. Manathunga, Lant and Mellick (2006, p367) state that interdisciplinarity emphasizes “the creative **synthesis** and new understandings that become possible when two or more disciplines become **integrated**”. Graybill et al. (2006, p757) describe the interdisciplinary approach as one which “involves the use of an innovative conceptual framework to **synthesise** and modify two or more disciplinary approaches.” Lynch (2006, p1120) discusses interdisciplinary research as being “between disciplines.. invokes notions of **exchange**.. something is actually **transferred across** disciplines” and finally Nissani (1995, p120) says that interdisciplinarity involves “**bringing together** in some fashion distinctive components of two or more disciplines”.

Of interest is the point made by Renschler, Doyle and Thoms (2006) that this integration to construct a new understanding can in fact be either additive, where two or more areas are combined intact to form a composite understanding, or extractive, where it is only

components from different disciplines which are brought together and combined. In both cases however it should be noted that synergism can also occur upon combination.

2. Perspective taking:- Much is made of the fact that by interacting across disciplines, you can begin to more fully understand another's position (and that is taken to include another *discipline's* position) and can more easily view a situation not simply from your usual, disciplinary standpoint but rather through wearing the lens of that other person or discipline – a holistic approach if you will. "The project set an **integrative** approach from the start… to look at literature **through the lens** of history and history **through the lens** of literature, and it gave students meaningful experience…" (Oitzinger and Kallgren, 2004, p66). Therefore interdisciplinary research and education allows us to better understand a situation, and at times ourselves, from another's perspective.

And so in order for interdisciplinarity to be created there has to be a progression, an evolution beyond multidisciplinarity, where the different subjects are simply bolted together much like a Meccano set (Lynch, 2006) and to get to the point where the different pieces actually interact, and meaningful connections are made between the constituent pieces.

For those involved in interdisciplinary education these bridges between the disciplines, and dialogues and exchanges to get there, have to take place on a number of pedagogical levels:

Content: How do we decide what is included in the module? Whose voice gets to be heard? How do we protect ourselves against disciplinary prejudices?

Objectives: What are the learning outcomes of the module? Are there discipline-specific learning objectives? To what extent is each discipline represented in the objectives? Are there outcomes associated with interdisciplinary learning?

Assessment: What method of assessment is best? How do you design methods of assessment that allow the students to demonstrate connection-making between the various units of knowledge?

All of these areas arose when we were planning the Science Ethics module, and this paper will seek to explore and explain the very practical ways in which they were tackled, outlining the challenges and the benefits of organizing a module across disciplines. Some of what is discussed may seem quite parochial, but the hope is that some of what is written will resonate with others in similar situations, and allow them to at least see how we began to address these situations. Needless to say the module is very much a work in progress.

The Challenges of Interdisciplinarity

The challenges faced can be loosely grouped under the following headings:

- Content
- Assessment
- Practical Arrangements

The Challenge of Content

The first challenge was to try and work out what to include in the module: what was essential, what would be helpful and what could be added if time allowed. Discussions took place with the Dean of Science, Directors of Teaching in different departments and academic staff with an interest in science ethics to try to work out what would be both appropriate and feasible in terms of content. In addition, in order to get a wider vision of bioethics teaching at undergraduate level, a number of key bioethics textbooks were consulted, the relevant educational literature was searched, comparisons were made with other similar modules at different universities and there were helpful discussions with colleagues at a national bioethics workshop.

Once it was clear which departments were interested in the ethical issues surrounding science, a rough timetable was designed where the module was divided into 5 areas – contributing teaching staff are listed in parentheses:

- Introduction to Ethics (Philosophy)
- Ethics and Scientific Research (Mathematics and Statistics; Physics; Economics; Psychology)

- Ethics and the Environment (Biology)
- Ethics and Biomedical Advances (Divinity; Philosophy; Biology)
- Science Ethics in Practice (Chemistry)

Each contributor was then given the freedom to develop their own lecture material and readings, based on their experience and expertise and in accordance with what they thought was appropriate for the overall aim and structure of the module. Lecture titles were then submitted and a provisional timetable was circulated. Numerous meetings were then held with each contributor in turn, and then as a large group, to ensure a cohesive and balanced approach. Where there were areas of related material, lecturers consulted one another directly to make sure that their lectures dovetailed and complemented rather than overlapped.

Examples of the kind of topics included in the module are: moral philosophy; ethical aspects of analysing data; bias and prejudice; scientific fraud; intellectual property rights; use of human participants in research; use of non-human subjects in research; the 'value' of nature; population growth vs. the environment; reproductive technologies and the 'right to choose'; stem cells, cloning and the status of the embryo; the emergence of neuroethics.

Content is a difficult issue because two requirements must be held in tension - the need for depth of discipline-specific knowledge (to allow an educated informed discussion) versus time restraints and the need for exposure to a variety of other disciplines (to allow a balanced, integrated response). The importance of this balance is such that some believe that interdisciplinary programmes, admittedly dependent on subject matter, ought only to be taught at graduate level, and until that point each of the disciplines ought to be kept separate to allow for depth of knowledge and specialization before advancing into the area of connection-making and integration. Within interdisciplinary degree programmes often the courses can be designed in such a way as to allow development of subject specific knowledge in the first couple of years, progressing to interdisciplinary teaching and learning in the Honours years. As Science Ethics is only 1 semester long, the need to produce depth, variety and the potential for connection-making takes place within a much shorter timeframe, and so it was decided that each week there would be two lectures, delivering

mainly discipline-specific knowledge, and then a tutorial where this knowledge could be applied and interdisciplinarity emphasised.

The Challenge of Assessment

In order to illustrate the difficulties associated with assessment in a module where staff members are from 8 different departments, and students range from geoscientists to those studying art history or international relations, it would be helpful to look at exam papers from each of these subject areas and to see what kinds of questions the staff members are used to setting, and what kinds of questions the students are used to answering at a second year level at St Andrews. (Note: due to space constraints these are just some examples and the questions are not necessarily equivalent in terms of mark allocation.)

Table 1. Examples of second year level Degree examination questions at the University of St Andrews (available: http://exams.st-and.ac.uk/exams/)

Metaphysics and Science	Should we be Platonists about numbers? (January 2006)
Modern Philosophy	In what sense if any does the 'cogito' argument of the Second Meditation provide an answer to the sceptical arguments of the First Meditation? (September 2006)
Ancient Philosophy	How does 'our nature' ground morality? Discuss with reference to Aristotle *or* Plato. (January 2006)
Animal Diversity	Describe the different ways of feeding in echinoderms. In particular, highlight how these mechanisms vary in relation to habitat. (January 2005)
Cell Physiology	Compare and contrast the intracellular signalling pathways activated by steroid and protein hormones. (January 2005)
Mathematics	Determine the equation of the tangent plane of the surface $x^2 - 2xy + z = 1$ at the point P = (4,2,1). (January 2003)
Statistics	Which one of the following functions of the continuous random variable X is a valid probability density function? (Assume that each function is zero outside the specified range.)

	(a) $f(x) = \frac{1}{x}, 0 \le x < \infty$ (b) $f(x) = \frac{2x}{3}, -1 < x \le 2$ (c) $f(x) = \frac{1}{5}, 0 \le x \le 5$ (d) $f(x) = \exp(x), 0 \le x < \infty$ (January 2003)
Organic Chemistry	Give an example of a good substrate and nucleophile for an S_N2 reaction. Explain your reasoning. (December 2005)
Physics and Astronomy	For a wave, write down the defining equations for phase velocity and group velocity, and describe their physical significance. Use a diagram of a travelling wave to distinguish between them. (January 2006)
International Relations	'Lenin's work on imperialism still has resonance today'. Discuss. (May 2005)
Art History	Was Monet a landscape painter? (January 2006)
Intermediate Microeconomics	A monopolist faces an inverse demand function $P = 50 - 2Q$. His total cost function is $TC = 20 + 2Q + 0.5Q^2$. a) What is the profit maximizing price and output level? b) What is the profit at this maximum? c) What is the consumer surplus at this maximum? (January 2006)

From these questions it is immediately obvious that the ways of assessing knowledge and understanding in the different disciplines are far removed. In the humanities it is clear that what is being looked for is an understanding of the discipline and also integration of knowledge, personal reflection, opinion and thought. In the sciences an understanding of the discipline is also required but in many ways, the student's own personal view or opinion on, for example, the intracellular pathways of hormones asked for above is not what is important – there is a correct answer, and appropriate evidence ought to be cited to prove that answer empirically. Integration of knowledge is required, as is original thought, but in markedly different way. It should be added that this is the situation at second year level, as the students progress through the university the assessment methods and criteria may not be as disparate.

Nikitina (2006) describes the ways the humanities and sciences differ pedagogically by outlining four areas: mechanism of connection, questions asked, nature of the inquiry that

takes place and standards of validation applied. She then describes three methodologies of knowledge acquisition which broadly reflect humanities, sciences and applied fields respectively, and discusses the strengths and weaknesses of all three methodologies: contextualizing, conceptualizing and problem solving. From the examples given above it is clear that in general, these divisions are indeed accurate. Contextualising knowledge is where facts and ideas are described with reference to, or embedded within, the relevant history, culture or ideology. Conceptualising is where there are core concepts that can be used as reference points, and commonalities and connections can be made based on these reference points. There is much import placed on replication of findings, verification, patterns and mathematical expression. The applied fields tend to be about problem solving and "not looking to deepen understanding but to apply this understanding to action".

Where do interdisciplinary projects and subjects find their home? And the answer is, one could postulate, in all three areas, but primarily in the last – often the reason why an interdisciplinary approach is called for is because there is a real-life problem to be solved. And real-life, as we all know, is never clear-cut and tidy, but rather tends to involve a variety of issues.

In order to determine the assessment methods for Science Ethics a meeting was held with all the members of staff involved in teaching the module and a provisional plan, comprising multiple choice question quizzes, a group project, and an end-of-semester examination was tabled.

What was quite remarkable was how divided the staff became and a very helpful discussion followed where, based on the disagreement over the inclusion of multiple choice questions - where some thought them apt, and a very good way of testing basic factual knowledge and others thought them superfluous and unhelpful - the real learning outcomes and key points of the module were illuminated. And, quite apart from the help that it was in terms of planning the assessments for the module, the discussion was fruitful also in that it opened people's eyes to the ways other disciplines emphasise different aspects of knowledge, and the relative weight they give to original thought (as it were). As discussed by Ivanitskaya et al. (2002) one cannot simply use the same methods one employs to

assess single discipline subjects, to then assess interdisciplinary work. To add to that, it is vital that we, as discipline-specific scholars, take time to reflect on what criteria we are in fact using in our assessment, and make sure that we have left behind our discipline-specific biases.

In the end it was decided that an assessed tutorial would be added in place of the fact-testing multiple choice question quizzes. Students would be given set readings and then asked to prepare written answers to questions pertaining to the papers prior to the tutorial. In the tutorial itself they would then swap sheets and respond to one another's answers. The assessment would be based on the merit of their own answers, prepared prior to the tutorial and also on their responses to the answers and arguments of others.

For the end-of-semester degree exam the paper would be divided into three sections: Moral Philosophy, Ethics and Scientific Research and Ethics and Biomedical Advances. Students would then have to answer 2 questions, each from a different section. Questions could either be essay-style or based on a case study. In both types of question however both discipline-specific knowledge and evidence of integration of knowledge would be assessed. Speaking with others who have set up interdisciplinary courses, the question of assessment is one that often rears its head, but one which is also very difficult to address. As with content, the balance is between depth of discipline-specific knowledge versus knowledge of enough areas to put together a balanced discussion or point of view, and it is evident that different courses will adopt different assessment measures depending on the nature of the course, the level at which the course is taught and the cohort of students studying within the programme. By way of illustration there is a Sustainable Development degree programme at the University of St Andrews and, as the course spans 4 years, then the organisers have the luxury, as it were, of allowing rich discipline-specific teaching over the first few years, and then progressing on to emphasising the connections and integration and synthesis of new knowledge as the students move through the system. For those of us teaching relatively discipline-specific students, who only opt in to an interdisciplinary module for one semester, the process is, of course, much accelerated.

The last area of assessment, and one where the potential for true and rich interdisciplinary learning and research can occur, is within the group projects at the end of semester – the

"Science Ethics in Practice" section. The students spend the final 2 weeks of the module working in small mixed-discipline groups tackling a current ethical issue. They then deliver an oral presentation to the rest of the class (and various staff members), outlining the different sides of the debate and justifying their conclusions. Depth of knowledge and sensible, intelligent choice of evidence and literature will be assessed, as well as the key concepts of integration and perspective taking. Small group work has been shown to be an extremely beneficial method for learning and the added benefit of working in mixed discipline groups will ensure that the students are exposed to other disciplines and, further, have to be able to explain and contribute knowledge from their own fields (Eisen and Laderman, 2005; Graber and Pionke, 2006; Oltzinger and Kallgren, 2004).

Throughout the module the tutorials also provide interdisciplinary learning with students working together on set readings, discussions, case studies, developing an oath/code of conduct for scientists, debates and role playing.

Finally, the learning outcomes from the module were designed in such a way as to reflect the particular emphases on connection-making, and the interdisciplinary process, against the backdrop of discipline-specific knowledge.

The Challenge of Practical Arrangements

When working across departments and schools there are a number of very practical arrangements which are simply not as straightforward as when working within your own department.

Normally staff within the same department can walk down the corridor to talk to a colleague, or bump into one another in the coffee room, or at the weekly departmental seminar. None of these chance or everyday ways of talking to one another, and especially talking with a number of the teaching staff involved in the module, can happen with ease when working across faculties. Therefore it is imperative that the organizer of the module has met each person face-to-face and one-on-one before the module is underway (even in the preparatory stages). It is also recommended that when possible, group meetings are

held prior to the start of the module to discuss planning and assessment, and also at the end of the module for a debriefing session to find out how it all went – what worked, what didn't work, what problems were there and what was successful?

As the modules are run with members of staff from different departments funding issues can sometimes arise due to the modules falling through the cracks of the different accounting departments. The more problematic issue is that of teaching cover if a colleague is off sick, or on sabbatical. Often the staff involved in interdisciplinary modules are teaching on them in addition to other teaching commitments and they do not perhaps see their interdisciplinary contributions as their "core" teaching (neither do their Directors of Teaching necessarily) and so it is therefore not as straightforward for cover to be organized for them if they are away. Further, the fact that their interdisciplinary teaching is often on top of their departmental teaching commitments can also lead to additional time and work pressures for these colleagues. It would be helpful if interdisciplinary ventures were supported more proactively and explicitly by universities such that some of these organizational and practical barriers were removed.

A central location is ideal as staff and students will be coming from all over campus. For Science Ethics, the other issue concerning location also related to timing. As many of the core modules that students have to take for their Degree streams occupy slots from between 9:00-1:00 and then 2:00-5:00, the only real options for timing of the module was a lunchtime slot (or the dreaded 5pm slot). A lecture theatre was thus chosen that was both central, but also one where the students could eat their lunch so that they did not have to take the decision of whether to eat or whether to attend class if they also had laboratory practicals in the afternoon.

In terms of timetabling, because the different degree streams have particular core modules that their students are required to take, the flexibility that is supposed to exist within the Pre-Honours years is not perhaps as realistic as it would seem or be hoped. Some of the students enrolled on the interdisciplinary modules have to take these modules on top of a full course load, which is good, in the sense that one would expect therefore that these students are enthusiastic and motivated about the subject, but less than ideal, as no doubt many others are put off taking these modules due to this constraint.

The Benefits of Interdisciplinarity

After a relatively long section on the challenges of interdisciplinarity, the benefits section will appear quite short, but that is not to say that the challenges or difficulties outweigh the benefits – far from it – but rather that the benefits are simply more straightforward than their more negative counterparts.

Benefits of Interdisciplinarity to Students

Much has been written on the benefits of interdisciplinary learning for students (see for example Nissani 1997; Graybill et al. 2006; Manathunga et al., 2006; Eisen and Laderman, 2005). The table below summarises some of the current thought as to the benefits of interdisciplinary programs.

Table 2 Predicted outcomes of interdisciplinary programs (Ivanitskaya et al. 2002)

Author	Outcome
Ackerman (1989)	Flexible thinking Ability to generate analogies and metaphors Understanding of the strengths and limitations of disciplines Ability to assess value to knowledge gained
Ackerman and Perkins (1989)	Enhanced thinking and learning skills Improved higher-order cognitive skills Improved content retention Capacity for proactive and autonomous thinking skills Ability to devise connections between seemingly dissimilar contexts
Field, Lee and Field (1994)	Ability to tolerate ambiguity or paradox Sensitivity to ethical dimensions of issues Enlarged perspectives and horizons Ability to synthesize or integrate Enhanced creativity, original insights or unconventional thinking Enhanced critical thinking Capacity to perceive a balance between subjective and objective thinking Humility, sensitivity to bias, and empowerment Ability to demythologize experts

From a pilot study carried out at the University of St Andrews amongst Second year students (Paxton and Shearer, unpublished results) there is currently a clear lack of critical thinking skills amongst some students, and therefore any module that seeks to encourage and develop these skills is worthwhile and should be of long-term benefit to students as they progress in their discipline-specific programs.

There is also the hope that the benefit of developing academic relationships across disciplines is not simply one that lasts for the duration of the module. Rather, as the students progress through the university they can continue to learn from one another and exchange in meaningful, intelligent dialogue and debate (as modelled, one would hope, by the interactions they see between staff members on the module) – strengthening the academic community of the university.

As this goes to press, a study is underway to investigate the student experience within this interdisciplinary module (which for many of the students is the first module they have had of this type). Initial impressions, through informal feedback from conversations after class, and via email, suggest that the experience is a positive one: “I really enjoy the lectures and tutorials…the content has been very interesting and well presented…broadens every scientific mind.” That sentiment has been echoed by others. For example, one of the students has recently started a ‘Facebook’ (virtual community) group where members of the class, and any other interested parties, can discuss and debate issues relating to science ethics. Also there have been some students attending lectures who are not in fact enrolled in the module, but have simply wanted to come along and hear the lectures. This enthusiasm has been felt by those teaching on the module. Several members of staff have said how much they have enjoyed being involved in the module and how encouraging they have found it. Interestingly it has been noted that compared to discipline -specific classes this multidisciplinary group of students seem much more enthusiastic and analytical in small group discussions, and are always keen to debate back and forth whilst also listening and asking questions of one another.

The Benefits of Interdisciplinarity to Staff

Again, much has been written on this topic (Lattuca, 2001b; Frost and Jean, 2003; Lindman and Tahamont, 2006; Shibley 2006) with clear benefits in terms of the impact on one's teaching, thinking and research. And from a personal viewpoint from being involved in this module and meeting numerous colleagues from all over the university I can testify to the academic enrichment and encouragement that it has indeed provided. Further, good friendships have already developed, collaborative research projects have been planned, and a Bioethics reading group, comprising of members of the teaching staff from the module and other interested parties is in the process of being launched.
Manathunga, Lant and Mellick (2006) elaborating on the sociocultural dimensions of interdisciplinary learning outlined by Lattuca (2002), describe the principles that ought to be adhered to, in order to develop interdisciplinary learning and research. They underscore the importance of:

1. Creating spaces for interdisciplinary dialogue
2. Engaging in interdisciplinary interaction with others and with the texts and tools of a number of disciplines
3. Synthesising disciplinary knowledge's in order to produce original, creative ideas and futures
4. Creating personal, interpersonal and communal intellectual contexts conducive to interdisciplinary exchange"

In many ways these principles bring us full circle back to the key themes of interdisciplinarity outlined in the introduction – dialogue, interaction, synthesis and exchange.

By being involved in teaching or studying on an interdisciplinary module one engages in at least principles 1, 2 and 4 and the hope is that 3, the production of "original, creative ideas and futures" will grow from that.

Conclusion

That individual disciplines ought to exist, and that specialization ought to occur is not, I believe, either under question or under threat by interdisciplinarity. We would none of us want the "naïve generalism" spoken of by Nissani (1997, p212) but what we do want is rigorous, creative, intelligent and informed dialogue and the construction of appropriate bridges between the "great divide". Implementing interdisciplinarity is not easy, but is it worthwhile, and as more and more courses and programmes develop, institutions may then become more flexible in their organization and more attune to the pressures and expectations of their academics and students, and allow interdisciplinarity to flourish, for the benefit of all.

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