OFFERING INTERDISCIPLINARY COURSES: THE WHY, THE HOW AND THE WHAT

Alidad Amirfazli¹, Murray Gingras², Linda Nostbakken³, Wayne Renke⁴

¹ Department of Mechanical Engineering, York University, Toronto, ON, M3J 1P3, Canada

² Earth and Atmospheric Science, University of Alberta, Edmonton, Alberta, T6G 2E3, Canada

³ Norwegian School of Economics, Department of Economics, Helleveien 30, 5045 Bergen, Norway

⁴ Faculty of Law, University of Alberta, Edmonton, Alberta, T6G 2H5, Canada

Corresponding Author e-mail: alidad2@yorku.ca

Abstract

Students in their future workplace will likely face multi-faceted challenges; as such, solutions require integration and collaboration across disciplines. An interdisciplinary instruction benefits students' learning by exposing them to fundamental topics and perspectives that they would not have been able to obtain easily within their programs. Peer learning and interactions by students from different backgrounds provides further learning opportunities. The paper is a reflection of the experience of the four instructors involved in teaching an interdisciplinary course in the area of energy who were from four distinct Faculties over the period of 2010-2012. Planning well in advance is important to allow instructors from different backgrounds with varied traditions in teaching to develop a working rapport. Throughout the planning stages dedicated administrative support must be provided to facilitate attending to logistics of setting up the course within the university system. The right incentive for the instructors should be provided due to higher than normal time commitment. What was learnt that there is a need to provide both foundation material and more advanced perspectives simultaneously given the diverse background of students and topics in an interdisciplinary course. Also, it was found that instructors benefitted from teaching such a course by learning from traditions and methods in another discipline, and went on to improve other courses in their discipline both in content and teaching style. It was also found that lack of integration with "regular" programs, or "official" endorsing can dissuade some students from participating. Other lessons include issues around instructor team's chemistry, course content design, e.g. the need for group projects to internalize the material, and the use of technology.

Keywords: interdisciplinary course; multi-instructor; interdisciplinary instruction

INTRODUCTION

University programs are mainly designed to educate students in a particular discipline with its own specific perspective and analytical views of a topic or area. Such an approach in principle is needed to train specialists who

have a concentrated knowledge of the area. This by and large is a sound approach for members of the future workforce who need to have fundamental knowledge of a discipline and its traditional perspectives, and who need to be able to apply its basic tools. In the past twenty years however, the trends in flattening of corporate structures, a move away from silos in institutions, and a technologically driven society, have meant that new graduates will have to operate in multi-disciplinary environments and face multi-faceted challenges, which require solutions or integration and collaboration across disciplines. The response of university programs has been mainly to encourage students to take courses from other disciplines, e.g. an expanded list of courses that engineering students can take from humanities, or to have students complete their fourth year capstone project with teammates from other disciplines [1]. Another approach has been to design dual degree programs, e.g. a Mechanical Engineering and Management program, see [2] (such programs usually require an additional year of studies). In the next sections we propose and discuss implementation of an additional approach to prepare students for their future careers in an increasingly multi-disciplinary world. We will also present a reflective discussion on lessons learned from implementation of our proposed approach.

INTERDISCIPLINARY EDUCATION AND INSTRUCTION

Why

To prepare students for working and living in an environment/society that requires understanding and functioning across and within multiple disciplines, we propose an additional tool. This tool is an "interdisciplinary course" which tackles a particular topic (for example, energy production and use) from coordinated and integrated perspectives of multiple disciplines, and which requires students to incorporate perspectives from multiple disciplines in course work.

The course should contain an integrated multi-perspective set of materials covering relevant foundation issues from each of the instructors' disciplines, as well as their interdependence or/and links. The course material

should be developed in a form that would mesh knowledge/perspectives from each of the disciplines - , i.e. the material should not simply stack together content that could be acquired from attending individual courses dealing with various aspects of the topic (e.g. taking three courses that would cover technology issues related to energy, energy economics, and environmental issues of energy). The course should also be wide open to attendance by students from different programs to allow peer learning and interactions which provide further valuable learning and teamwork opportunities to familiarize students with the ways of thinking and presenting materials from different disciplines (see Appendix A). This will emulate the likely work environment students will experience after graduation.

Development and delivery of such course should be led by a team of instructors from multiple disciplines (e.g. all or a combination of more than two disciplines such as science, law, economics, health, sociology, engineering, etc.). When instructors from different disciplines come together to offer such a course their usual approaches – taken when teaching even the same topics in isolation – should be modified through the interactions needed for development of the course (see below).

An interdisciplinary course as described above can even fulfill the social responsibility of universities in educating the next generation of citizens, for whom exposure to multidisciplinary perspectives is important.

Such an educational tool is useful for engineering students in particular, and students in other programs in general, who focus on a relatively regimented set of discipline specific courses. The heavy course load of an engineering program usually leaves little appetite for students to explore other areas; but, such a course when designed properly can be fitted into the complementary studies requirements by accreditation bodies such as Canadian Engineering Accreditation Board [3].

Context

For the purpose of piloting such an idea, a course in the area of energy seemed ideal, as energy and environment subjects are seldom single-discipline issues. The topic has many facets; and solutions require integration and collaboration across disciplines. Also, if students are going to do any work in the area – whether they are engineers, geologists, economists, lawyers; whether they are working with (or in) NGO's, government, or industry – multidisciplinary will be their reality.

The objectives of the course were then defined as follows. To provide an overview for: fundamentals of conventional (e.g. coal/oil), nonconventional (e.g. oil sands/shale gas), and renewable energy (e.g. wind, solar, hydro, nuclear) sources and technologies in a broad sense; regulatory responses and responsibilities,

ownership of resources, as well as international obligations; elementary economics related to the consumption patterns, prices, production costs, externalities, and relationship to carbon costs and intensities; cultural and social drivers were discussed in each case when appropriate.

The rest of this paper provides the how to and the lessons learned from implementation of the idea of an interdisciplinary course as described above. This is based on the reflection and the experience of the four instructors from four distinct Faculties of Law, Science, Business and Engineering involved in conceiving, designing and delivery of the course called “IntD 361 - Fundamentals of Energy, Environment, and Sustainability” (an undergraduate level course aimed at students who had received at least 50 credits from their respective programs) over the period of 2010-2012, at the University of Alberta. The students taking the course during the three years it was offered ranged from those registered in disciplines from native studies to engineering (who formed the largest group. The enrollment was between 20 and 35 depending on the year.

HOW TO MOUNT AND DELIVER AN INTERDISCIPLINARY COURSE

The Team

One of the early questions that needs to be addressed is the instruction team. It is very likely that in the formative stages/years of mounting a course as proposed in this paper, the home departments/Faculties of instructors would not appreciate or recognize delivery of such a course as a part of the usual teaching load of the instructors. Moreover, an interdisciplinary course as proposed will not be in perfect alignment with instructors' research or usual teaching expertise or routine. All this means that a significant investment of time is needed. The matter is further complicated by the fact that instructors from different disciplines are likely steeped in the tradition of their fields regarding teaching and pedagogy, evaluation, delivery and communication style, etc. Taken all together then there are a number of characteristics that are highly desirable when considering instruction team members. Such characteristics are obviously in addition to the technical qualifications of the individual instructors in each of the fields that make up the topic of the course.

The team members should be open to listen to ideas of others, be prepared to compromise when necessary, and have a sense of communal flexibility. This means that the team members should have a sense of adventure, and desire to experiment and learn about new points of view outside of their usual comfort zone or belief system. Such characteristics will be the key to development and delivery of an integrated course contents. The team

members should be willing to share responsibilities, and to be cooperative. This allows balancing or smoothing of the additional workload such a course would likely have initially, and accommodate any unexpected or other commitments that would arise in the course of a usual academic business.

The team members need to be adaptive. This means that the team members should be able to acknowledge predominate student learning styles (e.g. Active, Intuitive, Sensing, and Reflective) [4] that may be different from students outside of their field's cohort, and adapt to their learning needs by adjusting their usual teaching practices. The adaptiveness also means that the instructors should be ready to evolve the course as it develops for the first delivery and the subsequent versions; the context of collective adaptiveness and flexibility in a multi-instructor environment is important here.

The instructors should be all at the "right stage", i.e. sufficiently "senior" so that they can engage in a somewhat out of the box activity without gravely jeopardizing their academic careers; but not so entrenched that they could not devote the necessary energy or have the mindset to try something new. Finally, all instructors should be confident that they will have and retain motivation and creativity throughout the process.

Preparations and Resources

Immediately after or during the final stages of assembling a team of instructors, there are a number of preparatory steps and resources that need to be considered.

First, a number of organizational meetings must be scheduled, perhaps as many as 10 meetings over a period of six months. The goals of these meetings are:

(1) Allowing the instructors to get to know one another and feel comfortable with communication styles, pedagogical thoughts, different traditions of various fields in teaching, and student learning needs in different disciplines. This goal is particularly important and should be kept in mind and monitored as it relates to fine tuning the dynamics of the instruction team, integration of course material and learning objectives, identification of any team issues, and consolidation of the commitment of the members.

(2) Identifying the goals of the course, keeping in mind the level of the course, number of credit units, and diverse background of the audience.

(3) Deciding on the details of course material and distribution of course content development workload. Course content development is an important step as very likely a textbook will not be available.

(4) Developing course evaluation strategy and tools to be used.

(5) Identifying resources needed, and dealing with logistical issues (e.g. projects with community involvement, invitation of guest lectures, e-learning

platform setup, etc.).

(6) Developing the course proposal document for approval by University. Here attention to pre-requisites is important due to the fact that students from various programs should be able to take the course and receive credit for it.

(7) Devising a strategy for creating awareness of the course amongst diverse student populations, and informing/engaging undergraduate program coordinators/advisors, if possible.

The period of six to nine months preparation also provides a window where ideally the instructors can share course contents developed to ensure proper meshing of topics and learning opportunities that meet the goal of providing a multi-perspective view on a topic (e.g. see Appendix A).

Second, in terms of resources and support two aspects are important.

(i) An administrative support person needs to be put in place. This is important for multiple reasons. For example, it is very likely that such a course will not reside in a single Faculty or Department, i.e. it would not have a natural "home". As such the usual support of a home unit to offer the course may not be there; or in the initial stages of such initiative, many process may be out of the norm of a particular unit and may require dedicated attention (there is no need for a full time administrator, but a dedicated administration support person must to be identified). The host of tasks that the instructor team should be free from, but are needed before students can actually register in the course includes: administrative aspects of course proposal, e.g. documentation, steering through the course approval process, and inclusion in the course calendar; advertising for the course; logistics of classroom booking, examination scheduling, and e-learning systems setup; securing teaching assistantships, if needed; and checking for prerequisite conditions. Administrative support is also needed for record keeping and scheduling meetings, speakers scheduling, course material preparations, and research into various program requirements and prerequisites. This support was identified as a key success factor during the six months organizational period, and the following period needed for course approval process.

(ii) A budget should be defined and provided (e.g. from internal University funds, through grants programs, cost sharing between various Faculties, an interested institute, etc.). These funds should be set aside to "buy" internally or hire part time administrative support. There should be also a mechanism to recognize the efforts of the faculty members involved in such an initiative. A natural path would be to offer course relief during the course development period (course buy out); however, in case that this is not possible because of administrative issues or demands for teaching in the "home" programs of the

instructors involved, the course buy-out funds should be used as a monetary tool and provided directly to the course instructors. Another idea would be to provide funds for individual instructors to be put in trust for their scholarly activities.

WHAT WAS LEARNED

In this section reflections on what worked, what needed rethinking, and what impact was observed are discussed.

In terms of course content development, we can report the following lessons:

(1) There is a need to provide both foundational material and more advanced perspectives simultaneously given the diverse background of students and topics in an interdisciplinary course.

(2) A close information exchange on course content of each instructor should be done routinely (during course delivery, and between iterations of the same course). This is especially important as instructors normally tend to adjust course contents on an ongoing basis; more so for novel course concepts such as the one described here. Although the team was fully aware of the material presented by other instructors, a further detailed exchange will be necessary for enhanced integration.

In terms of student learning, we can report the following lessons:

(1) Anecdotally we found that students thought the course to be different from other courses they have taken as it seemed more dynamic and fun which provided a window to “other” issues and perspectives not otherwise available to them.

(2) Inclusion of a team course project (see Appendix A) was observed to enhance student learning substantially, as not only the students dealt with a topic from an interdisciplinary perspective, but also worked in an emulated interdisciplinary environment given that team members needed to be from different disciplines.

(3) Student learning and awareness of interdisciplinary perspectives were enhanced by requiring students to blog on questions or lecture topics. As such, integration of an e-learning tool was found to be useful in course design.

(4) Since it is very likely that a textbook does not exist for this sort of course, development of a course pack will have a positive impact on student learning.

(5) It was also found that lack of integration with “regular” programs, or lack of “official” endorsement can hamper student learning opportunities by dissuading some students from participating. Such lack of integration into “regular” program at an institutional level can also affect longevity of offering interdisciplinary courses in general, limiting student learning opportunities.

(6) It was important to not only provide information, but to create space for the students to think about the

implications of the different disciplinary perspectives. This was done by encouraging participation in class, having group projects, student presentations, online reflection through blogs, inviting 3-4 speakers from NGOs, regulatory bodies, politicians, industry practitioners, campus groups, etc., and advertising relevant campus events in the class.

In terms of course logistics, we can report the following lessons:

(1) A dedicated and purposefully tasked administrative support staff was found to be a key factor in success of mounting and developing such a course. The ongoing (however much less onerous) support during the delivery phase of the course was also found to be useful.

(2) A long enough (e.g. 6-9 months) preparation period is a must for proper course development and building the right team dynamics. The period does not take into account the time needed to identify suitable instructors across various units in the university. Also, added to this period should be the time needed for the approval process of a new course and registering in the course calendar of the university.

(3) A champion(s) is needed to not only initiate the idea and the search stated in (2) above, but also to secure the needed funding resources. It may be unreasonable to expect instructors to also act as fund raisers for such a project.

(4) For offering a roster of interdisciplinary courses, a “neutral” or “willing” home Faculty or Department should be identified. The preference will be with a “neutral” home as it will remove any suggestions of a particular disciplinary bias in the mind of students, thus promoting student uptake.

(5) A coordinated effort is needed to make sure that students from direct disciplines are (i) aware of such a course offering; (ii) they can receive credit for taking such a course.

In terms of instructors’ experience, we can report the following lessons:

(1) The delivery of such a course broadened the perspective of each of the instructors in various techniques and pedagogy that is exercised across a university with diverse program offerings.

(2) Instructors involved reported that participation in delivery of this course has had two major impacts on their teaching skills/activities. Firstly, it has allowed them to use or “import” new techniques as a result of working with instructors from other fields. Secondly, it has led to development of new courses for their home department, or provided new perspectives/materials into other courses they have been teaching.

(3) Faculty members in general would perceive such a course as an unattractive teaching assignment/activity. However, in the experience of all instructors involved the opposite was found, i.e. this has been a very rewarding

experience on the professional development, as well as student learning levels; one of the team members noted that the cooperative nature of the team and their flexibility made delivery of such a course very rewarding, and the comradery made it “fun”.

If the idea of an interdisciplinary course is appealing, how might such a course be implemented in any institution? An interdisciplinary course rests on four pillars. First, resources - instruction and administration come at a cost. Second, the team - if the members do not know one another or cannot be identified through a course organizer's networks, they must be "recruited". This would probably require the involvement of a senior colleague, such as a Dean, to do the "call for volunteers" - the call must be heard through the noise of other messages. Third, staff support - the myriad administrative details of offering and delivering a course must be attended to. Finally, and most importantly, the course needs a "champion" - someone who takes responsibility for starting the processes and kick-starting them when they stall. If these four pillars are in place, the course can likely be developed in any institution.

Impact

Some of the external or additional impact that developing and offering such a course provided can be summarized as: (1) a demonstration of cross-Faculty collaboration on teaching; (2) seeds for writing a textbook in the future that may not only be useful for such interdisciplinary style courses, but also as a resource for students in “regular” programs to learn about basics of other perspective on a particular topic in an accessible way as suggested by one of the instructors. (3) Offering of such a course also brought in some positive publicity for the University through an article in a local newspaper.

CONCLUSIONS

The experience showed that organizing, developing, and delivery of an interdisciplinary course requires considerable amount of preparations, dedication and time commitment from instructors. It however provides an exceptional learning opportunity for students. Somewhat surprisingly the instructors also benefited in unexpected ways such as developing or enhancing other courses for their home department. It was also clear that administrative support early on together with providing the right incentive to attract instructors with appropriate attitude, skill, and at the right career stage are key issues.

Acknowledgements

Canada School of Energy and Environment at the Univ. of Alberta is acknowledged for its financial support; Dean Joseph Doucet is acknowledge for his support and encouragement of this initiative in its formative stages.

References

- [1] ENG4000 Engineering Project course at York University (www.yorku.ca/eng4000/index1.html) Accessed 4/14/2014. Students e.g. from Space Eng. team up with ones from Computer Science ones, etc. to complete a capstone project.
- [2] Mechanical Engineering and Management program offered by McMaster University (<http://registrar-old.mcmaster.ca/CALENDAR/current/pg1227.html>) Accessed April 15, 2014.
- [3] “Canadian Engineering Accreditation Board: Accreditation Criteria and Procedures”, Engineers Canada, 2013.
- [4] R.M. Felder and L.K. Silverman, “Learning and Teaching Styles in Engineering Education”, *Engr. Education*, 78, 674-681, 1988.

Appendix - A

Excerpts from the instructions given to students regarding the course project is provided here to demonstrate how multidisciplinary peer learning opportunity was combined with encouraging students to take a multidisciplinary and multi-faceted examination of a topic.

- *Group Formation* - Students are required to form three-member groups (each group should have members from at least two different disciplines).
- *Project Proposal* - Each group must propose a project (also an alternate).
- The project topic should be relevant to the scope of the course and follow the structure as per the Decision Tree below.