

Interdisciplinary Team Teaching: An Effective Method to Transform Student Attitudes

Amanda Little¹ and Anne Hoel
Wisconsin-Stout, Menomonie, Wisconsin 54751

Abstract

In order to maximize student development in an interdisciplinary context, we implemented and evaluated a business-biology team teaching approach. The class project involved teams of environmental science and business students analyzing an industry stakeholder interested in participating in the development of a community composting network. We compared the results of this team-taught section with a more traditionally-taught business section with a sustainability emphasis, with the objectives of identifying student learning gains and reflecting, as faculty, upon the experience. In the affective domain, there was initial discomfort with the interdisciplinary team teaching method on the part of both faculty and students. In the cognitive domain, both team-taught and traditional sections perceived significant gains in understanding both business and natural systems, although the treatment group alone made significant ($P < 0.10$) gains in linking interdisciplinary thinking and an understanding of both business and natural systems to future success. These findings suggest that the affective and cognitive transformations experienced in team-taught settings are important for teaching expanded worldviews and diverse perspectives.

Keywords: Team teaching, active learning, interdisciplinary studies.

We investigated how team teaching strategies helped produce learning outcomes in the context of sustainability education. As teachers, we believed that we needed to move beyond our specific disciplines to engage students in an interdisciplinary learning process. Team teaching as a means of facilitating learning can have a highly positive impact on student learning outcomes, largely due to the increased opportunity for student participation that team teaching provides. The presence of more than one instructor in the classroom increases the occasions for student-teacher interaction (Wadkins, Miller, & Wozniak, 2006). We engaged diverse student groups from business management and science and placed them into an interdisciplinary learning environment in order to increase their appreciation of diverse viewpoints and solve a real community problem – developing a community composting food waste network. As the course progressed, the goal of students developing as thoughtful, open-minded individuals, emerged as a priority.

The instructors desired to test their theory that if sustainability education involves the coordination of business and science domains, studying how the two disciplines interrelate

¹ Corresponding author's email: littlea@uwstout.edu

within a college classroom would advance the knowledge base of how different teaching strategies can effect student development.

Our experience started with an identified need, and institutional support for making students' learning a hands-on experience. In our case, the growth of sustainability efforts both on campus and within the broader community encouraged a joint teaching effort between business and biology faculty. Choosing the subject to focus our course on came naturally, as both instructors were involved in environmental sustainability projects, and other universities have had success team teaching about sustainability (Hoare et al., 2008). Bringing together senior students in the Problem Solving in Environmental Studies (BIO 444) and Strategic Management and Business Policies (BUMGT 490) courses for a joint capstone experience was a logical fit. Science students are not familiar with the language of business, nor are business students familiar with the language of science. Working jointly on a community project incorporating both disciplines allows continuity of study and immediate opportunities to address issues encountered during a semester-long analysis. Structuring interdisciplinary courses around problems is a successful team-teaching approach (Silver & McGowan, 1996). The nature of "interdisciplinary" suggests doing something that can't be done individually and is not initiated by a single subject. Davis (1997) states that, "the ideal interdisciplinary course begins with a great idea that can come from anywhere. Once the course is established that idea grows and the course takes on a life of its own."

The primary objectives of this paper are to: 1) disseminate and reflect upon the course structure and development, 2) assess the efficacy of the pedagogy through qualitative and quantitative student outcomes, and 3) discuss peer and student interactions for those considering interdisciplinary team-teaching in the future.

Methods

The class project involved teams of environmental science and business students analyzing an industry stakeholder interested in participating in the development of a community composting network. Our interdisciplinary experience utilized problem-based learning to integrate theory, knowledge, and practice from business, social and natural sciences to explore current environmental issues and strategic challenges of varying types of organizations. Coordinating the planning, implementation and evaluation aspects of delivering a team teaching experience required ongoing fine-tuning of initial ideas and a broad belief in flexible delivery methods. The degrees of exploring new learning possibilities grew as the class progressed.

In order to better evaluate the contribution of team-teaching to student outcomes, we compared a team-taught section to a non-team-taught "control" section. In both sections, we expected that students would be challenged to develop an understanding of business systems and natural systems. The team-taught section focused on sharing relevant and applicable knowledge to help organizations contribute to the triple bottom line of strong profitability, healthy communities, and a healthy environment within the context of a business composting network.

General Course Structure and Development

The “treatment,” team-taught section consisted of 24 BUMGT 490 students and 1 BIO 444 student co-taught by a Business and a Biology Department faculty member. The “control” section consisted of 27 BUMGT 490 students taught by a single Business Department faculty member. BIO 444 was an initial offering to a relatively young but growing Environmental Studies cohort. Each course was composed of approximately 50% males and females. We did not investigate the role of gender in this study.

Each section had a semester-long project-based group learning experience, in which they applied knowledge of business strategies and environmental problem-solving to a real-world business problem. Much of the course curriculum was compiled from various business sources, but the course text was *Environmental Problem Solving: A How-To Guide* by Hughes (2007). Although it emphasized environmental applications, much of the framework presented by the text overlapped substantially with the business curriculum. Throughout the semester, students worked in groups to learn the components of a strategic business analysis. They then applied these concepts to their own business stakeholder and assembled the findings into a final synthesized report at the end of the semester. The environmental component was emphasized in both treatment and control sections by interaction with the text, and related business news articles and speakers. The treatment section was given an overarching problem, “How can Business X participate in a community composting network,” and a restricted selection of appropriate businesses. The control section was given more flexibility in that their business selection and problem definition was open-ended and not necessarily sustainability-focused. The control section did participate in a sustainability-related side project during the semester, however.

In both sections, the student voice was heard by beginning each session with a student-led current events discussion. As a senior capstone course, we encouraged students to choose topics that related to our subject matter, with at least one topic specifically dealing with sustainability. A variety of perspectives arose from the discussions, naturally modeling the collaborative classroom climate we were aiming for. As instructors we also shared reactions to the topic discussed while validating diverse viewpoints of classmates.

Since students in the treatment section had never participated in a team teaching experience, it was important that the value of doing so was stated clearly. As instructors, we chose to stress the advantages of looking at the world in a more holistic fashion. The job market demands multiple skills, and differentiating themselves from other business and environmental science students by possessing experience in both subject areas would be an asset to potential employers. Having access to two faculty members every class period to answer questions as they arose during a hands-on sustainability project was an advantage that we stressed. Realizing that our students may have been expecting a more traditional classroom experience than we were offering was also a consideration. In some cases, faculty must work hard to overcome students’ resistance; a good first step is to be clear about the format of the course right from the start (Helms, Alvis, & Willis, 2005).

Assessing Student Learning: Data Collection and Analysis

Assessment consisted of a set of quantitative pre- and post-surveys administered at the beginning and end of the semester in combination with three open-ended questions in the post-survey. Quantitative questions addressed student perceptions of their own values (Table 1). Qualitative questions addressed specific learning gains and student impressions of the learning environment. All survey forms are available in Appendix A. In order to reflect upon our own experiences as faculty members in a team-taught, interdisciplinary setting, we also kept journals throughout the experience.

Results

General course experience

Within the team-taught section, students were initially surprised by slightly different course content than they expected and the additional biology faculty member in the classroom. Many students had the business professor in previous business courses, but the environmental science curriculum was just ramping up. It took some time for them to realize that the team-taught experience was not going to “ruin their GPA” or create excessive amounts of extra work for them.

The classroom cultures of the control and treatment sections were vastly different. The treatment group, influenced by three vocal classmates, exhibited a pessimistic, “glass half empty” attitude for much of the semester. It was more antagonistic toward environmental sustainability principles and the open-ended, independent and project-based structure of the course. The students’ paradigm was that sustainable practices would be automatically costly, and not profitable to a business. These attitudes presented an obstacle to initially learning the sustainability and composting content.

As instructors, we modeled positive classroom behavior, and stressed the benefits of the team taught sustainability project. We also shared our belief, as well as that of potential employers, in the value of problem-solving and compromising with those holding diverse opinions. In order to encourage students to at least consider alternate paradigms, we discussed a series of current news articles that integrated sustainability and profitability, had students share sustainability-related current events, and invited a series of guest speakers that reinforced the profitability of sustainable activities. Students also contributed to the subtle paradigm shift in the classroom by sharing their research and reflecting upon their employment experiences during classroom discussions. We encouraged students to be respectful in their dialogues and to question their own beliefs.

Quantitative Survey

The quantitative survey responses of the treatment section changed significantly over the course of the semester, while the control group did not. In order to compare the general, multivariate survey of each group, we conducted comparisons based upon the eight survey responses using multi-response permutation procedure (MRPP) in the package PC-

Table 1. Quantitative results of pre- and post-surveys are means and (standard errors). A 95% confidence interval estimate is included with the change in score. Students in the control and treatment (interdisciplinary) sections gave responses on a scale of 5 = strongly agree to 1 = strongly disagree. Statistical differences in pre- and post-responses were assessed using the unpaired, two-sided T-test. Means with differing letter superscripts were significantly different ($P < 0.05$) using Tukey's HSD.

Question	Control section				Treatment section			
	Pre-	Post-	Change	P-value	Pre-	Post-	Change	P-value
<i>Positively-phrased</i>								
1. Interdisciplinary thinking is necessary to success in my field.	3.91 (0.16)	3.85 (0.13)	-0.06 ± 0.41	0.778	3.72 (0.17)	4.13 (0.13)	0.41 ± 0.43	0.061
2. Environmental sustainability issues are important in the business world.	4.50 ^a (0.17)	4.26 ^{ab} (0.15)	-0.24 ± 0.45	0.289	3.76 ^b (0.24)	4.08 ^{ab} (0.15)	0.32 ± 0.57	0.261
3. I have an understanding of both business systems and natural systems.	3.32 (0.15)	3.74 (0.14)	0.42 ± 0.41	0.045	3.40 (0.12)	3.75 (0.12)	0.35 ± 0.34	0.044
4. I feel that I can communicate effectively with professionals outside of my field.	3.82 (0.16)	4.07 (0.18)	0.26 ± 0.49	0.294	3.96 (0.18)	3.88 (0.18)	-0.09 ± 0.51	0.741
5. If I had a choice, I would request a course taught by instructors from different disciplines.	3.68 ^a (0.17)	3.59 ^a (0.16)	-0.09 ± 0.47	0.705	2.96 ^b (0.18)	3.17 ^b (0.21)	0.21 ± 0.55	0.450
<i>Negatively-phrased</i>								
6. A knowledge of multiple disciplines is not important for my future.	1.86 (0.18)	2.11 (0.19)	0.25 ± 0.53	0.351	2.04 (0.23)	1.79 (0.15)	-0.25 ± 0.55	0.368
7. It is not necessary for me to understand both business and natural systems.	2.27 (0.22)	2.33 (0.22)	0.06 ± 0.63	0.848	2.54 (0.25)	2.00 (0.19)	-0.54 ± 0.64	0.095
8. Communicating effectively with professionals outside my field is not important.	1.73 (0.24)	2.04 (0.24)	0.31 ± 0.68	0.365	1.96 (0.25)	1.75 (0.23)	-0.21 ± 0.68	0.537

Ord 5 (McCune and Mefford). The test indicated no significant multivariate difference between the pre- and post-survey responses of the control group (test statistic = -0.055, $A = 0.0004$, $P = 0.380$), but slightly significant differences between the pre- and post-surveys within the treatment group (test statistic = -1.419, $A = 0.0090$, $P = 0.091$). There was no significant difference between the initial surveys of the control and treatment groups (test statistic = -1.061, $A = 0.0074$, $P = 0.134$).

Despite a lack of overall difference, the treatment section initially exhibited a significant lack of appreciation for environmental sustainability issues, and a reluctance to participate in a course taught by interdisciplinary instructors in comparison to the control group (indicated by significantly more negative initial opinions on question 2 (Tukey's HSD, $P = 0.028$) and question 5 (Tukey's HSD, $P = 0.032$, Table 1). By the end of the semester,

the treatment section had made gains on question 2 so that it was no longer significantly different from the control, although students continued to express overall discomfort with the interdisciplinary pedagogical setting, with continued significantly lower scores on question 5 (Table 1).

Both student groups perceived significant gains in understanding both business and natural systems (Question 3, Table 1). The treatment group alone made significant ($P < 0.10$) gains in linking interdisciplinary thinking and an understanding of both business and natural systems to future success (Questions 1 and 7, Table 1). ANOVA of the data, analyzed by survey time and treatment, revealed few significant relationships, although trends are consistent with the T-test analyses presented here.

Qualitative Survey

Student qualitative responses to the open-ended post-questionnaire revealed that students within the treatment group were more aware of environmental perspectives over the course of the semester. Both control and treatment sections were asked to “List activities in this course that expanded your perspective or changed your thinking.” A majority of students within the control section listed traditional course activities, with only four out of seventeen describing sustainability or “expanded thinking” in their responses. Within the treatment section, twelve out of 22 comments related to integrated course outcomes, with ten sustainability-related comments, and seven interdisciplinary perspective comments.

When asked to, “Explain how environmental sustainability concepts apply to your future career,” students in both control (14 of 15) and treatment (22 of 23) sections expressed an ability to see the relevance of sustainability concepts.

Finally, we asked students to “List the benefits or detriments that [they] experienced in this collaborative learning environment.” More students in the treatment section (22 to 23 out of 24) responded to open-ended questions, compared to the control section (15 to 17 out of 27). A larger number of students within the treatment group perceived benefit from sustainability-related gains than did the control group (Table 2). Due to the collaborative course structure, students in both sections perceived benefit from working with group members who had different perspectives. Individuals in the treatment section experienced both benefit and detriment from the multiple-instructor setting, although only a small number of students focused on this aspect of the course. Students within the treatment group were more vocal about detriments than those in the control group (who expressed none, Table 2). Despite completing the same set of business exercises as the control group, two students within the treatment group felt deprived of business experiences.

Table 2. Categorization of student comments in response to the question, “List the benefits or detriments that [they] experienced in this collaborative learning environment”.

	Control (n = 15)	Treatment (n = 23)
<i>Benefit</i>		
• Sustainability information	2	7
• Variety of perspectives	5	6
• Working in a group with others	5	2
• Different teaching styles	-	2
• Activities/Field trips	3	-
<i>Detriment</i>		
• Lack of business exercises	-	2
• Two different teachers	-	1
• General lack of support	-	2

Discussion

Expanding Student Perspectives

The results suggested that, although students are able to learn sustainability-related concepts within a non-team-taught course, the presence of the interdisciplinary faculty member reinforces the importance of alternative viewpoints and perspectives to a much greater degree. Other researchers have found that team teaching results in significant gains in student attitude and modes of thinking, (Carpenter, Crawford, & Walden, 2007). Yellowley and Farmer (2006) also found that team teaching resulted in improved student process in problem-solving. However, several researchers found no gains in student learning or attitude in their study of team teaching (Dugan & Letterman, 2008; Wadkins, Miller, & Wozniak, 2006). Our findings suggest that team teaching is worthwhile in courses in which worldview and attitudinal change are primary goals.

Faculty Lessons Learned – Essential Elements of Effective Collaborative Teaching

Faculty choosing to participate in a team teaching experience need to carefully consider their expectations. Selecting an appropriate team teaching partner is very important. The process involves each person asking themselves if they can remain open-minded, share control, and not become easily offended. Robinson and Schaible (1995) recommend that collaborative team teaching be limited to two people, as good team teaching is too complex with more than two teachers. They insist that a “healthy psyche” is needed to achieve desired outcomes, as is “disagreeing amicably.” Within our individual disciplines, we were challenged to think in new ways to explore the topics, moving outside our comfort zones (Silver & McGowan, 1996). A natural roadblock within this process included faculty trained in their own discipline, as this training leads itself to conflicting viewpoints (Silver & McGowan, 1996; Shibley, 2006). Jointly navigating beyond such roadblocks is where ideas for reaching our students most effectively occurred. Being able to dialogue professional views in the presence of students as questions arose strengthened our knowledge and modeled the realities of the workplace for students. Team teaching also requires different preparation than traditional, single-instructor courses, particularly concerning organizational aspects of course management. Careful and extensive planning

can help instructors prevent disagreements down the line regarding assignments, grading procedures and teaching strategies (Letterman & Dugan, 2004; Wentworth & Davis, 2002).

Specific suggestions for planning an effective interdisciplinary experience:

- Notify students in advance of the course so that they may “opt-out” of the interdisciplinary section.
- Make sure that interdisciplinary integration is one of the core goals of the course, and that students understand this. Stress that the experience involves expanding knowledge in an interactive environment. Initial uncertainty of how information from two disciplines will come together to form a cohesive project is natural and part of the learning process.
- • Provide numerous project possibilities to assist in selecting a workable issue that encourages student success. For example, in the treatment group, we chose to emphasize a common community problem and suggested business participants. In the control group, students chose their own problem-focus and therefore took more ownership of the project.
- Achieve a good balance of students from different disciplines within the course so that they can inform each other.
- Guiding students outside of their comfort zones in researching unfamiliar topics is part of the process. Sharing the benefits of shared research when team members possess divergent skills and knowledge can allay fears and motivate students to explore unfamiliar areas of study.
- Value and acknowledge each others’ distinctive teaching styles. Sincere praise and requesting clarification of unfamiliar teaching techniques role models the behavior for students.
- Ensure that both faculty team members are equally invested in the process of creating assignments and the overall course / grading structure. If not, one faculty member may feel excluded and “clueless,” while the other may feel overly responsible for the course.

- Maintain flexibility in scheduling daily activities and delivery of information.

Conclusion

The objectives of student attitude transformation and environmental sustainability awareness can be achieved most effectively in an interdisciplinary team-taught course. This type of capstone experience mirrored a workplace environment in which multiple viewpoints are valid and flexible connections must be made between natural processes, business models, and societal needs. This interdisciplinary experiment led to significant learning outcomes by changing student attitudes, expanding worldviews, and sharing diverse perspectives.

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