

**AC 2008-1461: MULTIDISCIPLINE TEAM TEACHING APPROACH TO
ENHANCE PROJECT-BASED LEARNING OF SUSTAINABLE DESIGN**

Steven Burian, University of Utah

William Johnson, University of Utah

Fred Montague, University of Utah

Arrin Holt, Cooper Roberts Simonsen Associates

Jim Nielson, Cooper Roberts Simonsen Associates

Rachel David, Cooper Roberts Simonsen Associates

Multidiscipline Team Teaching Approach to Enhance Project-Based Learning of Sustainable Design

Abstract

This paper describes a multidiscipline team-taught course providing a project-based learning environment for students of sustainable design practices at the university level. The *Sustainability Practicum* course developed by the authors at the University of Utah aims to integrate students from multiple disciplines with faculty and design professional mentors, also from multiple disciplines. Multidiscipline student teams are first provided a basic introduction to sustainability concepts and then introduced to an on-going building or development project, environmental assessment, or coupled human-natural process investigation for which they must incorporate a sustainable feature. By using active projects for the course, students are immersed directly into the planning and design experience providing them insight into stakeholder-client-decision maker-professional practice interactions. Students become involved in these interactions as they innovate, plan, design, and in some cases create, implement, or construct their sustainability project. This paper describes the challenges and benefits of the multidisciplinary approach to teaching and learning sustainability concepts and the value of using on-going projects and involving design professionals.

Introduction

A Google search of ‘sustainability’ returns more than 13 million hits. Thousands of definitions of the term can be found from a wide range of perspectives. Wikipedia, for example, defines sustainability, in general, as the characteristic of a process or state that can be maintained at a certain level indefinitely. Sustainability must be placed in the context of a particular process to narrow its scope for tractable application. The purview of civil engineers is generally resource sustainability and sustainable development. One of the most often referenced definitions of sustainable development was presented by the Brundtland Commission¹:

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

This definition continues to be reincarnated in various forms, including the definition of sustainable development adopted by the American Society of Civil Engineers (ASCE) Board of Direction:

“Sustainable Development is the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.”

As Mays² points out, the concept of sustainability is not new. However, official recognition of the concept in practice has come relatively recently. For example, The ASCE Board of Directors introduced the concept into their Code of Ethics a little more than a decade ago³.

Equipping civil engineers at the university level to plan and design sustainable developments, buildings, and processes is also relatively new. Steineman⁴ reviewed the history of declarations of the roles and responsibilities of universities to promote sustainable development and traced the calls for action back nearly two decades. She also highlighted the position of universities to help answer the call of the profession. Since the profession (e.g., ASCE) introduced the concept of sustainable design and in turn made a call for increased adherence to its principles and provided guidance for implementation⁵, sustainable development and design have been incorporated into engineering education in a variety of ways. Educators have developed approaches to introduce sustainable engineering concepts across departments in Colleges of Engineering⁶, in environmental engineering⁷, in civil engineering^{8,9,10}, and to address ABET criteria⁶. Sustainable development concepts have also been introduced into international university curricula^{11,12}. And very recently implementation of sustainability has been highlighted as a means to realize the ASCE Body of Knowledge¹³.

Although numerous pedagogical advances to education of sustainable development have been introduced in the archived literature, one area that is relatively unexplored is the use of a multidiscipline team of instructors and professionals to create a project-based learning environment for student teams comprised of disparate disciplines. Planning, designing, managing, and operating the built environment using sustainable principles requires creative solutions from a range of technical and non-technical professionals, along with skilled laborers, working in concert. Helping future professionals innovate in such an atmosphere is difficult because it requires a multidisciplinary learning perspective, which challenges the traditional university paradigm. Toward this end, Professors from Geology and Geophysics, Civil and Environmental Engineering, and Biology at the University of Utah working in collaboration with design professionals have developed a new multidisciplinary project-based learning environment for students interested in sustainability. The *Sustainability Practicum* course is described below and the benefits of involving sustainable design professionals as mentors to student teams and using local, on-going projects are described. Survey and interview responses are used to present the benefits from the student learning perspective.

Course Description

The *Interdisciplinary Practicum in Sustainability* (the original name for the course subsequently shortened to *Sustainability Practicum*) was created to address the following key goals (1) integrating multiple disciplines into a single course and teaching from a multidisciplinary perspective, (2) immersing students in real problems and projects and facilitating their development of creative interdisciplinary solutions meeting constraints and the approval of design professionals and stakeholders. Although intended initially to focus on sustainable building, the course has broadened to cover building and processes within the built environment attracting a wider array of cohorts (students, faculty, and professionals) to participate.

The first offering of the *Sustainability Practicum* was in the spring 2007 semester and it has continued to be offered every semester since. The course regularly attracts students from a range of disciplines including engineering, business, environmental science, geology and geophysics, biology, chemistry, urban planning, and architecture. To encourage the broad participation, we

cross-listed the course in Geology and Geophysics, Civil and Environmental Engineering, Biology, Environmental Studies, and Urban Planning. Each semester we seek additional cross listings and participation of additional faculty and professionals to generate greater multidisciplinary interaction. We view the course as a university-level offering and not affiliated with a particular department or set of departments, although for practical reasons it must remain affiliated with the departments of the faculty responsible for the offering. However, as the University of Utah develops a Certificate in Sustainability we see this course serving as a potential model for a capstone experience or perhaps the capstone course itself.

In the *Sustainability Practicum*, students are introduced to the concepts of sustainability from the global, regional, and local perspectives and the foundation of design and certification (e.g., Leadership in Energy and Environmental Design (LEED[®])). Students are initially introduced to the global issues of sustainability including population growth, resource availability and usage, and global change. The course then immediately delves into the practicum component by requiring students to identify an actual project, process, or action with a sustainable aspect that they can find on the Internet or something local from their own experiences. Students must prepare a slide and present their idea to the entire class. Instructors, invited faculty mentors, design professionals, and administrators and decision makers review the ideas and provide constructive feedback during the student presentations. Discussions of the ideas are encouraged and directed to identify links and explore initial feasibility between the student ideas and the pre-selected project(s) for the course.

Subsequent class periods cover topics of team dynamics, communication, climate change, energy management, sustainable design, and presentations from design professionals, decision makers, and other stakeholders associated with the pre-selected course projects/themes. The guest speakers and affiliates serve to provide the much needed multidisciplinary perspective to sustainable development. Students are expected to improve their ability to (1) solve problems independently and collaboratively, (2) succeed within multidisciplinary teams, (3) communicate, (4) comprehend sustainable development from a multidisciplinary perspective, (4) learn independently, (5) work within conflicting goals, and (6) meet deadlines.

The course description provided in this section changes slightly from semester to semester depending on the projects pre-selected, the faculty, design professionals, and administrators/decision makers involved, and the discipline distribution and number of students registered. Each semester presents a new challenge and affords a chance to test new teaching tactics. Details of projects and instructor-professional-student interactions are described below for each semester the *Practicum* has been offered.

Spring 2007

The spring 2007 semester was the initial offering of the *Sustainability Practicum*. The course was developed to provide a learning experience based on the design and construction of the Frederick Albert Sutton Geology and Geophysics building on the University of Utah campus. Upon completion, the building targets LEED[®] silver certification, making the engagement of students interested in sustainability especially relevant. The flexibility of the building funding (the donor and potential for additional donations) provided students the opportunity to see their

projects implemented. A professor (Dr. William Johnson) affiliated with the Geology and Geophysics Department acted on his idea to engage students to innovate, design, and implement sustainable projects as additions to the new building by creating the *Sustainability Practicum*. Dr. Johnson recruited faculty members from Biology (Dr. Fred Montague) and Civil and Environmental Engineering (Dr. Steve Burian) to provide a multidisciplinary team with technical expertise and broad insight into sustainable principles. The course was advertised across the University and 23 students registered (6 students were civil engineers).

As described above, students were introduced to fundamental principles of sustainability and then divided into multidisciplinary teams and guided by the team of three instructors and multiple design professionals including the building architects, construction managers, consultants, and engineers. Depending on their selected part of the Sutton Building project, students interacted with the construction manager, University of Utah facilities management staff, architects and engineers, energy consultants, faculty mentors, landscape architects, civil engineers, electrical engineers, mechanical engineers, and decision makers (Dean, College Development Officer). Students progressed with their project mentors through the process of project selection, preliminary research, feasibility analysis, cost estimating, conceptual design, and final design. During this process students received weekly feedback on their project ideas and designs, exposing them to professional perspectives on sustainability as well as design, construction, and policy constraints.

Sutton Building projects created and designed by students included a green roof, rainwater harvesting system, a bioretention basin, permeable pavement, xeriscaping, resource (e.g., electricity, natural gas, and water) use monitoring, and tubular skylights. Students also introduced ideas for sustainable building furnishings, interior materials (paints and carpets), interior educational features, composting toilets, sun shades, photovoltaic cells, and exterior low-water use landscaping. The projects selected for completion were designed by multidiscipline student teams with guidance from the faculty, working closely with design professionals. The final Sutton Building project presentations were delivered as a press conference at the Sutton Building construction site. At the press conference, students displayed physical models of their projects and provided short descriptions highlighting functions and sustainable aspects for an audience of news media, students, university administrators, teachers, and other interested individuals.

The interaction between the student teams and the design professionals the first semester turned out unexpectedly to be a two-way street. The design professionals brought unique insight (for an academic environment) into the design process by providing students immediate feedback on feasibility of their ideas, guidance on design activities, and exposure to design team interactions. And the students provided fresh ideas (even if not always feasible for the given project), research effort, and preliminary design activity. In addition, and not foreseen as an original benefit by the course developers, the interaction itself contributed a possible point to the LEED[®] silver certification of the Sutton Building project.

Summer-Fall 2007

The Sutton Building sustainability projects designed in the spring 2007 semester were further evaluated by the design professionals and a funding source was identified. A new set of students was engaged in the selected projects during the summer of 2007. Projects selected for implementation in the Sutton Building were the green roof, infiltration basin, bioretention basin, permeable pavement, resource use monitoring, and tubular skylights. Some of the original students continued on with the practicum to carry the projects to completion and to help mentor the new students. With the student teams reconstituted, the design team leads at Cooper Roberts Simonsen Associates (CRSA) requested cost proposals from the consultants and construction manager on the design team. Meetings were organized at the office of CRSA to facilitate the exchange of the project details (including design calculations, technical drawings, specifications, narratives, pictures, and oral descriptions) between the student teams and the professionals. The design professionals then worked closely with the students to implement their vision and provided periodic updates of the design progress. For example, civil engineers with Psomas worked closely with a set of nine civil engineering students (over the two semesters) on the project teams responsible for the design of the bioretention, infiltration basin, and permeable pavement projects. The multidisciplinary interaction was reduced for this phase of the direct design professional – student interactions because discipline specific knowledge was necessary. The civil engineering professional met approximately once every two weeks with the students to review design progress. Students were given assignments after each meeting to continue to refine the design following in a parallel path to the design professionals. Coordinating the timing of this interaction was extremely challenging because a design professional devotes substantially more effort over a shorter time period than a student. Parts of the actual design project were not completed by the students (e.g., selected technical drawings and LEED[®] documentation) although the students were given the opportunity to review the process by the engineer. This type of professional-student interaction occurred for each of the projects. Sutton Building sustainability project designs were completed by the end of the fall semester and moved into the construction phase slated for completion in 2008.

Spring 2008

With the Sutton Building projects being implemented, new ideas for sustainable designs were sought for the spring 2008 offering. Drs. Johnson (Geology and Geophysics) and Burian (Civil and Environmental Engineering) coordinated with the University of Utah Office of Sustainability to develop a list of potential projects associated with campus. Dr. Craig Forster, director of the newly formed Office of Sustainability, joined the instructor team for the spring 2008 offering to facilitate the interaction of the students with the necessary design professionals and administrators associated with the campus sustainability projects, plus interjecting his experiences and knowledge to enhance the student projects. From an extensive list of potential projects, students aligned with the following four:

- Water Neutrality of the University of Utah Campus. A student team is developing a water budget at the campus level and identifying a combination of wastewater recycling and stormwater and snowmelt capture and reuse to achieve water neutrality (i.e., meeting campus water needs with precipitation inputs only). A team of four students is

quantifying the components of the water budget, identifying sites for harvested water storage facilities, creating hydrologic and water balance models to design the storage facilities, and assessing costs, policy, and water rights limitations associated with their proposed plan. The Director of Plant Operations is the champion of the water neutrality vision and he is serving as the key project advisor along with other professional engineers and the civil engineering consultants to the University of Utah involved with the water neutrality vision.

- Sustainability Assessment Template and Demonstration. A student team is working with the “Green Team” from the Office of Undergraduate Studies, the campus Energy Manager, and a sustainability consultant to develop a sustainability assessment tool in the form of a spreadsheet to quantify use and impact of energy, water, transportation, materials, and more. Using the Sill Center building, occupied by the Office of Undergraduate Studies, the students will use their developed assessment template to identify resource use inefficiencies, identify opportunities for increased efficiency, identify opportunities for conservation, develop plans for conservation education and outreach on campus, and design recycle/reuse systems.
- Design and Comparison of Wastewater Recycling Alternatives for the University of Utah Campus. A student team is aligned with the water neutrality vision, but focused entirely on wastewater recycling. The team is researching policy constraints in Utah with the help of a professor from the law school, developing sewage flow estimates, planning and siting two wastewater recycle options - living machine and membrane bioreactor, and comparing and contrasting the two options in terms of cost, footprint, energy requirements, capacity, reliability, regulatory acceptance, and more. The key advisors for this project are a lawyer and two environmental engineers.
- Energy and Water Usage Monitoring Interface. This project has carried over from the Sutton Building project (described above) but expanded to the entire campus. A student is working closely with the campus Energy Manager and a computer programmer to design a template to collect and effectively disseminate water and energy usage data from campus buildings and facilities to not only provide essential data for operations staff, but also to provide key information to instigate behavior change of the campus population.

Several key changes were made to the course execution in spring 2008. One that has had the greatest impact thus far is the creation of Project Advisory Committees (PACs). Students must select professionals with expertise or a management or stakeholder role in their project. The purpose of the PACs is to provide feedback on student design ideas and practices at meetings three times per semester. The experience thus far has been extremely positive for both the students and the professionals. Students are receiving great interest and enthusiastic support from their PACs, plus incredible aid and resources to achieve their project goals. Another key change is the involvement of the University of Utah student group SEED (Sustainable Environments and Ecological Design). A representative from SEED completed the *Practicum* course in 2007 and has volunteered to remain involved as a mentor to the students. Her involvement brings experience in this type of student design projects, additional sustainability ideas, and information from the SEED network on sustainability happenings at the University of Utah. Future course offerings will seek to have a liaison from SEED. One other key change was the involvement of the Office of Sustainability. The newly formed entity, directed by a Professor of Architecture and Urban Planning (Craig Forster), provides a resource base for students in the Sustainability

Practicum, but also it provides an archive for completed projects and a means to continue to progress towards implementation of projects. This solves the major time constraint associated with this type of project-based learning environment – the duration of a semester does not coincide with the conceptualization, planning, design, implementation/construction of a project. The Office of Sustainability or some other entity can serve as the archive for completed *Sustainability Practicum* projects and long-term champions. Overall, the changes implemented have vastly enhanced the multidiscipline learning environment and provided a substantial immersion in real-world sustainability issues for the students.

Teaching Sustainable Development

The wealth of recent references to implementing sustainable development into engineering education was briefly reviewed in the **Introduction**. The key contributions of this paper are the use of a multidiscipline mentoring (instructional) team to guide multidiscipline student teams, the use of on-going projects to provide student exposure to projects as they evolve, and the incorporation of design professionals to provide unique insight for students into the stakeholder-client-decision maker-practitioner interactions. These three aspects of the course are briefly described below. Student responses from surveys and interviews of civil engineering students are reported to provide the student perspective into the benefits of these three aspects of the course.

Multidiscipline Team Teaching

As described in the introduction achieving sustainability requires interdisciplinary ideas and skills. Therefore, we felt the need to provide a multidiscipline instruction team to support the students in their sustainable development experience. Our approach is to identify the faculty mentor to align with particular pre-selected projects, but also to provide continuous feedback from multiple disciplines at frequent (typically every week once projects are initiated) progress reports.

To assess the civil engineering students' perspectives of the benefits of the multidiscipline team teaching approach the following questions were asked on the end of course survey:

- Did the multidiscipline team of instructors enhance your learning of sustainability concepts? How so? Why not? Please clarify with examples.

Selected student responses:

- “I enjoyed hearing different opinions on feasibility and impact of the projects”
- “Yes, I felt I learned about specific environmental impacts of building projects that I have not heard from previous civil engineering professors”
- “The Biology prof. made the big picture of sustainability very clear”
- “Broadened project scope to include ideas that wouldn’t be considered otherwise”
- “Did open my eyes to different thoughts and priorities of the various instructors”

In our opinion one of the key themes in the responses (and reflected in the selected responses above) is the ability to see the bigger picture given the multiple perspectives of sustainability provided by the team of instructors.

Multidisciplinary Project-Based Learning

In the spirit of a practicum, the foundation of the course content is rooted in sustainable design projects. We promote an active learning environment emphasizing learning by doing in the mold of problem-based learning¹⁴. Students self-direct their learning with instructors serving the role of mentor.

Our approach for the *Sustainability Practicum* is to pre-select on-going projects or problems for the students. Requirements for considering a project for use in the course are (1) commitment of professionals (planning, design, administrative, management, etc.), (2) local, relevant, and interesting, (3) feasible, and (4) potential for implementation. Students must then devise specific sustainability project ideas within the scope of the pre-selected project or problem. For example, for the spring 2007 offering students were given the design and construction of an academic building as the problem space. They then were required individually to devise project ideas within the scope of a building design. Students present these ideas and the top ideas are selected by the students and teams are formed.

To assess the civil engineering students' perspectives of the benefits of our approach to project-based learning (using on-going projects) and the benefits of multidisciplinary interaction with other students the following questions were asked on the end of course survey:

- Did your interaction with students from other disciplines enhance your learning of sustainability? How so? Why not? Please clarify with examples.
- Did you find the use of on-going, real projects aid your learning of sustainability concepts versus using hypothetical examples or assignments based on completed designs? How so? Why not? Please clarify with examples.

Selected student responses:

- "I focused on my design and did not interact very much with other students"
- "The best part of the problems here is that nothing is handed to you as a problem to solve. We had goals and had to come up with the question, find givens that were available, then solve the problem in any way we could figure out. This was definitely more like real world practice."
- "Collaborating with other student groups helped to expand the scope of work to include ideas that were novel and interesting."
- "Building a real project gave feedback on proof of concepts"
- "Developing a design with budget constraints helped to keep the project grounded"
- "Working on a project that is going to be built gave a sense of pride in the work that wouldn't have been in hypothetical project"
- "YES!!! Real life projects=real life experience"

- “Actually showed what was possible and how you were limited”
- “Helped to understand where the world is now in the case of sustainability”

The first comment was provided after the first offering of the course and was a cause of change in course delivery. We permitted self selection of teams, which unfortunately produced single-discipline teams in some cases. This was especially the case for the engineering type projects. And the interaction between teams was limited. To avoid this we have taken a more active role in forming teams to be sure there is a better distribution of disciplines, yet still the technical and non-technical expertise necessary to accomplish the project objectives. We also facilitate greater interaction of the teams working on different projects to enhance the disciplinary interaction.

Involvement of Design Professionals

One key to the success of the initial round of offerings of this course has been the involvement of the design professionals. Members of the design team for the Sutton Building (architects, structural engineers, water resources engineers, electrical engineers, mechanical engineers, energy consultants, landscape architects, and construction managers) regularly attended the class sessions to describe their activities, their approach to sustainable design and construction, and guide student projects. The design team leaders from CRSA were present at nearly all class meetings and provided opportunities for students to get involved in design team meetings, client-professional interactions, and often provided their own contributions to individual projects through meetings, phone conversations, and email responses. In addition to the design aspects of the projects, students were also exposed to fund raising, public relations activities, and policy discussions.

The involvement of design professionals was uncertain when the course concept was originally developed. Their participation would be entirely without compensation and would in many ways impede their progress to project completion. But, the first offering of the course proved passion for sustainable design and interest in involvement in education were sufficient to engage the participation of design professionals associated with the selected project. The instructors felt the active involvement of the design professionals was one of the primary keys to success for the course. The need for committed design professionals is now considered a requirement for project pre-selection by the instructors.

Interestingly, student interaction with design professionals in the beginning was in the form of design professional (student teams)-decision maker (design professionals) relationship. Students had to present their project ideas, feasibility assessment, and preliminary design. The design professionals provided constructive feedback and ultimately decided if the projects moved forward and in what form. Once the projects moved beyond preliminary design the students and design professionals interacted more as peers to cooperatively create the design. This progression of student-mentor interaction will be facilitated in future offerings to provide students the opportunity to experience the different relationships they will likely face in the professional world.

To assess the civil engineering students’ perspective of the benefits of the design professionals the following questions were asked on the end of course survey:

- Did the involvement of the design professionals enhance your learning of sustainability concepts? How so? Why not? Please clarify with examples.

Selected student responses:

- “Absolutely! These were real solutions to problems that can not be covered in a general textbook type of class. The professionals provided insight and guidance on needed information not only on possible solutions, but the technical details needed to properly design a system.”
- “Yes, working with professionals helped define a realistic scope of work, provided decision guidance based on real world engineering judgment and oversight of the economic decision making.”
- “Yes, multiple disciplines provided context for individual work.”
- “Provided a real life experience to the project”
- “Introduced what goes on in meetings”
- “Insight into limitations that come along with ideas and projects”

These responses support the expected theme – the design professionals make the project more real to the students and thus enhance their learning experience.

Several benefits of the course were identified by the authors, but others likely were noted by the students, but not by the instructors. Therefore, a general question was included on the end of course survey to identify additional benefits and to highlight the most important aspect of the three described above from the student perspective.

- What was the most valuable aspect of this course to aid your learning of sustainability concepts? Please clarify with examples.

Selected student responses:

- “Knowing that what I was doing was going to be built made me more interested”
- “Looking at sustainable practices in a critical way”
- “Weighting the cost/benefits of a sustainable practice in the short and long term”
- “Understand the concerns of industry professionals with sustainable project and how concepts must be presented in order to have them seriously considered”
- “Actually working with professionals”
- “Working on something that was being built”
- “Making a difference”

Nearly all students responded that the project-based learning (using real projects) and the involvement of the design professionals were the most valuable parts of the course. The second most common response was the enthusiasm of the professors and design professionals. Interestingly, no responses pointed to the multidisciplinary team of instructors as the most valuable. The final comment is now something we use as motivation for the students. Their efforts have an impact beyond their education - they are making a difference.

The final part of the survey focused on the student perspective of the benefits and drawbacks of the *Sustainability Practicum* compared with a required civil engineering undergraduate design course (Hydraulics) and the required civil engineering capstone course:

1. Describe the differences (positives and negatives) between the *Sustainability Practicum* design experience and the design experience in a civil engineering design course (e.g., Hydraulics). Please clarify with examples.
2. Describe the differences (positives and negatives) between the *Sustainability Practicum* design experience and the design experience in the civil engineering capstone source. Please clarify with examples.

Selected student responses:

- “Interaction with architects and engineers – big difference and big positive”
- “This class gave the student the freedom to explore any discipline that related to the course that he chose. For example relating to civil engineering, the student could study: hydraulic modeling, concrete design, hydrology, environmental processes, or any combination of the above.”
- “The student was not hand fed a bunch of ‘givens’ in order to come up with the ‘right answer’. Instead the student was shown a problem and asked to figure out how to solve it with the support of the instructors and the rest of the class. This has much more real world use.”
- “This course was much like the capstone course in that it was to solve real world problems.”
- “The course did not cover several issues addressed in the capstone course, for example: ethics, finance, and drafting.”
- “Design courses focus on understanding the mechanics while working on a project requires higher thinking to understand the context those mechanics and their applicability to the project. A good analogy for the differences would be a toolbox. Design classes focus on what is in the toolbox while working on a project focuses on selecting the right tool for the job.”
- “The capstone class is required and individual roles are assigned. For many students, it is their last semester and the focus is completing the project quickly.”
- “The capstone class is stuffed with many lectures focused on meeting ABET requirements that were not met elsewhere and have nothing to do with the project. Sustainability Practicum focuses solely on the project and its development.”
- “Frustrating at times by not having a structured course”
- “Great actually working with people who design everyday”
- “Presented work in front of professionals”

Working with actual people involved in the projects on a weekly basis was the most significant difference. Furthermore, it seems to also have been a primary reason for accomplishing the learning objectives. Overall, the survey responses provide valuable information for not only

improving the *Sustainability Practicum* (for example by incorporating coverage of ethics), but also improving design courses and the capstone course.

Summary

This paper described a multidiscipline team teaching approach to introduce sustainable design to a multidisciplinary set of students. The paper provides unique insight into the use of a multidisciplinary team of instructors and professionals to facilitate learning of multidiscipline groups of students. Further, the paper describes the benefits and challenges of incorporating design professionals in the classroom and using active projects as the vehicle for project-based learning. Instructor and student perspectives of the benefits and challenges are reported and synthesized into major points. Important conclusions of the primary course instructors (Drs. Johnson and Burian) based on three (and one partial) offerings of the *Sustainability Practicum* include:

- The use of a multidiscipline team of instructors provides students essential exposure to a range of perspectives and attitudes associated with sustainable design. All team members do not need to be responsible for technical details of the design, but can contribute in other ways addressing their discipline-specific education needs.
- Team dynamics must be stressed early in a multidisciplinary team-based course in order to facilitate the communication between students not used to “speaking the same language”.
- Using design professionals from pre-selected on-going projects provides unique insight for students and an opportunity to become immersed in stakeholder-client-decision maker-practitioner interactions.

Several unforeseen benefits of the course include:

- Design professionals can benefit from student effort by receiving fresh ideas, research products, preliminary designs, and by counting the interaction towards LEED® credits.
- Multidisciplinary team teaching provides an avenue for cross-training faculty to teach sustainability from an interdisciplinary perspective.

Although not yet incorporated into the course delivery, the potential for this teaching paradigm to facilitate service learning is substantial. The potential has been noted by the Bennion Center at the University of Utah by the award of a grant to extend the course impact beyond the University Community to the Salt Lake City Community. The University of Utah Office of Sustainability has also become involved to promote greater/wider community impact. Finally, we conclude with suggestions for several improvements to the course based on our reflection and student feedback:

- Provide end of course survey to all students to increase the student feedback (at the conclusion of the fall 2007 semester it was only administered to civil engineering students for ABET documentation purposes).
- Alter course time to be a 3-hour block once per week to promote sustained interaction and cultivate the professional environment (implemented for spring 2008 course).

- Facilitate greater diversity of student disciplines in each team.
- Encourage project ideas aligning with social sciences, policy, organizational psychology, communication, and health sciences to enhance the opportunities for engineers and physical scientists to experience this ABET required content. Goal is to make the course a university-wide fixture expanding beyond the origins in engineering and physical sciences.

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