



The potential of community-based sustainability projects for deep learning initiatives

Will O'Brien ^{a,*}, Joseph Sarkis ^{b,1}

^a Clark University, Graduate School of Management, Worcester, MA 01610, USA

^b Worcester Polytechnic Institute, School of Business, Worcester, MA 01609, USA



ARTICLE INFO

Article history:

Received 22 May 2012

Received in revised form

1 June 2013

Accepted 1 July 2013

Available online 13 July 2013

Keywords:

Community-based projects

Deep learning

High impact educational practices

Stakeholder management

Sustainable development

Sustainability consulting

ABSTRACT

This paper provides and illustrates a generic framework for deep learning in a Sustainability-based course for higher education instruction. The use of Sustainability Consulting Projects is detailed with potential application to similar programs as part of their Sustainable Education curriculum. Using four disparate institutions of higher learning across the eastern coast of the United States we can complete an exploratory analysis of the framework. This analysis will provide us opportunity to identify and characterize community sustainability projects and their contribution to higher order, integrative and reflective learning. This deep learning framework and model will be helpful to curriculum developers and instructors who wish to introduce these types of projects into their courses and curriculum. These processes and tools may be integrated into current Sustainability Management courses or used as the basis for development of specific courses focused specifically on this topic; e.g., Sustainability Consulting or as a capstone course. Lessons learned and framework design and implementation provide opportunities for further research and development of these courses.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

In recent years, the pervasiveness of sustainability education at the college, or tertiary level, has been in response to a variety of social forces that have caused increasing sustainability awareness among various stakeholders. Communities, industry, consumers, NGO's, and government agencies have each played a role in greater demand for deep knowledge of sustainability, its principles, practices and theories (Yarime et al., 2012). The advent of these stakeholder pressures has caused significant response across a variety of academic disciplines including social sciences, engineering, and business disciplines (Wiek et al., 2011).

In response to these needs universities throughout the world are introducing new programs, pedagogical techniques, practices, and resources with respect to environmental sustainability (James and Card, 2012; Krizek et al., 2012; Velazquez et al., 2005). Increasing emphasis is being placed on the integration of sustainability into business and management curriculum. This integration

is especially pertinent within business education as business programs seek further legitimacy by offering sustainability in their curriculum (Boyle, 2004).

Sustainability is a complex topic and has been defined in a variety of ways (Arena et al., 2009). We focus on environmental sustainability education, but the expansion to other 'triple-bottom-line' dimensions can occur. Economic and social issues are related to environment sustainability actions.

Over the past several years a number of studies have been published on how to integrate sustainability into higher education including studies focused on business and management education (e.g., Krizek et al., 2012; Martin and Samels, 2012; Velazquez et al., 2005; Rusinko and Sama, 2009). Both academics and practitioners have observed the need to integrate sustainability into management education and across the business school, e.g., into faculty research and administrative practices (Rusinko and Sama, 2009). Thus, schools of business are using diverse means to implement their sustainability education goals, including (McMillan and Higgs, 2003; Ceulemans and De Prins, 2010):

- *infusion* of sustainability into current courses
- *new courses* specifically focused on sustainability
- *activities and programs* within and outside of the curriculum
- *modeling of sustainable practices* through the school facilities, operations, governance, and faculty lifestyles.

Abbreviations: HIEP, High-Impact Educational Practices; NSSE, National Survey of Student Engagement; SAP, Sustainability Action Plan; SOW, Statement of Work.

* Corresponding author. Tel.: +1 978 793 1635 (mobile).

E-mail addresses: wobrien@clarku.edu (W. O'Brien), jsarkis@clarku.edu (J. Sarkis).

¹ Tel.: +1 508 793 7659.

An important and proactive approach to aid 'deep learning' for sustainability amongst business and management students is through the use of high impact educational practices (HIEP) such as community based sustainability projects (Hansen et al., 2012; Kuh, 2008). In this paper the case-based research study examines the use of community-based sustainability projects as an integral part of a deep learning curriculum offered by management, engineering, and even public policy (social science) disciplines in university settings. The tools, effectiveness, and limitations of such a program is a research question that will be examined. That is, two primary research questions will be answered by this study: 1. How well do community-based sustainability projects contribute to deep learning and deep learning outcomes for University students; and 2. Does a deep learning framework aid in the design and management of sustainability education?

Using a course that has been delivered in four university case study settings we provide instructors and pedagogical researchers with insights into the effectiveness and limitations of the use of community-based sustainability projects courses and High Impact Educational Practices (HIEP) focusing on environmental sustainability management. We focus on innovative sustainability consulting projects to help students achieve deep learning outcomes. Another contribution of this paper is a general framework bringing together the antecedents to deep learning, deep learning practices, and deep learning outcomes in a graduate professional school sustainability education environment. The framework can be a valuable process oriented tool in observing, designing, and evaluating sustainability courses and programs. Practically, pedagogical materials for a course utilizing sustainability consulting projects are also presented for use by instructors and researchers.

In the next section we begin by providing background from the literature on HIEP, deep learning and stakeholder outcomes. This background sets the theoretical and practice framework for introducing the application of community based sustainability projects courses. Background on the design of these courses and the university settings are then provided. Findings from the many projects completed in these courses with feedback from instructors, students and project participants are presented. General findings and lessons learned are summarized with avenues for future development and research in this important and evolving instructional method and topic also presented in the concluding sections of this paper.

2. Background – high impact educational practices, deep learning and stakeholder outcomes

The core elements of a high impact post-graduate education include the development of intellectual powers and capacities; ethical and civic preparation; personal growth and self-direction (Kuh, 2008; Barth, 2012). HIEP for higher education can help achieve long-lasting, deep learning and outcomes. HIEP practices represent the antecedents in our framework for deep learning and outcomes summarized in Fig. 1. The elements of the framework, HIEP, deep learning and outcomes are each described in this section.

HIEP include: common intellectual experiences that link various courses; a focus on 'big questions'; writing intensity; collaborative projects; research; and community based experiences and service oriented activities (Kuh, 2008).

Many HIEP have been targeted at undergraduate students. Similar practices at the graduate level, especially for relatively inexperienced graduate students, and as discussed later provide deep learning outcomes. The more complex a subject, the less possible it is for participants to achieve mastery through passive educational practices. HIEP are especially conducive for education

in complex and socially integrated issues exemplified by sustainability (von Blottnitz, 2006). Sustainability requires a systemic 'big picture' and asking 'big questions' perspective to fully comprehend the myriad issues that are faced by this topic and discipline (Feng, 2012; Frisk and Larson, 2011; Hansen et al., 2012; Porter and Cordoba, 2009).

Building on Kuh's (2008) HIEP, cross-disciplinary and multiple course perspectives may also be integrated into environmental sustainability understanding and education (Feng, 2012; Yarime et al., 2012). Collaborative projects, writing intensity, research, community, service-oriented practices are all experiential and are recommended for sustainability education practices (Ferreira et al., 2006; Bergea et al., 2006; Sipos et al., 2008).

Deep learning has been defined as a key learning strategy from which students extract meaning and understanding from course materials and experiences (Warburton, 2003). Deep learning is defined to go beyond simple intellectual development becoming more transformational, which includes physical, emotional, aesthetic, moral, social, personal, and spiritual growth (Bentz, 1992; Grauerholz, 2001; Miller, 1999; Sterling, 2010). Although there are many scales for deep learning (see Nelson Laird et al., 2005 for a review), in our conceptual framework of deep learning the scales of the national survey of student engagement (NSSE) (NSSE, 2012), based on Nelson Laird's work (2008), are used. These elements and scales are some of the most comprehensive and tested and thus serve as a solid basis for evaluating deep learning in academic settings.

The deep learning elements of this comprehensive scale include higher order learning, integrative learning, and reflective learning (Nelson Laird et al., 2008). A summary of the specific elements in the NSSE Deep Learning Scale are shown in Fig. 1. Our evaluation and exploration of sustainability education in business and professional schools in this paper is qualitative. Thus, we do not explicitly use this scale in the evaluation of our case study results, but point to some features and results around the three major categories of HIEP. These results are what can be measured from the various HIEP that sustainable instruction can effectively implement due to sustainability's characteristics, especially organizational environmental sustainability characteristics.

The next stage of the conceptual framework includes the outcomes of the practices and deep learning that occurs. We summarize the outcomes as various stakeholder benefits from deep learning and HIEP, which include (Schantz and Louge, 2008):

- Academic gains and school connectedness by students (Scales and Roehlkepartain, 2005),
- Greater civic engagement of students helping to build 'town-gown' relationships and future community engagement in the future (Boyle et al., 2011).
- Building non-discipline, personal and social competencies of students (Hoxmeir and Lenk, 2003).
- Building social capital for students and schools. (Koliba et al., 2006).
- Protective factors such as greater retention rates and higher quality relationships.
- Broadened career exploration for students.

The variety of stakeholders that benefit from HIEP and deep learning with sustainability as a focus includes students, the university, college or school, and the broader community (Yarime et al., 2012). A systems perspective of sustainability higher education not only requires consideration of the content and the pedagogical delivery, but the stakeholders that will benefit from this broad education (Porter and Cordoba, 2009). Thus, in our final stage we consider the stakeholder outcomes from the cases presented in this paper.

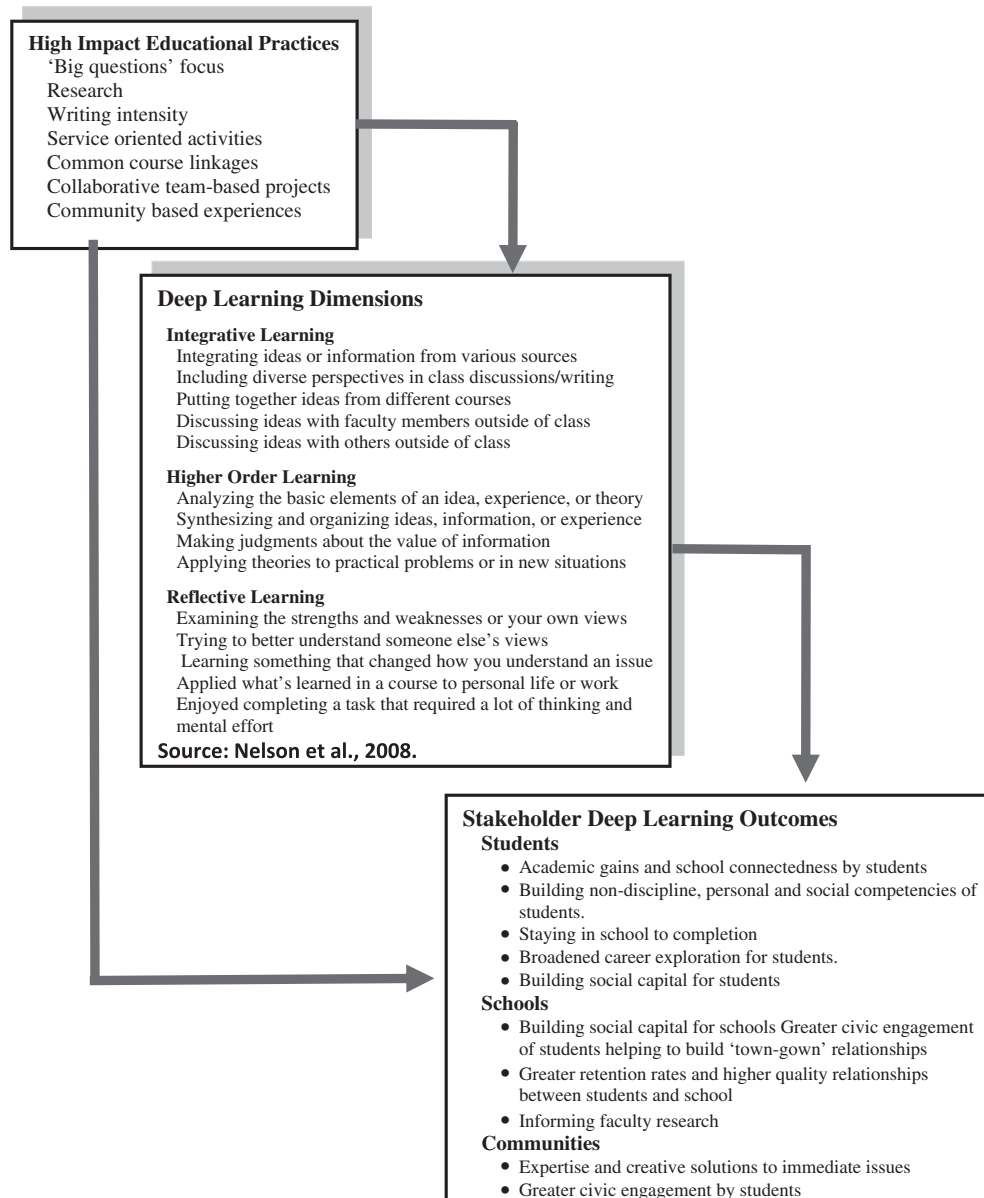


Fig. 1. Framework for deep learning and outcomes.

3. Methodology

To evaluate the effectiveness of HIEP for deep learning and stakeholder outcomes in sustainability education we will utilize four case study University programs. In case study research purposive sampling is typically used (Yin, 2008). That is, we purposively selected cases that have similar characteristics with the ability to compare common findings. These programs have implemented HIEP primarily through a major course project representing over half the student performance assessment in the class. The case studies were selected from graduate university courses delivered by the researchers. The course and project design is presented below. We utilize primary data from stakeholders to evaluate the outcomes based on the project and course design, and implementation. A multi-dimensional approach to data collection and subsequent analysis was completed. For example, a questionnaire survey, individual and stakeholder comments, and participant observation were all information used for the case analyses. See Appendices A–D for various course materials and data collection instruments.

To describe the sample and methodology used in this study an overview of the institutions, sustainability consulting projects courses, and major project within these courses is provided in the remainder of this section. We then briefly overview the data collection instruments from Appendices C and D that help form our outcomes analysis.

3.1. The institutions

The course that will be used for the case study evaluation has been called (among its variants) as "Sustainable Consulting Projects". It has been delivered at four institutions of higher education in the Northeastern and Mid-Atlantic regions of the U.S., including three universities and one military academy. The four institutions include:

- A leading business school that offers both a liberal arts education as well as business programs including MBA and MS degrees. The course was taught to students; i.e., both full-time and part-time earning their MBA curriculum.

- A co-ed maritime college that provides undergraduate, graduate and continuing education programs including an MS in Facilities Management, the program in which the course was delivered.
- A small liberal arts and research university that includes a graduate school of management offering MBA and MS degrees with a student body consisting of a high level of cultural diversity.
- A university offering undergraduate and graduate programs including programs in Environmental Studies, in which this program was delivered to the students remotely.

A summary of the characteristics of the four institutions is offered in Table 1.

3.2. The sustainability course

Since the initial delivery of the course in 2008, the course has been delivered twelve times to over 300 students at various schools. The students were involved in some aspect of management education but with them earning one or more of the following degrees: MBA, MA in Environmental Science & Policy and/or MS in Facilities Management. The course was tailored to the specific backgrounds and interests of the students; e.g., if the students were MBAs and Environmental Scientists, there was a business and management focus in the readings. Similarly, for the students earning the MS in Facilities Management, there was greater emphasis on energy, resource and building management topics. Eleven of the courses were provided in a classroom environment and one was delivered remotely to students distributed across the U.S., with one student located in Indonesia. Student teams developed over 85 Sustainability Action Plans (SAPs) for a wide variety of organizations in a regional metropolitan area in the US as well as outside the U.S.

The objectives and approaches of the case study course included:

1. Accelerate learning by challenging students to work with real-world 'clients' on Sustainability Projects, including many non-profit, community organizations as well as businesses.
2. Leverage multidisciplinary and intercultural diversity in the student teams to enhance team building skills.
3. Require students to conduct comprehensive analysis and use critical thinking techniques; e.g., the students are required to review for example current staff behavior regarding recycling in an organization and develop a practical strategy and action plan to foster sustainable behavior.
4. Use the knowledge learned in accounting, finance, marketing, operations management, project management, data analysis and performance management, an interdisciplinary integrative focus.

5. Develop and/or enhance management and consultative skills; e.g., selling ideas, change management, financial analysis, project management, resource management and public speaking, multiple skills targeted for advancement.
6. Enhance learning by using various delivery methods based on the learning environment and student requirements.

The course program objectives have a number of HIEP characteristics which are elaborated on below after discussion of the project. How the program objectives are executed and potential benefits and risk outcomes from the delivery method are summarized in Table 2. This table can also be valuable for the course overall when linking to educational institutions' assurance of learning and outcomes assessments.²

The course runs a full 15 week semester; i.e., 45 class hours. The primary reading material is a practical book which addresses various sustainability initiatives typically implemented by organizations. In addition, students are exposed to articles describing business strategy and sustainability, change management and energy management. The students analyze five cases of various types of organizations and their respective journeys to become 'green'. Since classes are 3 h in length, this allows adequate time for guest speakers such as sustainability consultants, corporate and city executives responsible for sustainability. Part of this course process and design engages some of the executives as mentors for graduate students concentrating in sustainability.

3.3. The team-based sustainability project

Since the focus is on the course's team sustainability project assignment, background on the sustainability consulting project is presented.

The sustainability project process and methodology was clearly delineated over a timeline and flow chart for the students (see Appendix A). Since the course was meant to be paperless all material was submitted and managed electronically. One of the important steps in the sustainability project process was a development of a statement of work (SOW). An example SOW is shown in Appendix B. Included in the SOW was background information on the organization and situation, the client requirements, and description of the project, and a timeline for deliverables to the client. This information is shared with the client similar to a contractual agreement between the organization and the student project team.

The SOW is a basic consultative tool used to capture client requirements, articulate deliverables, communicate the timeline and illustrate the content of the SAP that will be delivered. This is an integral part of the methodology that all student teams are required to develop with their respective clients. It is essential for several reasons. In order for the student team to develop a SOW, they must meet with, engage and listen to the client. This process is facilitated by a set of generic questions provided to student teams prior to the meeting. After the client outlines its requirements and priorities as well as any prior accomplishments and/or attempts that have failed in sustainability, the student team then defines the scope of work and deliverables that are possible to accomplish during the

Table 1
Case study educational institutions summary information.

Type of Institution	Location	Size	Degree programs of students	Level of cultural diversity
Liberal arts	New England	Medium	MBA	Low
Liberal arts	New England	Small	MBA, MA in environmental science & policy	High; i.e., typical graduate classes, >50% of students are non-U.S.
Military academy	New England	Small	MS in facilities management	Low
Liberal arts	Mid-Atlantic	Large	MS in environmental sciences & policy	Low

² Many U.S. based universities and colleges are required by their accrediting organizations to have assurance of learning and outcomes assessment processes. For example AACSB, the accrediting organization for business schools, requires explicit outcomes assessment processes that should be documented. Table 2 can help link to specific outcomes required of overall programs. Sustainability programs are especially supportive of many dimensions of outcome assessments and assurance of learning criteria.

Table 2
Mapping program objectives to approaches, benefits and risks associated with course delivery.

Program objective					
#	Description	Method	Benefits	Risks	When to use
1	Accelerate learning by challenging students to work with real-world 'clients' on Community-Based Sustainability Projects.	Develop and present a practical Sustainability Action Plan (SAP).	Actively engages students.	Uncooperative clients.	As a capstone course where the client commits to work with students.
2	Leverage multidisciplinary and intercultural diversity in the student teams to enhance team building skills.	Management majors w/ Environmental Scientists and/or Engineering students from various cultures.	Demonstrates the value of diverse thinking in dealing with complex problems.	Too much diversity may make reduce the likelihood of success.	When a diverse set of students is available and a capable project manager is empowered to lead the team.
3	Require students to conduct comprehensive analysis and use critical thinking techniques.	Identify organizational issues, create alternative solutions and formulate practical solutions.	Sharpens skills in preparation for challenging job assignments.	N/A	This is an essential component of Community-Based Sustainability Projects.
4	Use the knowledge learned in accounting, finance, marketing, project management, data analysis and performance management.	Apply knowledge to help solve organizational problems.	Enhances learning by application to the organization's issues/requirements.	N/A	This is an essential component of Community-Based Sustainability Projects.
5	Develop and/or enhance management and consultative skills; e.g., selling ideas, change management, financial analysis, resource management and public speaking.	Create initiatives, justify the business case for investments, recommend appropriate metrics.	Sharpens skills in preparation for challenging job assignments.	Some students may be inadequately prepared for these challenges.	This is an essential component of Community-Based Sustainability Projects.
6	Enhance learning by using various delivery methods based on the learning environment and student requirements.	Classroom	Direct and interpersonal communication.	May not be applicable for all teaching situations.	When student team members are in the same location as the institution.
		Remote	Convenience for student, faculty.	Quality of communication may be unacceptable	When students are dispersed geographically.
		Hybrid	Tailor delivery method to activity.	N/A	When both methods may be applied.

semester. This project scope may coincide with the stated requirements, may be less than or, in some cases, greater than what the client expects. An outline of the client's SAP is provided in the SOW to provide an illustration of the SAP that they will receive with the understanding that the actual content of the SAP may change. The timeline included in the SOW is provided by the instructor which enables completion of the deliverables within the semester. The deliverables include the SAP as well as a formal presentation to the client at the end of the semester. This SOW is used to not only set the client's expectations in terms of timing but for the student team to manage to the project schedule. Once the SOW is completed and approved by the client, the student team uses the SOW as the basis for delegation of the various components of the SAP and to begin their research.

The student project teams are also provided a SAP outline they should follow. This outline also provides them a general protocol

for interviews and data gathering from the case organizations for their projects. It is expected that support from their recommendations comes from the classroom discussions, readings, guest speakers as well as case studies. It is also expected that student teams will be using their knowledge and skills from other courses in their degree program to integrate into the recommendations provided in SAP.

We will be using a sample of 85 Sustainability Consulting Projects and project teams from the courses to provide a qualitative evaluation. Of the 85 projects completed, student teams worked with a broad variety of clients including: small businesses, non-profit organizations, municipalities both large and small as well as a few larger organizations; i.e., with several thousand employees. There was some level of consistency in the requirements vis-a-vis sustainability of the various types of clients depending, of course, upon the type of operation. Table 3 provides a summary of the

Table 3
Sustainability consulting project organizations and example characteristics.

Type of Organization	Examples	Size	Primary areas of focus
Global/national corporation	<ul style="list-style-type: none"> Networking company Nuclear power plant 	Revenue = \$300 M+ Revenue = \$500M+	<ul style="list-style-type: none"> Energy management Supply chain management Waste management
Large non-profit	<ul style="list-style-type: none"> Regional hospital 	Employees = 10,000+	<ul style="list-style-type: none"> Energy management Waste management
Small non-profit	<ul style="list-style-type: none"> Chinese community center 	Employees = @300	<ul style="list-style-type: none"> Change management; e.g., Fostering sustainable behavior
Medium-large municipality	<ul style="list-style-type: none"> City of Boston City of Worcester 	Employees = 1500+ Employees = 500+	<ul style="list-style-type: none"> Change management; i.e., Fostering sustainable behavior Recycling
Schools	<ul style="list-style-type: none"> Elementary – high schools 	Employees = 100+	<ul style="list-style-type: none"> Community engagement & education Energy management Sustainability education
Small municipality	<ul style="list-style-type: none"> Town of Stow, MA 	Employees = 100+	<ul style="list-style-type: none"> See details below

types of organizations and examples of sustainability related topics that were evaluated by the teams.

The range of projects included:

- Helping large and small local businesses to become environmentally sustainable.
- Organizations ranged in size from a regional medical center employing over 10,000 employees to a local coffee shop with 5 employees.
- Businesses vary from a nuclear power plant to a global networking company to a local organic food farm store and restaurant.
- Supporting a medium sized city with initiatives to become a green city; e.g., creation of a web-based reference tool called the 'Green Pages' which provides information on the environmentally friendly businesses in the city.
- Designing an eco-friendly food system for implementation for a community of 3000 in Hangzhou, China.

3.4. Primary data collection instruments and methods

Personal observation, course documentation such as syllabi, and course design materials (some of which is shown in [Appendices A and B](#)) are used for evaluating the courses in [Sections 4.1 and 4.2](#). In addition, primary data on feedback from the students and the project organizations involved in the sustainability consulting projects was also utilized for results in [Sections 4.1–4.3](#).

[Appendix C](#) is described as a reflection form which is used to gather information from the student as the course progresses. It is based on a service-oriented reflection instrument as referenced in the [Appendix](#). The reflections are meant to help guide the student but also provide information related to learning and its impact on student outcomes, including deep learning dimensions. The questions are for early, middle and late semester feedback by the students.

[Appendix D](#) has the "Client Satisfaction Survey" which collects information about the performance of the student groups, which included open-ended questions. This information is primarily used for community/organization feedback and outcomes summary analysis. This information was supplemented with personal observation and unstructured conversations by the instructor working in mentoring the student teams and organizations participating in the projects.

4. Sustainability consulting projects and deep learning

In this section we frame the analysis of the sustainability consulting projects within the deep learning framework introduced earlier and summarized in [Fig. 1](#). We describe and map the HIEP covered in the projects (and course), how these HIEP relate to deep learning dimensions, and the eventual outcomes from these projects based on stakeholder feedback and observations.

4.1. High impact educational practices

The objectives and approaches identified for the sustainability consulting projects course can also be translated into specific HIEP experiences. Although many HIEP can be introduced into the sustainability consulting projects course, we focus on four HIEP which are most evident and unique in the team project assignment design. It is a given that the course is focused on the 'big question' of sustainability and that writing intensity and research are in most university courses. These four include service-oriented activities, common course linkages, collaborative team-based projects, and community based experiences.

Service-oriented activities – were designed into the course projects by having most of the projects focus on or encourage community service at some level. The students learned from serving actual clients and reflecting on lessons learned to reinforce the new found knowledge. In some cases an entire course was designed around a specific community, with multiple organizations in that community as a focus of each project. For example, in one small community, schools, fire departments, police department, department of public works, were each selected as projects. Even in for-profit organizational settings, many of these organizations were small and financially constrained. So the unpaid services of the students were used to help these small vulnerable companies in a recessionary period.

Common course linkages, the second HIEP, were completed by addressing the client's requirements through application of broad-based knowledge gained in the classroom and from many courses. Students learn through integrating knowledge from across the curriculum in this consultative experience. For example, students gained knowledge through various broad based case study readings and theories that organizations will respond to sustainability initiatives if there is a 'win-win' eco-efficiency outcome can be generated for the organization. Thus, when students were making recommendations and identifying solutions, they realized that organizations would respond more quickly and be more motivated when substantial savings were accrued, which required financial, management, and operational knowledge. Rarely did they experience a situation when an organization would agree with a recommendation just for the sake of sustainability without consideration of cost, economic and technical feasibility. This is a reality in most organizations; i.e., from small businesses to large corporations, non-profit organizations and municipalities. For example, most if not all small business owners will not even consider upgrading their lighting until all the incentives are clarified, net costs and annual savings estimated and the payback period calculated.

Collaborative team-based projects that focused on the major consulting project began early in the course with the formation of teams. Student teams are established with a reasonable level of diversity, where practical; e.g., have a 2–3 MBA students work with 2–3 Environmental students, if the course was formed by students from more than one discipline. This situation was not true for all project team cases since some programs were explicitly with one type of major. Yet diversity could still be maintained since these were graduate students whose undergraduate programs tended to be from a variety of disciplines. The diversity enhances the learning experience of all team members on the project team; the outcome of this project team work is the SAP which is evaluated by the client as well as the course instructor.

Community-based experiences work in conjunction with service-oriented activities by focusing on local communities to aid in deep learning. As mentioned in the service-oriented activities context specific communities were identified where students were allowed to focus. The connections that student teams establish in working with local businesses, non-profit organizations or municipalities provide a valuable real-world experience which enhances the students' maturity and academic development.

4.2. Deep learning dimensions

Taking the various course and project HIEP into consideration we now describe some of the resultant deep learning dimensions and outcomes. Described below are the three major deep learning dimensions and how the course project experiences relate to each.

Integrative Learning – in order for the students to accomplish the goals of the project it is essential that they integrate ideas from the client since ultimately the SAP must address the client's

requirements. At the same time, students are integrating ideas and information from the diverse team members to construct the SAP. The course has been used as a “capstone course” in light of the various components of a typical SAP; i.e., operations management, finance, change management, leadership, information systems, project management, consulting and, in some cases, marketing. The purpose of capstone courses is to integrate knowledge gained from across the curriculum. Furthermore, the methodology used in the project requires regular interaction with the client during which ideas are shared and discussed in order to determine the feasibility in the client's work environment.

Higher Order Learning – the challenges for the students in the project involve understanding synthesizing the client's requirements in such areas as: energy efficiency, water conservation, waste reduction and fostering sustainable behavior in the leadership and staff. Next, the students are required to apply theories and knowledge gained in the classroom, experience from guest speakers and case studies in an organized manner to properly address the client requirements. The course text describes in detail for example how to increase energy efficiency, reduce water consumption and waste production, and minimize energy consumption in data center operations. To properly determine which set of best practices may work in a particular organization and then adapt it to the client's environment and operation necessitates the application of judgment; i.e., to determine what is applicable and what is not. During the semester as part of the consultative process, such judgments made by the student team are validated through discussions with the client. The goal is to achieve buy-in from the client for specific recommendations which will be included in the final version of the SAP and presentation.

Reflective Learning – for the student team to be successful, they need to not only listen and understand the client's point of view but also ultimately convince the client that the students' recommendations may actually work for the client. This ‘selling of ideas’ is a skill that many of the students develop during the project through understanding and respect of the client's point of view. At the same time, the process involves taking knowledge from the classroom, conducting additional research and testing the concepts in the real-world. It is therefore quite common that the student team comes away from a meeting with a client with an entirely new perspective on a topic; e.g., a solution for increasing energy efficiency from the text may simply be impractical if the client were a hospital where 24×7 operations is required. Students are also asked to complete a ‘Reflection Form’ concerning their activities and outcome results (see [Appendix C](#)). This form helps the student, and instructor, capture some reflective learning that is occurring in the course and project team. Some of these reflections are valuable to also determine if the results and outcomes from this deep learning activity are being achieved.

4.3. Stakeholders' deep learning outcomes

At least three major stakeholder groups can gain from these sustainability projects, students, communities, and the schools themselves. In order to evaluate the outcomes and results of the projects and course from the perspectives of the students and the communities, evaluation feedback forms are utilized. The reflective learning form is one type of feedback tool that was used to determine some of the deep learning outcomes that occurred. Course evaluations may also be utilized to gain insight into these outcomes. Other methods include classroom discussion through presentations and the team reports. For the communities (which include all organizations) a “Client

Satisfaction Survey” is utilized (see [Appendix D](#)). This client satisfaction survey includes both closed ended and open ended questions. We will provide example outcomes and results, qualitatively, through quotations, for these two stakeholder groups. We will also describe some specific examples we observed of University/Institutional outcomes from this deep learning initiative.

Student outcomes can occur at multiple levels with the various HIEP and deep learning practices. There are professional and personal skills, learning and values development that are outcomes for students. Even the most basic social competencies, which are important in professional settings as well, can be developed. An example of one critical professional and social skill, working in teams, is evident by comments such as:

“I learned that I really enjoy working on projects that can actually be implemented within an organization. Although at times it can be frustrating working in a team and with a client, it is very rewarding to present a finished product that you can be proud of and that the client can use within their organization.”

The social belief structure, and part of building social capital, was also evident in the outcomes. That is, the higher order learning and involvement in community and service activities, have aided students and strengthened their social consciousness perspectives. Remember that many of these students are core business or engineering professional students. It is not surprising that a sustainability projects course can help integrate the technical with the social, but the implications can be life changing. One such feedback comment that exemplifies the value and social laden aspect of the outcomes is:

“My values and beliefs in the importance for sustainability and social responsibility have strengthened. I have seen the value and need for people and companies to act in a socially responsible manner and after taking this class this has strengthen my values and opinions. The need for companies to act as socially responsible as possible is not only good for the environment and the communities around them, but it is also very important in business world in order to be competitive.”

But it is not only about the values and softer skills, specific skills that are integrative can also be built in these project-oriented team efforts. Two aspects are career exploration and development, and additional skills development can and do occur. A couple student quotes get to the heart of this outcome:

“I have learned how to evaluate projects better in financial terms. This is the best way to present this information even though at times it is challenging to figure out. It is also nice to practice interacting with a client which definitely will help in my future professional career.”

“I developed great teamwork, research, consulting, presentation, and analysis skills from this sustainability project. Before now I had never worked directly with a client, it was a great practical learning experience for me that I will be able to leverage in the future. I want to go into a field that encompasses some form of sustainability and I think this experience will set me apart.”

Specific student outcomes were also observed in eventual placement and business development. One graduate is working for the Environmental Protection Agency; another with the Environmental Defense Fund. A recent graduate is now engaged as an intern for a medium-sized consulting firm helping the organization to reduce operating costs, become more environmentally sustainable and enhance their competitive positioning. An alumnus with a Masters in Finance is aiding in the planning and delivery of a ‘Green

Business Seminar' in Beijing to enable Chinese businesses become 'green'.

Other student outcomes from deep learning are not easily measureable or fully applicable to this setting. For example, staying in school to completion is not something that is of a concern for graduate students in shorter (2 year programs). But, undergraduate higher education programs which typically last 4 years in the U.S. do see significant attrition³ and can be managed using these deep learning and HIEP techniques. The other issue is whether school connectedness (even after graduation, as alumni) occurs. This may not be as easily measurable due to the length of time between graduation and connectedness that would need to be measured and compared.

School (University) outcomes can also be accrued from the Deep Learning approach, most of the evidence we have from this effort is based on observations by the researchers who are not only instructional insights but also administrative insights from the potential outcomes.

Development of new and deeper relationships with the various community organizations which have been served including: corporations, non-profits and municipalities. These relationships are valuable for purposes of further integration into school and university collaboration and cooperation. For example, one school is using some of the connections made through these projects to develop an advisory council for its new Sustainability concentration in its MBA program.

Another specific outcome is the relationships built between the school and institutions to pursue joint grant funding related to improvement in community sustainability through research and teaching at the school. An ultimate town-gown relationship is the mutual economic benefit for investment by governments and philanthropic organizations in both institutions (communities and schools).

One other exemplary school benefit, as evidenced by the examples in student outcomes, is the development of community relationships to help in placement of students in internships and jobs. The schools benefit from this perspective, especially business schools, whose major criteria include job placement of students. This criterion helps to build reputation and makes it easier to recruit students. Students who are seeking a program with Sustainability at its core are concerned with practical and career based experience. This type of course and specifically the projects have been used to provide examples for students in recruitment activities.

Community outcomes, in many cases community and institutional feedback on the projects showed that many had significant and immediate impact on planning and development issues facing these communities. Non-profit organizations with minimal resources were able to take advantage of some of the project outcomes and the SAP generated from student teams. One quote exemplifies the almost immediate reaction to one set of findings that would be viewed by top management and boards of some of these organizations:

"What a pleasure it was to work with Anna and Sarah as they developed a Sustainability Action Plan...We will be meeting with our President and Board in the months ahead to discuss the adoption of sustainable goals for the organization based upon this report." (Non-profit Organization for clean and renewable energy, Operations Executive).

Even organizations that had expertise and initially were involved in sustainability efforts may not have had the latest academic, best practices and practical insights into managing sustainability programs in their organizations. For example, one of the projects focused on a community's secondary school and the feedback comments made clear that new insights and additional excitement was brought back into the institution based on the student project team efforts:

"Carolyn and Jessica did a spectacular job. All of our requests were considered in their work...Their suggestions were reasonable and presented in a way that was highly respectful of the organization and the individuals who have already worked on sustainability issues here...The presentation and the report ...went beyond my expectations...their suggestions and their study have positioned the school to take immediate action. The way they presented their ideas leaves us feeling that there are manageable baby steps we can take that will ultimately lead to large institutional change. They left my management team with a feeling of excitement to take on some of these challenges..." (Mid-Atlantic area Private School, Headmaster)

The communities served are not only local ones nearest the case study schools, but international locales as well. In the case of the distance learning course, this made it easier for students to participate in community based projects across the world. But, it is not only the distance education program, but also the on-site programs that influenced distant communities. One Chinese student team developed a comprehensive plan for a community organic farming system for Hangzhou, China. Another team worked with a community in Indonesia that produces patchouli oil from aceh. In this case one of the students worked in Indonesia and the student located in the U.S. was responsible for the sustainable supply chain aspect.

"Indonesia is one of country that has high traffic of environment pollution such as illegal logging, unsafe management waste plant and illegal mining that less concern of environment safe issues. In this case Dianna provided much advice to the project especially issues relating to (the) patchouli cultivation ... project...The improvement that Dianna made is giving contribution about environment issues that come up in the project that carry out by Caritas Czech republic..." (Director, Non-profit focused on social and health care in Indonesia)

Entrepreneurial students, as mentioned earlier, would also take their knowledge and learning from these courses to develop their own enterprises. For example, the case of the student who is taking the knowledge and structure of the SAP to develop their own consulting company to aid Vermont businesses become more sustainable.

We have provided examples of how the HIEP and the deep learning dimensions of the sustainability projects have contributed with actual outcomes to multiple stakeholders. But, not all the outcomes were positive. There were challenges in managing the projects and their outcomes. We provide some additional critical analysis on the team projects characteristics and outcomes.

5. Common challenges

Although many advantages do exist for following the deep learning framework for a sustainability projects based course and curriculum, there are significant limitations and challenges. Based on critical examination of the desired Deep Learning model and outcomes, it is clear that we have experienced challenges in a number of areas, and across each of the case

³ For example, one institution in our study had an attrition rate of approximately 13% per year, which is considered a 'good' rate in academic circles.

institutions apply the sustainability projects approach. We provide an overview of these challenges based on the stakeholders involved.

5.1. Students

While many of the students involved in teams excelled and gained deep knowledge through the project experience, some students were less engaged and there was question as to whether deep learning occurred. This may be an issue of lower levels of commitment, interest and motivation of some students. It was observed that some students allowed more highly motivated team members to complete the preponderance of the work for the project assignment. Thus, a clear moderator in the successful outcome of HIEP designed programs is the level of motivation, intrinsic or extrinsic that exists within each student for the topic (Guay et al., 2008; Holdsworth, 2010). Since the course in question is not 'required' but is an elective, it is typically assumed that some intrinsic motivation will be evident in many of the students (i.e., sustainability is an internal value and belief that I personally wish to gain deeper understanding and knowledge). Extrinsically motivated students may only wish to take this elective for a grade to be able to complete their program and move on. The extrinsic motivation is less associated with a deep learning aspect, but more for an external reward, i.e., a grade.

Although a well-designed deep learning course may result in intrinsically motivated students (Lawson, 2012), the result is not always one that will occur with passive students. One approach which has enabled the instructor to better address this situation of having students rely on a 'free-rider' approach and passive learning is to utilize a very traditional project management approach, of having a 'project manager' for each student team. This approach was utilized in the more recent courses due to this challenge in earlier courses offered. The 'project manager' must be selected by the team members and empowered by the instructor. The instructor is then able to monitor progress more easily throughout the semester to ensure that each student is contributing and engaged, and take corrective action if this is not the case.

5.2. Schools

This deep learning project based approach to integration of Sustainability into the curriculum is relatively novel for many institutions. The process of managing the teams and organizing client partners for the student groups is not trivial. The level of faculty involvement and school support required can be substantial if there are few clients in the region. Since these courses were offered in highly urbanized areas their application was met with less difficulty due to abundant local resources in terms of organizations available to be projects for the students. Eventually, as the course matures building these consulting relationships may become more difficult as willing organizational partners become scarce. For this reason, it is expected that the course may have to evolve depending on these resources.

In addition, the topic of Sustainability is a new topic to many business schools and other professional schools (e.g., engineering). Simultaneously, many faculty members are in the process of understanding and applying deep learning. Building these relationships and exposing faculty to these approaches is still a major effort at each of the Universities. Classroom learning through traditional lecture mode or through on-line education based on passive learning techniques is still the norm. Whether faculty will embrace

sustainability topics and/or HIEP is still a question. The level of effort, initially, may be greater for many established faculty members.

5.3. Communities

The challenge in this area is threefold. First, as mentioned with the schools based issue, identifying organizations who are interested in having a SAP developed, is a major concern. Even though care is taken to *qualify* the organizations by assessing their commitment to implement the SAP, in many cases little or no action is taken after the SAP is submitted and presented to the client. It is the rare exception that SAPs developed by the students are actually implemented. This lack of follow-up may be due to lack of resources, time, energy and/or expertise to lead change in the organization. The exceptions, those organizations that have moved to actual implementation of project recommendations, have been in those organizations where there is a capable internal champion as well as a committed green team. Another situation would be a pre-existing client team dedicated to reducing costs and achieving a greater level of environmental sustainability. A final challenge is the quality of client feedback on the student work was consistently biased toward positive statements. This bias is as a result of the typical respectful relationships established by the student teams and the clients plus the fact that the SAPs are provided pro bono. Critical comments on the work have typically been from the instructor.

6. Lessons learned

Experience and results from the 85 projects have indicated that this approach of Deep Learning can be effective. The Sustainability Consulting Project approach enabled student teams in various institutions of higher learning with significant diversity to achieve deep learning objectives. The approach has been used successfully in the classroom setting as well as via remote delivery of the course. The lessons learned have both practice and research lessons and implications.

6.1. Practice

Securing clients that will support the student teams in their project work can be effectively completed. Although the identification and selection process for project clients does have its challenges.

The project teams should contain as much diversity as possible, e.g., MBA students with graduate Environmental Science students, or students from different cultural backgrounds. This situation may not be easily developed in all programs, especially schools where the lack of diversity of programs, or students, may not exist.

There needs to be some process to ensure that a 'project manager' is selected by the team members for each team, and that the project manager is reliable, committed and competent.

The need to effectively introduce and implement the process, templates and tools described in this paper requires significant thought and preparation. Students need to be provided with the necessary tools, have some repeated descriptions provided and access to sample SAPs. There is a need to aid the teams schedule the appropriate forum and involvement of client stakeholders for the formal presentation of the SAP to the client. Part of the process is reminding and requesting that the student complete the

Reflections during the semester to enable the instructor to use the information, as appropriate.

Since the project is a semester long process continued coaching, mentoring and support and support of the student teams throughout the semester is required. Typically this is completed during class time, but a need for outside of class time for guidance may also be required. Part of this continuous monitoring requires that the teams submit drafts of the SAPs for the instructor's review and critique, well in advance of the delivery to the client. In many cases, two-three reviews are necessary to ensure the proper level of quality.

6.2. Research

The research implications of the evaluation of the deep learning framework and its various elements begin with the applicability of such a model. We only focused on certain HIEP. More than the four or five HIEP exist and significant other approaches may be integrated into the instructional setting, e.g., simulation games, in-class exercises, etc. that are not considered in this project-oriented course.

We made some general conjectures and relationships between the deep learning dimensions and the different practices. Direct linkage between specific HIEP and the deep learning dimensions were not made. This type of analysis would require a careful empirical design and could be used to generate scales for classroom education research that links up the various factors throughout the framework. Although the scales for the deep learning dimensions have been developed and studied, the HIEP, as described in our context are a little more ambiguous. For example, community based experiences and service-oriented activities have significant overlap. To be able to capture the influences of each of these on deep learning dimensions requires a very careful and discriminatory definition that clearly defines the boundaries of each.

We also found that the stakeholder deep learning outcomes are not all easily measurable. The feedback instruments do provide some information for short-term gains and outcomes. How to measure broader and longer term outcomes is not a simple matter and may be very impractical to be able to determine. For example, greater civic engagement can only be tested after the students have left the school environment. Potential immediate scores may occur, but there is no guarantee that this type of situation will exist if students leave the school community to other regions of the world. Some of the outcomes may need adjustment depending on the level of the student. For example, staying in school to completion is a deep learning outcome, but may be more appropriate for secondary or undergraduate level of education.

Overall, the evaluation and implementation of the framework within this setting was purely qualitative, quantitative evaluation would be necessary.

7. Summary & conclusion

In this paper we introduced a deep learning framework for sustainability education. We developed this framework based on sustainability and general education research. The framework is composed of select HIEP, deep learning dimensions, and general stakeholder outcomes. Using this framework we evaluated a Sustainability Consulting Projects course that had a number of HIEP in place in a professional school setting. In answer to one of the research questions, the framework was found to be a useful guide to help understand the advantages and disadvantages of using

Sustainability Consulting Projects as a core pedagogical method for deep learning in sustainability education, especially at the tertiary and post-graduate level of education. The second research question that sustainability consulting projects do aid in deep learning for sustainability education in university students was also answered, in that they do help. The cases from four universities and 85 projects also provided a number of lessons learned with direct implications for practice and research.

Overall, deep learning and HIEP have proven to be effective in the classroom and via remote delivery with diverse types of students from four institutions of higher education. For the most part, students have achieved the stated learning objectives and, in some situations, have become inspired to pursue careers in sustainability management or consulting. The universities have connected more fully with the communities by working together to reduce costs, become more environmentally sustainable and to help the students to learn. Some of the organizations have benefited from the SAPs but, for the most part, it has been the students who have derived the most from the experiences.

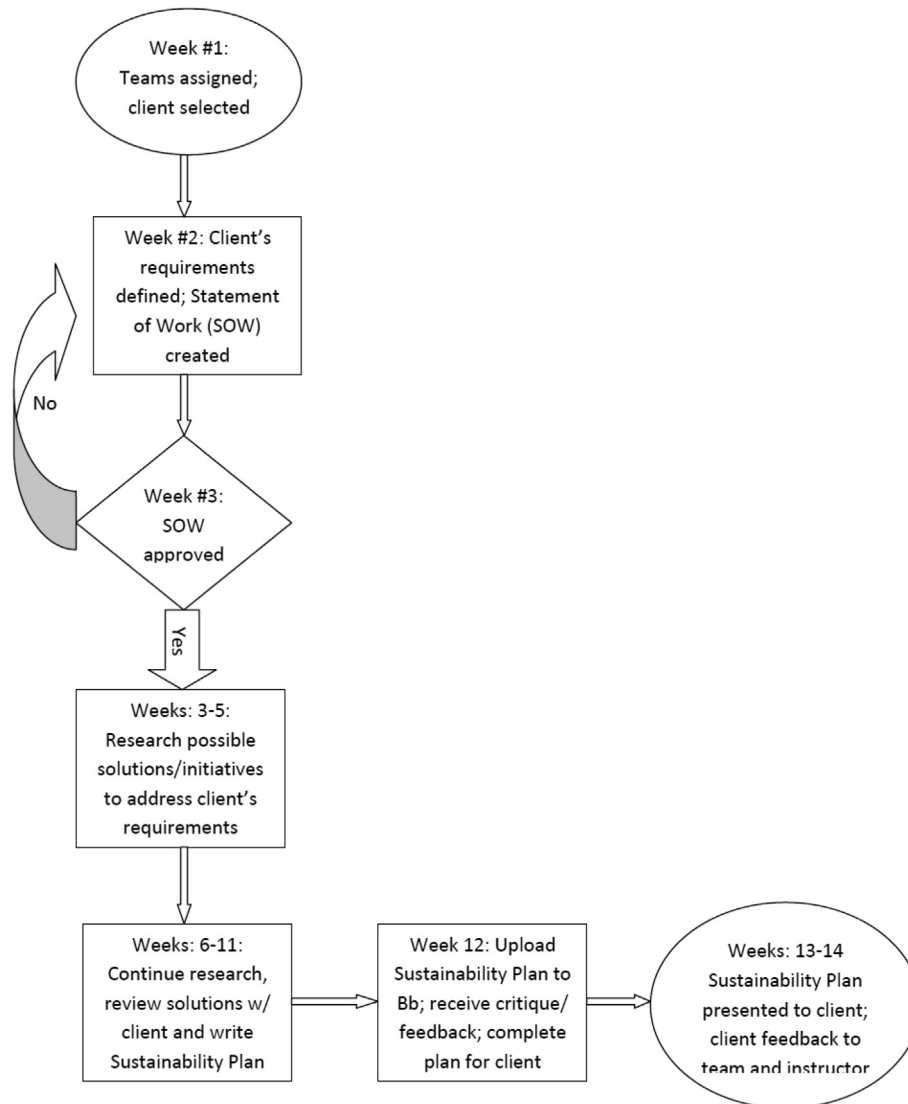
However, this approach is not always effective, and may be mitigated by a number of environmental factors. For example, the level and type of motivation of the students for taking such courses may provide a moderating effect for the outcome effectiveness. Since the sustainability projects approach is still relatively novel for each of the case study institutions, it will require some time before the long-term effectiveness and resiliency of the sustainability projects course. That is, after time, the available population for sustainability projects will tend to decrease within a given community, making projects and clients more difficult to locate. There are also other limitations and issues learned from this framework and course delivery which we identified and require further scrutiny from those who offer sustainability consulting projects-like courses.

The limitations of this research are relatively clear. We used a qualitative approach to evaluate the framework and courses from only four institutions. The expansion of the sample for broader empirical studies can certainly be a direction for research. Feedback was received from both students and stakeholders and used in the evaluation, but much of this feedback was qualitative and could potentially be biased towards a positive perspective. We also have a very limited sample with the analysis completed at the course project level. A comparative analysis at the institutional level and even the individual level could provide more insight into the advantages and disadvantages of using sustainability projects for deep learning.

Extension of this work to a more objective quantitative research study can also be completed using the framework as a foundation. Each of the major aspects of the framework can be scaled for a survey instrument using items we have identified from the literature. One additional characteristic that can be used to enhance the framework is environmental and individual characteristics that can moderate or control, as mentioned with student motivation, the relationships amongst the scale items and general HIEP and deep learning constructs.

Therefore, additional research should be completed and experience gained and analyzed to address the challenges faced by the delivery of this course. It is the intent of this paper to establish a foundation for additional opportunities for future research and new knowledge to improve in this emerging role of sustainability education for business and professional (e.g., engineering) education. There are many insights we have gained, but further refinement and development is certainly necessary for the most effective deep learning environment for today's students and tomorrow's leaders.

Appendix A. Sustainability consulting project methodology



Appendix B. Student team project organization tools

Statement of Work

Client: ABC Company.

Executive Sponsor/Email Address: Ian M. Smart, VP; IMSmart@abc.com.

Student Team Members:

Background	Since this document is for the client, provide a brief description of the organization, reasons for their interest in 'going green', etc.
Client requirements	Articulate the client's requirements in a bullet format.
Description of project	Describe the work that you are going to do to address the client's requirements and modify attachment A, as appropriate. This is to clearly set expectations for both the client and enable the student team to focus on and organize for the development of the SAP.

Sustainability Action Plan Outline

Deliverables/ timeline:	Dates	Activity/deliverable
	Jan. 30th–Feb. 8th	Client provides information, describes requirements for the project; student team develops draft Statement of Work (SOW)
	Feb. 9th	Team uploads draft SOW to Cicada; O'Brien provides feedback.
	Feb. 13th	Team sends SOW to client for approval.
	Feb. 13th–April 6th	Team works with client, conducts research, and obtains regular feedback from client re: proposed initiatives; develops draft of Sustainability Action Plan (SAP).
	April 9th	Team uploads draft SAP to Cicada for O'Brien's feedback.
	April 13th	O'Brien provides feedback re: drafts of SAPs

(continued)

Deliverables/ timeline:	Dates	Activity/deliverable
	Week of April 23rd	Team presents SAP to client stakeholders – see attachment B; client provides feedback to team and O'Brien

After you define the scope and deliverables in “Description of Project”, you will be able to create the first pass of the outline below.

1. Background
2. Client Requirements
3. Recommended Initiatives:
 - a. Energy use including lighting, heating and AC
 - b. Water conservation
 - c. Recycling and waste management
 - d. Paper use reduction
 - e. Green office including cleaning supplies and practices
 - f. Green IT
 - g. Sustainability education
4. Change Management (how to foster sustainable behavior of leadership, staff and the community in support of the initiatives)
 - a. Vision of Sustainability – incorporate into client's mission
 - b. Leadership's role and recommended actions to engage the staff
 - c. Organizational structure in support of Sustainability
 - d. Communication/Marketing – increase awareness, website, newsletter.
 - e. Educational Programs – integrate into curriculum, workshops, etc.

Note: in this section, to be most effective, you are expected to use John P. Kotter's eight step process and/or the “Fostering Sustainable Behavior” process; i.e., the five steps to deal with the identifying barriers of change and creating appropriate strategies.

www.cbsm.com/public/world.lasso

5. Recommendations: Future initiatives; may include capital investments
6. Cost: Benefit Analysis for future initiatives, as appropriate
7. Performance Metrics & Reporting (how to measure and report results of initiatives internally and externally)
8. Roadmap: Provide the action plan in terms of specific steps the client is to take to implement the Sustainability Action Plan.

A very important aspect of most sustainability planning projects is change management for our client. Therefore, a key event at the end of the project is the physical delivery and presentation of the plan to key stakeholders so that they understand the benefits of the initiatives, required behavioral changes and specifically what actions need to be taken.

Attachment B – Presentation Event Plan

- Date/Time/Location (week of April 26) and Attendees; i.e., all Stakeholders
- Agenda & Approach; e.g., it may be a combination of presentation and workshop; i.e., walk through the plan with the stakeholders, staff, etc.

Appendix C. Reflection form – students

Reference: <http://www.csuci.edu/servicelearning/Reflection.htm>

To be effective, it is important that proper reflection occur at specific stages during the semester. Below are the questions which you are asked to reflect upon and answer per the schedule in addendum A. Please consider the questions, document your thoughts and upload the assignment to the appropriate folder on Cicada.

Reflection #1 – Questions for the beginning of the semester:

- Describe your sustainability project. Include a description of the organization you will be working for (i.e., what is their purpose? How big are they? What is their history? What is their mission? What are their goals?).
- How is your client addressing that need?
- Why are you needed?
- What are some of your perceptions or beliefs about the client you will be serving?
- What concerns, if any, do you have about working with your team?
- What concerns, if any, do you have about working with the client?
- What do you hope to gain from this experience?

Reflection #2 – Questions during the semester:

- How does your project experience relate to the learning objectives of the course?
- What did you do with your client since the last reflection discussion?
- What did you observe?
- What did you learn?
- What has worked? What hasn't?
- How is your project experience related to the readings, discussions, and lectures in class?
- What do you think is (will be) the most valuable service you can offer to your client?
- Is there something more you could do to contribute to the solution?

Reflection #3 – Questions toward the end of the semester:

- What have you learned about yourself?
- What have you learned about your client?
- What have you contributed to the client?
- What values, opinions, beliefs have changed?
- What was the most important lesson learned?
- What new skills have you developed since the beginning of the project?
- How does the project experience connect to your long-term goals?
- How have you been challenged?
- What characteristics make a community/corporation successful in terms of environmental sustainability?
- What impact did you have on the client organization?
- Describe what you have learned about yourself as a result of your service.
- Were there any member(s) of your team who made an extraordinary contribution to the project?
- If yes, identify the student(s) and describe his/her performance as a team member.
- Were there any member(s) of your team who made a minimal or no contribution to the project?
- If yes, identify the student(s) and describe his/her behavior and performance as a team member.
- What recommendations for improvement would you make to this individual(s) for future team projects?

Appendix D. Client satisfaction survey

Company/Organization Name:

Student Team Names:

Date:

1. Evaluate the quality of the Sustainability Action Plan provided by the student team.

Low (1)	Low – Average (2)	Average (3)	Above average (4)	High (5)
---------	-------------------	-------------	-------------------	----------

2. Evaluate the team's responsiveness to your requirements.

Low (1)	Low – Average (2)	Average (3)	Above average (4)	High (5)
---------	-------------------	-------------	-------------------	----------

3. Evaluate the effectiveness of the team's communication and project management.

Low (1)	Low – Average (2)	Average (3)	Above average (4)	High (5)
---------	-------------------	-------------	-------------------	----------

4. Evaluate the team's professionalism.

Low (1)	Low – Average (2)	Average (3)	Above average (4)	High (5)
---------	-------------------	-------------	-------------------	----------

5. Your overall satisfaction with the project.

Low (1)	Low – Average (2)	Average (3)	Above average (4)	High (5)
---------	-------------------	-------------	-------------------	----------

6. Describe any areas of improvements that you might suggest with the approach, Tools and/or services provided.
7. Would you recommend this team to develop a Sustainability Action Plan for other companies/institutions?
8. Other comments, as appropriate.

References

- Arena, M., Ciceri, N.D., Terzi, S., Bengo, I., Azzone, G., Garetti, M., 2009. A state-of-the-art of industrial sustainability: definitions, tools and metrics. *International Journal of Product Lifecycle Management* 4 (1), 207–251.
- Barth, 2012. Social learning instead of educating the other. *GAIA-Ecological Perspectives for Science and Society* 21 (2), 91–94.
- Bentz, V.M., 1992. Deep learning groups: combining emotional and intellectual learning. *Clinical Sociology Review* 10, 71–89.
- Bergeå, O., Karlsson, R., Hedlund-Åström, A., Jacobsson, P., Luttröpp, C., 2006. Education for sustainability as a transformative learning process: a pedagogical experiment in EcoDesign doctoral education. *Journal of Cleaner Production* 14 (15), 1431–1442.
- Boyle, M.-E., 2004. Walking our talk: business schools, legitimacy, and citizenship. *Business & Society* 43 (1), 37–68.
- Boyle, M.-E., Ross, L., Stephens, J.C., 2011. Who has a stake? How stakeholder processes influence partnership sustainability. *International Journal of Community*

- Research and Engagement 4. <http://epress.lib.uts.edu.au/journals/index.php/ijcre/article/viewArticle/1778>.
- Ceulemans, K., De Prins, M., 2010. Teacher's manual and method for SD integration in curricula. *Journal of Cleaner Production* 18 (7), 645–651.
- Feng, L., 2012. Teacher and student responses to interdisciplinary aspects of sustainability education: what do we really know? *Environmental Education Research* 18 (1) available on-line 11 Jan 2012.
- Ferreira, A.J.D., Lopes, M.A.R., Morais, J.P.F., 2006. Environmental management and audit schemes implementation as an educational tool for sustainability. *Journal of Cleaner Production* 14 (9), 973–982.
- Frisk, E., Larson, K.L., 2011. Educating for sustainability: competencies and practices for transformative action. *Journal of Sustainability Education* 2.
- Grauerholz, L., 2001. Teaching holistically to achieve deep learning. *College Teaching* 2001 (49), 44–51.
- Guay, F., Ratelle, C., Chanal, J.-C., 2008. Optimal learning in optimal contexts: the role of self-determination in education. *Canadian Psychology* 49 (3), 233–240.
- Hansen, L.T., Dann, S., Kerr, J.M., 2012. A critical learning cycle model for sustainability education: two case studies of water conservation programs in Jordan. *Journal of Sustainability Education* 3.
- Holdsworth, S., 2010. A Critique of Academic Development in Sustainability for Tertiary Educators. PhD Thesis. School of Global Studies, Social Science and Planning, RMIT University, Australia.
- Hoxmeir, J., Lenk, M., 2003. Service-learning in information systems courses: community projects that make a difference. *Journal of Information Systems Education* 14, 91–100.
- James, M., Card, K., 2012. Factors contributing to institutions achieving environmental sustainability. *International Journal of Sustainability in Higher Education* 13 (2), 166–176.
- Koliba, C.J., Campbell, E.K., Shapiro, C., 2006. The practice of service learning in local school-community contexts. *Educational Policy* 20, 683–717.
- Krizek, K.J., Newport, D., White, J., Townsend, A.R., 2012. Higher education's sustainability imperative: how to practically respond? *International Journal of Sustainability in Higher Education* 13 (1), 19–33.
- Kuh, G.D., 2008. High-impact Educational Practices: What They Are, Who Has Access to Them, and Why They Matter. Association of American Colleges and Universities, Washington, DC.
- Lawson, R., 2012. The effect of viva assessment on students' approaches to learning and motivation. *International Review of Social Sciences and Humanities* 2 (2), 120–132.
- Martin, J., Samels, J.E., 2012. The Sustainable University: Green Goals and New Challenges for Higher Education Leaders. Johns Hopkins University Press.
- McMillan, V.M., Higgs, A.L., 2003. Implementing Sustainability Education – Lessons from Four Innovative Schools. Working Paper. University of Michigan, Ann Arbor, 2003.
- Miller, J.P., 1999. Making connections through holistic learning. *Educational Leadership* 56, 46–48.
- Nelson Laird, T.F., Shoup, R., Kuh, G.D., Schwarz, M.J., 2008. The effects of discipline on deep approaches to student learning and college outcomes. *Research in Higher Education* 49 (6), 469–494.
- Nelson Laird, T.F., Shoup, R., Kuh, G.D., 2005. Measuring deep approaches to learning using the national survey of student engagement. In: Paper Presented at the Annual Meeting of the Association for Institutional Research, Chicago, IL, May. http://nsse.iub.edu/pdf/conference_presentations/2006/AIR2006DeepLearning_FINAL.pdf (last accessed February 2013).
- NSSE, 2012. National Survey of Student Engagement. <http://nsse.iub.edu/>.
- Porter, T., Cordoba, J., 2009. Three views of systems theories and their implications for sustainability education. *Journal of Management Education* 33 (3), 323–347.
- Rusinko, C.A., Sama, L.M., 2009. Greening and sustainability across the management curriculum: an extended journey. *Journal of Management Education* 33 (3), 271–275.
- Scales, P., Roehlkpartain, E., 2005. Can Service-learning Help Reduce the Achievement Gap? <http://www.nylc.org/sites/nylc.org/files/files/114AchieveGap.pdf>. last downloaded, May, 2012.
- Schantz, K., Louge, N., 2008. Service-Learning: An Overview. ACT for Youth Center of Excellence, Cornell University. http://www.actforyouth.net/resources/rf/rf_servlring_0108.cfm (last accessed July 2013).
- Sipos, Y., Battisti, B., Grimm, K., 2008. Achieving transformative sustainability learning: engaging head, hands and heart. *International Journal of Sustainability in Higher Education* 9 (1), 68–86.
- Sterling, S., 2010. Learning for resilience, or the resilient learner? towards a necessary reconciliation in a paradigm of sustainable education. *Environmental Education Research* 16, 511–528.
- Velazquez, L., Munguia, N., Sanchez, M., 2005. Deterring sustainability in higher education institutions: an appraisal of the factors which influence sustainability in higher education institutions. *International Journal of Sustainability in Higher Education* 6 (4), 383–391.
- von Blottnitz, H., 2006. Promoting active learning in sustainable development: experiences from a 4th year chemical engineering course. *Journal of Cleaner Production* 14 (9), 916–923.
- Warburton, K., 2003. Deep learning and education for sustainability. *International Journal of Sustainability in Higher Education* 4 (1), 44–56.

- Wiek, A., Withycombe, L., Redman, C.L., 2011. Key competencies in sustainability: a reference framework for academic program development. *Sustainability Science* 6, 203–218.
- Yarime, M., Trencher, G., Mino, T., Scholz, R., Olsson, L., Ness, B., et al., 2012. Establishing sustainability science in higher education institutions: towards an integration of academic development, institutionalization, and stakeholder collaborations. *Sustainability Science* 7 (0), 101–113 available on line February 2012.
- Yin, R.K., 2008. *Case Study Research: Design and Methods*, vol. 5. Sage Publications (Incorporated).