



International Journal of Sustainability in Higher Education

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Article information:

To cite this document:

Maria Margarita Meza Rios, Irene Marie Herremans, Jean E. Wallace, Norm Althouse, David Lansdale, Manuel Preusser, (2018) "Strengthening sustainability leadership competencies through university internships", International Journal of Sustainability in Higher Education, <https://doi.org/10.1108/IJSHE-06-2017-0097>

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Strengthening sustainability leadership competencies through university internships

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Received 29 June 2017
Revised 9 November 2017
29 January 2018
Accepted 5 February 2018

Abstract

Purpose – This paper aims to determine whether high school students can become agents of change in their local communities by participating in a formal internship program implemented through a partnership between academia (high schools and universities), nonprofit organizations and key community stakeholders.

Design/methodology/approach – Pre- and post-assessments, activity journals and on-line interviews are used to measure the impact of internships on high school students' sustainability leadership, using a train-the-trainer intervention led by university interns. A conceptual problem-solving framework is proposed and empirically tested to explore the linkages between complex problem constellations, sustainability transition strategies and sustainability visions.

Findings – The five core leadership competencies (systems thinking, strategic, anticipatory, normative and interpersonal) may not be as uniquely discrete as suggested in the literature. An effective learning experience depends on students' developing competence in their ability to implement a strategic intervention, which is better acquired through hands-on experience rather than a classroom setting.

Practical implications – Students need experiential learning outside of the classroom to make sustainability come alive as a viable option for their communities.

Social implications – The principles of social responsiveness, engagement, experiential learning, capacity-building and entrepreneurialism can be executed by transforming the campus into a learning lab, which includes the local community.

We would like to acknowledge the ten students from the Sustainable Energy Development (SEDV) Master of Science program at University of Calgary who participated in the program and made this research possible. Alonso Alegre, Connor Bedard, Jeff Coombes, Jillian Kareema Haneiph, Margarita Meza, Nic Ritchie, Namrata Sheth, Andria Panidis, Cristina Vallejo and Kasondra Harbottle. We would also like to thank the SEDV program, the Canadian Centre for Advanced Leadership at the University of Calgary, and CPA Alberta, and University of Calgary's Teaching and Learning Centre who provided financial support either for the internships or the research.



Originality/value – This study empirically demonstrates that students need involvement in strategic interventions to imagine and conceptualize sustainability visions. It also shows how academia can help fulfill the United Nations sustainable development goals.

Keywords Education, Community, Experiential learning, Competencies, Systems thinking, Sustainable actions

Paper type Research paper

Introduction

It is well documented that education provides a robust and durable foundation for journeying toward more sustainable communities, whether at the local, regional, national or global level (Barth *et al.*, 2007; Dieleman and Huisingh, 2006; Brundiers and Wiek, 2013; Juárez-Nájera *et al.*, 2006). Furthermore, there is general agreement that declarative knowledge (how sustainability works) is necessary but insufficient to attain the end objective. To increase the probability that students of all ages will become to some extent agents of change, other types of knowledge are also critical. Procedural knowledge (how to take action) is important to support change. Furthermore, behavioral aspects of effecting change are necessary at the implementation stage. Therefore, effectiveness (how perceptions and beliefs affect actions) and social (how social norms affect actions) are types of knowledge which complete the knowledge set (Frisk and Larson, 2011). From these four types of knowledge (declarative, procedural, effectiveness and social), various competencies can be created to achieve sustainability goals, specifically the 17 United Nations (UN) sustainable development goals. Sipos *et al.* (2008) supported the concept of using different types of learning and suggested balancing cognitive (head), psychomotor (hands) and affective (heart) learning to realize truly transformative sustainability education. Furthermore, there is general agreement from the literature that these competencies are best acquired in a context that incorporates some form of experiential learning (Orr, 1991; Sterling, 2010; Wiek *et al.*, 2015; Brundiers and Wiek, 2013; Senge, 2014), such as community-based, applied learning experiences (Sipos *et al.*, 2008).

Even though the 17 UN sustainability goals are not mutually exclusive (as achieving one goal often helps to achieve another, at least in part), this research addresses two of the sustainable development goals: Goal 4, “Ensure inclusive and quality education for all and promote lifelong learning” and Goal 17, “Strengthen the means of implementation and revitalize the global partnership for sustainable development” (United Nations, 2015). Goal 4 includes ten targets; however, Goal 4.7 related to sustainable development education specifically pertains to this research:

By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development (United Nations, 2015, p. 17).

Goal 17 can work in tandem with Goal 4 by creating international partnerships to build capacity in developing countries to ensure education in sustainable development. Goal 17.9 is stated as follows:

Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation (United Nations, 2015, p. 27).

Furthermore, UNESCO leads efforts to ensure education for sustainable development (ESD) occurs in all countries in the world (UNESCO, 2016). ESD prepares learners to make well-informed decisions that lead to responsible sustainable actions for current and future generations. ESD is not only limited to formal education but also includes education through organized, non-formal learning settings; experiences related to daily activities such as work, home and leisure; and various types of training (UNESCO, 2014). UNESCO's ESD, in part, also calls for systems thinking, applied learning, critical thinking, values clarification and futuristic thinking.

This study takes these concepts and provides insight into how these can be incorporated in an internship experience developed under the umbrella of an inter-disciplinary graduate-level sustainable energy program offered at University of Calgary. The internship program was developed through a partnership with two non-for profit organizations in Ecuador, the Beyond Chacay Foundation and the Centro de Competencia Educativa para Espacios Comunitarios (Center for Educational Competence in Ecuadorian Communities). The main objective of the internships was to prepare the high school students to become agents of change in their communities with the intent of improving their sustainable practices.

The internship program

In 2016, ten student interns from the Master of Science graduate program in Sustainable Energy Development (SEDEV) participated in an internship in Ecuador after completion of their 16-month course-based program, just prior to their graduation approximately one month later. The SEDEV program is an inter-disciplinary program in which Master of Science students take courses in engineering, business, environmental design and law with energy and the environment as a focus of each course, culminating in a final capstone project. This program of study is offered by the University of Calgary, which is guided by six principles identified in its institutional sustainability strategy: social responsibility, engagement, experiential learning, capacity-building, diversity and entrepreneurialism. To apply these six principles, faculty and staff create experiential learning opportunities by using the campus as a learning laboratory with the intent to develop competencies similar to the UNESCO ESD program and, ideally, extend these for practical application at the community level. Six foundational competencies are the focus for sustainability education at the University of Calgary (University of Calgary, 2018, p. 33):

- (1) anticipatory thinking and long-term foresightedness;
- (2) empathy and understanding of different worldviews and relationships;
- (3) capacities for stakeholder engagement and group collaboration;
- (4) action-oriented leadership skills and change agency skills;
- (5) critical thinking and decision-making capacity within complexity; and
- (6) systems thinking and an understanding of connectedness.

To experience campus as a learning lab, the ten interns spent the month of September 2016 at three separate locations in Ecuador where they supported local sustainability initiatives related to eco-tourism, energy efficiency, water use and renewable energy. Groups of three to four SEDEV interns worked on community-specific projects in Mindo (cloud forest), Archidona/Santa Rita (Amazon region) and the Galapagos Islands (1,000 km offshore of the mainland). Each group had predetermined project-specific goals and timelines, but they also had flexibility to engage with local stakeholders to refine and customize these goals and develop implementation plans over the course of the project. In addition to working with the communities, the SEDEV interns provided local high school students with workshops in

sustainability resulting in a final public presentation by the high school students of a project that could then be implemented to make their community more sustainable.

The Archidona/Santa Rita Project group's goal was to evaluate the potential for implementing sustainable energy technologies to enhance local livelihood, reduce greenhouse gas emissions and improve waste management at a cacao and tea cooperative located at Archidona that employed many individuals from the indigenous community of Santa Rita, in addition to 36 indigenous Kichwa communities. The Mindo and Galapagos groups' goals were similar. They performed energy and water audits and waste creation assessments for small hotels in each community. On the basis of these assessments, recommendations were made that were economically viable and environmentally less impacting.

Although broad goals for each internship were predetermined, each project group had to assess current community needs and interests in their specific location and then to collaborate, educate and work with the communities to help them fulfill their long-term planning goals. Key to success was helping to empower individuals of all ages to develop smart communities for the future. The SEDV interns helped provide resources, training and guidance to develop leadership within the communities.

Not only was the goal of the internships to develop leadership capabilities in the Ecuadorian communities but also to develop leadership capabilities in the University of Calgary SEDV interns by applying their knowledge acquired in their courses before transitioning into leaders in their own careers. The results of the interns' personal leadership development will be presented in a separate article. The focus of the current article is to examine the extent to which the Ecuadorian high school students, who were mentored by the university SEDV interns, developed sustainability leadership capabilities.

Theoretical framework

Capra (2007, p. 13) defined a sustainable community as "one whose institutions and practices co-operate with the processes by which nature sustains life." Building sustainable communities starts with a strong theoretical foundation that is laid in the classroom, helping students to comprehend the complexity of interrelated and interdependent systems. Capra (2007, 2009) suggested including a study of how systems and their interconnected elements work. Therefore, comprehending "networks, nested systems, interdependence, diversity, development, cycles, flows, and dynamic balance" is essential (Capra, 2007, p. 13). According to Hudson (2001), formal classroom education focuses on the harm we have done to our planet and therefore is not visionary. Although this knowledge is an important first step, it should be coupled with learning outside the classroom in the community to take positive steps forward: to envision a more sustainable future.

Because the objective of education for sustainability is sustainable communities, Orr (1991) and Sterling (2010, p. 526) advocated for real world, action-oriented learning that is accomplished through a variety of learning methods such as "reflective, experiential, experimental, participative and iterative" to create a resilient learner. To aid in the development of a new perspective of how we fit in the world around us, service-based and/or community learning is more conducive for tackling problems that are considerably more complex than can be addressed in a formal education setting. The community setting lends itself to learning at several levels: cognitive, affection and behavioral (Haigh, 2006; Pless *et al.*, 2011). As education becomes personalized, students may develop confidence that motivates new enthusiasm and energy for positive change (Haigh, 2006). Astin *et al.* (2000) found that service learning can enhance understanding of theories through practical application. Students appreciate that they are making a difference within communities,

making them feel valued (Cadwallader *et al.*, 2013). Community learning provides students an opportunity to help address complex, sometimes ambiguous, problems within our systems through the application of their classroom knowledge (Bringle and Hatcher, 1996). Thus, education for sustainability that occurs in communities is more likely to build sustainable communities.

Through formal classroom learning coupled with community-based projects, certain competencies can be developed. Wiek *et al.* (2011, p. 204) synthesized the literature on sustainability competencies and defined them specifically as they apply to sustainability learning in higher education as:

[. . .] functionally linked complexes of knowledge, skills, and attitudes that enable successful task performance and problem solving with respect to real-world sustainability problems, challenges, and opportunities.

They identified five core competencies that may lead to the desired learning outcomes of sustainability education: systems thinking, strategic, anticipatory, normative and interpersonal. Based on the studies of Wiek *et al.* (2011, 2015) and Savage *et al.* (2015), we define these core competencies as follows:

- *Systems thinking competence* refers to the ability to analyze complex sustainability problems from a holistic perspective.
- *Strategic competence* is action oriented and refers to the ability to construct and implement interventions that realize sustainability visions.
- *Anticipatory competence* is future oriented and refers to the ability to create scenarios about sustainability problems and problem-solving framework.
- *Normative competence* is the ability to assess sustainability problems and interventions in terms of justice, equity, social–ecological integrity and ethics.
- *Interpersonal competence* is the ability to work in close collaboration with those from other disciplines as well as with different groups of stakeholders.

It is noted that to better understand the social issues, one must consider the interactions of interdependent systems (Whiteman *et al.*, 2013). The complexity of these interdependent systems requires a systems thinking approach (Gladwin *et al.*, 1995; Marcus *et al.*, 2010; Roome, 2011). Gruenewald (2004) suggested that knowledge, especially in Western societies that rely on a standardized curriculum, is highly fragmented into disciplines, which is not conducive to the systems thinking that is essential in sustainability education, especially in the context of emerging market economies. Therefore, Wiek *et al.*'s (2011) work is particularly useful. They offered a valuable overview and synthesis of the literature that is vital to laying the groundwork for designing and evaluating sustainability programs. Their later work in 2015 proposed how to operationalize the different competencies for use in curricula and course design, delivery and assessment. They neither, however, explicitly addressed how these key competencies, unique to sustainability education, are acquired nor how to determine if they are acquired through a certain pedagogical approach. As Wiek *et al.* concluded in this later paper, a needed area of inquiry is an assessment of competency acquisition from participation in sustainability education programs.

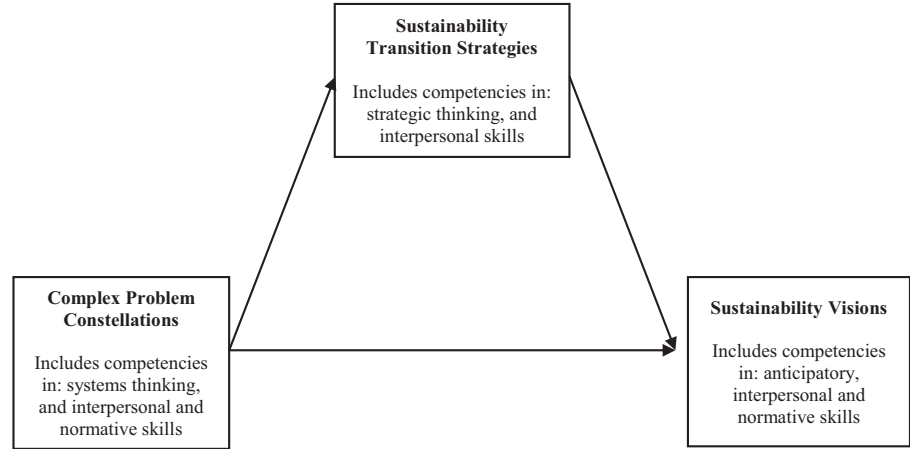
Building on Wiek's work, Savage *et al.* (2015) constructed a 15-item scale designed to assess the change in and acquisition of the five core sustainability leadership competencies. They tested the scale using pre- and post-assessments completed by undergraduate students who participated in an experiential learning program. The current research extends the conceptual work of Wiek *et al.* and the empirical measurement work of Savage

Figure 1.
Conceptual model of
acquisition of key
competencies in
sustainability
leadership training*

by developing and testing a model of key sustainability leadership competencies. First, the underlying structure of [Savage et al.'s \(2015\)](#) instrument is assessed using factor analysis. Following this, the relationships among the competencies are empirically assessed using multiple regression to predict relevant outcomes for the Ecuadorian high school students who participated in the sustainability leadership program.

[Figure 1](#) depicts the proposed conceptual model of the acquisition of key competencies in sustainability leadership training for the current research. This model reflects a more parsimonious approach to [Wiek et al.'s \(2011\)](#) conceptual competencies framework and is grounded in this study's empirical results pertaining to [Savage et al.'s \(2015\)](#) competencies scale. In addition, this paper includes qualitative examples from the high school students' journals to illustrate their first-hand experiences of these competencies in the leadership training program.

The conceptual model proposed in [Figure 1](#) from [Wiek et al.'s \(2011\)](#) integrated sustainability and problem-solving framework is modified in this paper for three reasons. First, as shown in the results section below, factor analysis of the 15 items in [Savage et al.'s \(2015\)](#) sustainability leadership competencies scale did not yield a clean five-factor pattern matrix that corresponds to the five core competencies that it was designed to measure. The factor analysis results suggest that there is considerable overlap particularly in terms of collaborative competence and normative competence items that loaded with systems thinking, sustainability strategies and anticipatory outcomes items. As noted in [Wiek et al.'s](#) subsequent [Figure 2](#) (p. 206), where they linked the five core competencies to the problem-solving framework, their model also suggests that there is considerable overlap in terms of how interpersonal and normative competencies are linked to sustainability strategies, dealing with complex problems and future scenarios/sustainability visions. For example, they proposed that interpersonal competencies are related to all of the underlying concepts of complex problems, strategies and future outcomes. Similarly, normative competencies are related to both dealing with complex problems and anticipating future visions and scenarios. Thus, the second reason for adopting [Wiek's](#) more parsimonious [Figure 1](#) over the more convoluted [Figure 2](#) is that it offers a more realistic guiding framework for



Sources: *Adapted from [Wiek et al.'s \(2011\)](#); [Figure 1](#) (p. 205) and [Figure 2](#) (p. 206)

operationalizing the core sustainability leadership competencies in relation to one another. Finally, the qualitative comments from the high school students' experiences offer strategic illustrations of the learning and problem-solving process as depicted in [Figure 1](#).

The proposed model includes three core organizing concepts:

- (1) complex problem constellations;
- (2) sustainability transition strategies; and
- (3) sustainability visions.

Complex problem constellations refer to being able to analyze, assess and apply problem-solving frameworks to complex sustainability problems. It involves a holistic, systems thinking approach that may be cross-disciplinary and cut across different domains or sectors. Sustainability transition strategies are grounded in strategic thinking in introducing transformational sustainability actions and transition strategies ([Wiek et al., 2015](#)). It involves assessing resources, designing sustainability plans or interventions and carrying them out. Sustainability visions are the ability to anticipate and predict the outcomes of interventions applied to sustainability problems that may require dealing with uncertainties.

As suggested by [Figure 1](#), it is hypothesized that the extent to which students feel they are competent in understanding complex sustainability problems is related to their sustainability visions. This understanding that is primarily rooted in systems-thinking competence refers to their ability to analyze complex situations and/or systems and understand the linkages among structure and function and cause and effect. Much of this competency, reflected in this broader concept of complex problem constellation, was initially acquired through the classroom component of the internship program. Over a period of one month, the SEDV interns provided 12 two-hour workshops to the high school students on the following topics: sustainable development; leadership and agents of change; types of energy and energy conservation; waste management, water awareness and management; and project management[1].

In addition, [Figure 1](#) suggests that gaining first-hand experience in implementing sustainability strategies is also relevant in bringing about the desired anticipatory sustainability outcomes. High school students' involvement in the community-based projects provided them the opportunity to put into action specific sustainability strategies for their community by actively engaging in various activities, such as environment-related scavenger hunts, demonstrations of land pollution and its impact on waterways, waste and biodigester models, nursery field trips and environmental impact reduction exercises.

At the end of the program, the high school students either presented or demonstrated a project that could help improve the environmental health of their community to key community stakeholders. Because improvement of the environmental condition of our planet requires a joint effort, the high school students worked together in small groups to develop their presentation or model project. It is proposed that competencies in sustainability strategies depend on their ability to understand complex sustainability problems. In addition, high school students' applied skills and experience in sustainability strategies are expected to partially mediate the relationship between their textbook learning and their sustainability visions for the future.

Mixed methods

Both qualitative and quantitative data were collected to determine the extent to which high school students can potentially become agents of change in their local communities as a result of participating in a formal internship program. The quantitative data were collected

through a 15-item scale that provided a broad assessment of the overall impact of the internships. The qualitative data were collected through journals and on-line interviews, which added depth and insight to the quantitative results. The methods of data collection are described in more detail below.

Quantitative data collection

[Savage et al.'s \(2015\)](#) 15-item Sustainability Leadership Certificate scale was used in pre- and post-assessments completed by the Ecuadorian high school students before and after their participation in the internship program. The items were translated into Spanish and the statements were adjusted slightly to use wording that would be more understandable to high school students while maintaining the same meaning of the original items. The high school students were asked to respond to the 15 items with a 10-point response set. The instructions stated: On a scale of 1 to 10 with 1 representing "not confident" and 10 representing "totally confident," how would you classify your confidence with respect to each statement?

Before their first workshop, all high school students participating in two of the communities ($n = 80$ students) were given the pre-assessment survey and asked to indicate their confidence in regard to the 15 items. Data were not collected in the third community because of a slightly different design of the workshop in that community. However, this only excluded potential responses from approximately ten high school students. At the end of the experience, the same 15 items were given as a post-assessment survey to the same 80 students. The model presented in this paper is primarily based on the high school students' post-internship experiences.

Quantitative data analysis

First, paired sample mean difference tests were conducted on the 15-item pre- and post-assessments completed by the high school students to determine whether they had changed their understanding of the sustainability concepts before and after engaging in the internship workshops. Then, the 15 items of [Savage et al.'s \(2015\)](#) sustainability leadership competencies scale were factor analyzed to determine whether they loaded on the five core competencies as set out in the sustainability literature and more specifically based on [Wiek et al.'s \(2011\)](#) conceptualization. Once the best fitting factor structure of the items was determined, mediation analyses were performed to estimate the relationships among the competences and how these relate to the outcome variable of interest. The [Sobel \(1982\)](#) test was used to statistically assess the effect of the proposed mediator (sustainability transition strategies) on the predictor (complex problem constellation) and outcome (sustainability vision) relationship. The Sobel test is basically a specialized t -test that is used to determine whether the reduction in the effect of the independent variable, after including the mediator in the model, results in a significant reduction and therefore whether the mediation effect is statistically significant. The results of these analyses are discussed in more detail below.

Qualitative data collection

During the month of the internship, the high school students were asked to periodically reflect on what they had learned and how their new knowledge impacted them in a journaling format. The high school students also filled in an online or hard copy interview with a few open-ended questions. Quotations from their journals are integrated into the discussion to provide understanding and richness to the quantitative statistical analysis.

Qualitative data analysis

The journal data were reviewed to obtain a general understanding of the high school students' impressions of their experience. Their journal data were analyzed using a directed content analysis approach (Hsieh and Shannon, 2005). The goal of a directed approach to qualitative content analysis is to support and extend existing theory and research. Prior research and theory on sustainability leadership competencies and sustainability community-based internships were used to help determine the initial coding scheme for the key concepts of interest as well as guide the discussion of the findings. The broad guiding coding themes of interest included references to systems thinking, sustainability actions and strategies and sustainability visions.

Results

Factor analysis results

The 15 items from the sustainability scale were factor analyzed using maximum likelihood/Oblimin with Kaiser normalization. Missing data were excluded with listwise deletion. The factor analysis showed two distinct factors. Two items (8 and 12) were excluded from the final analysis because of their cross loadings on Factors 1 and 2. Items with loadings higher than 0.5 were retained, as exhibited in Table I. These factors are identified as the complex problem constellations (Factor 1) and the sustainability transition strategies (Factor 2) based on Wiek *et al.*'s conceptualization (2011 and 2015). The reliability analysis revealed Cronbach's α of 0.90 for Factor 1 with six items and 0.85 for Factor 2 with five items. All items were summed and divided by the number of items to compute an overall mean score for each variable.

The complex problem constellations measure includes items reflecting aspects of system thinking, and interpersonal and normative competencies, which is consistent with Wiek *et al.*'s (2011, p. 206) Figure 2 model. The high school students gave numerous examples in their journals of their awareness of the complexity of sustainability issues. They mentioned the importance and challenges, for example, of reducing all types of pollution to protect the environment. They described how they *now* understand how this may be done, and offered a wide range of ideas, such as educating others, reducing pollution, introducing a good waste management plan and

| Survey items | Factor 1 | Factor 2 |
|--|--------------|--------------|
| Q1. Articulate a vision of a just and sustainable society | <i>0.965</i> | −0.103 |
| Q2. Account for individual and cumulative social, environmental and economic implications of a decision or process | <i>0.810</i> | 0.095 |
| Q3. Analyze complex problems drawing from multiple disciplines | <i>0.761</i> | −0.017 |
| Q5. Collectively assess the current and future states of social-ecological systems | <i>0.688</i> | 0.071 |
| Q15. Work together across differences (e.g. discipline, sector, nations, perspectives and professional/non-professional) | <i>0.652</i> | 0.021 |
| Q14. Understand your own strengths and weaknesses as a sustainability leader | <i>0.549</i> | 0.280 |
| Q13. Understand the future as open and something that we can help to shape | −0.127 | <i>0.822</i> |
| Q4. Assess the resources available and necessary for an action | 0.125 | <i>0.743</i> |
| Q9. Motivate positive change in others | 0.037 | <i>0.705</i> |
| Q11. Pursue collaborative approaches to problem-solving | 0.207 | <i>0.571</i> |
| Q7. Design integrated actions that draw on resources from across disciplines | 0.261 | <i>0.512</i> |

Note: ^aMaximum likelihood/Oblimin with Kaiser normalization; the items in italics show which items load on each factor

Table I.
Results of
exploratory factor
analysis^a

learning more. They described how they personally were committed and understood what changes they could make as well as changes that “we” as citizens can make. For example, several high school students wrote the following:

We, the human beings, are destroying our planet; we contaminate the air, water and land. For this reason, I now understand that we must take care, protect, and value what is around us. I must take care of my body as we must take care of nature. I learned to take care of nature and not to unjustifiably pollute it. We must plant trees, take care of animals, not throw garbage into the rivers, and conserve the environment for the future of our children.

The sustainability transition strategies include items that reflect aspects of strategic and interpersonal competencies also consistent with [Wiek et al.'s \(2011\)](#) Figure 2. The high school students gave examples of how they are now more aware and confident in introducing potential strategic responses to sustainability issues. For example, some of their comments highlight their recognition of the resources available that reflect community involvement and teamwork, and how essential education and dialogue are for making things happen:

We need to teach the kids and adults not to throw garbage on the ground [...] in that way, we learn to preserve the environment in which we live. I can reflect and share my knowledge with my community to preserve our rivers. The teamwork is the best. From that, we learned to create conversation among our teammates and to give our opinions. We must tell everyone that we need to work together to take care of our planet and protect the environment from pollution. We need to work together to achieve great things.

Items 6 and 10 are both identified as indicators of anticipatory competency in [Savage et al.'s \(2015\)](#) study. Specifically, these refer to students' assessments of their confidence to “deal with uncertainty and future predictions” and “predict and consider possible repercussions in our actions and decisions prior to their implementation.” The two items were combined to construct a single measure of sustainability visions, which is consistent with [Wiek et al.'s \(2011\)](#) conceptualization. The two items were summed and averaged to compute a mean score of sustainability visions with a Cronbach's α of 0.78. Comments from the high school students' journals illustrate their confidence in knowing what comes next. Their comments suggest that they are optimistic and have the understanding and skills to implement sustainability strategies in the future. For example:

We can change the world by doing good deeds to help not destroying the world. What I learned, and this is crystal clear for me, is that we must preserve the water since it is vital for human survival [...] now I know a lot of things that will be really useful for me. Reflect and question ourselves about how we can prevent the pollution of the environment and global warming. I feel really satisfied and ready to participate.

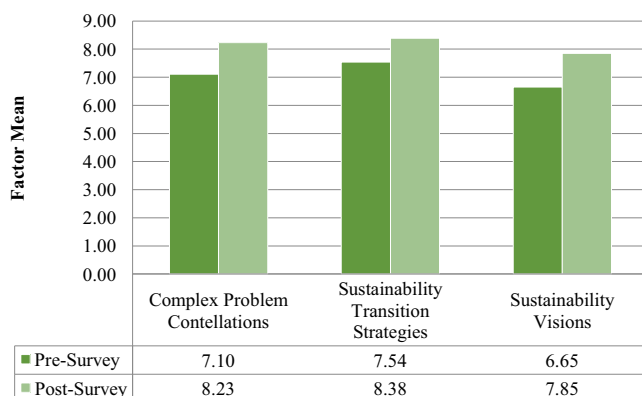
Mean difference tests

The results of the mean difference tests showed significant differences in the pre- and post-assessments of the Ecuadorian high school students' confidence in complex problem constellations, sustainability transition strategies and sustainability visions.

The results indicate an improvement of 16, 11 and 18 per cent in the high school students' confidence with regard to complex program constellation, sustainability transition strategies and sustainability visions, respectively, as observed in [Figure 2](#).

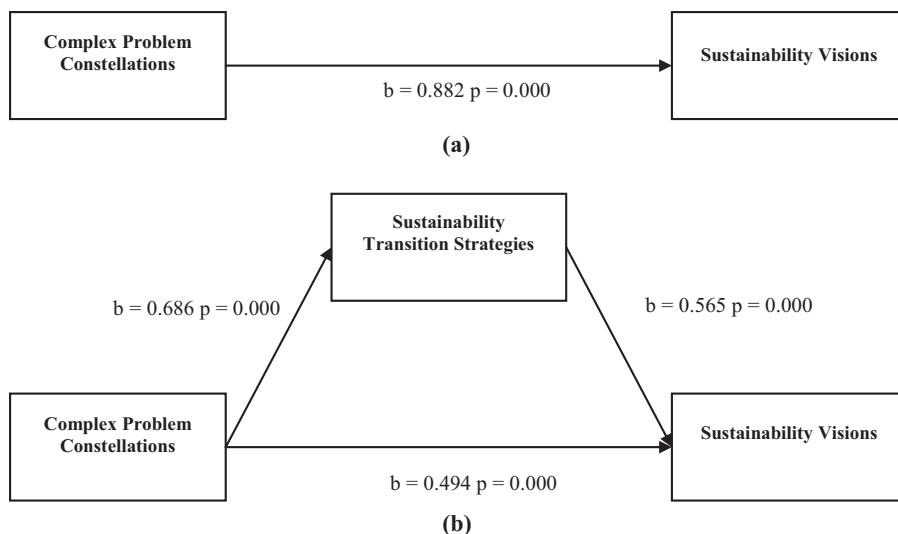
Mediation analysis results

To test the relationships represented in Figure 1, a two-stage regression analysis was carried out, and the results are summarized in Figure 3. First, the direct relationship between complex problem constellations and sustainability visions was examined, which is statistically significant and positive ($b = 0.882$). The more confident the students feel in understanding complex sustainability problems, the more competent they feel in dealing with future sustainability situations. Next, whether sustainability transition strategies mediate the relationship between complex problem constellations



Notes: $n = 80$; *All pre- and post-assessment differences are statistically significant at the 0.05 level (two-tailed test)

Figure 2.
Mean differences in
pre- and post-
assessments



Notes: (a) Direct path results; (b) mediated path results

Figure 3.
Mediation regression
results for
sustainability visions

and sustainability visions was explored. The results in Figure 3 show that the relationship between the complex problem constellations and the sustainability visions is mediated by sustainability transition strategies. The results presented in Figure 3, as well as the results of the Sobel test ($z = 4.8167, p = 0.000$), suggest that the association between complex problem constellations and sustainability visions is partially mediated by sustainability transition strategies. This suggests that not only having a good sense of systems thinking and understanding of complex sustainability results in more confident sustainability visions, but also the hands-on experiences and applications obtained during the internship are significant in understanding students' anticipatory confidence in pursuing their sustainability vision.

In practice, the model as shown in Figure 3 was reflected in the classroom by the transition that the high school students experienced from the first day of the workshop to the presentation of their final projects, three weeks later. The pre-assessment results and the field experience showed that high school students were already aware of pressing environmental issues in their communities and had a sense of the necessity for conservation. However, the interconnections between the three pillars of sustainability and the different elements of a system were not clear enough for them to propose holistic solutions. Similarly, they were not able to propose transition strategies beyond conservation. In particular, waste management, quality of drinking water and cooking gas supply were some of the concerns of the local community.

The first portion of the workshop provided them with the knowledge to understand how waste management could affect or improve the quality of their drinking water and at the same time that waste was a potential source of energy. The second part of the workshop, which aimed to present tools for sustainability transition strategies, allowed them to propose the use of a biodigester for the management of waste water and biodegradable waste that could improve the quality of their drinking water and supply a source of cooking gas. Beyond that point, high school students started seeing and wondering about future scenarios, with and without sustainability transition strategies. For instance, they asked how the reduction of consumption/waste could affect their local economy and how a government project for electric stoves could be a more efficient and reliable source of energy compared to propane. Their final projects proposed strategies to solve complex problems of the local community and promote eco-tourism.

One of the final projects aimed to reduce plastic waste and improve the local economy by reintroducing an ancestral tradition from an Ecuadorian indigenous group, the Yumbo. The project consisted of fabricating reusable bags from natural fibers to be distributed around the hotels, tourist services providers and convenient stores. The reusable bags would be fabricated by local people who had the traditional knowledge, and they could be sold, rented or lent as part of an eco-tourism program of the town. In this way, a tradition would be reintroduced to create a local business, plastic waste would be reduced and tourists would be educated to promote eco-tourism.

Discussion

The results of this paper offer five key contributions:

- (1) measurement analysis of Savage *et al.*'s sustainability leadership competencies scale;
- (2) development and test of a model of sustainability leadership competencies;

- (3) practical development and implementation of internship programs in sustainability leadership;
- (4) identification of concrete benefits of the program to high school students and their communities; and
- (5) an illustration of a role for educational institutions in fulfillment of the UN sustainable development goals.

Each of these contributions is discussed more thoroughly below.

Measuring and modeling sustainability leadership competencies

The results of this research support the concepts and model proposed by [Wiek et al. \(2011\)](#) that they developed by integrating the sustainability research and problem-solving framework. The process of learning is not simply one where perceived competence in understanding complex problems results in confidence in new visions or interventions; rather, the latter also depends on believing in one's ability to implement a strategic intervention which is a competency usually acquired through the internship experience rather than the classroom setting.

The results of this study suggest that the five core competencies (systems thinking, strategic, anticipatory, normative and interpersonal) may not be as uniquely discrete as suggested in the literature. For example, and consistent with [Wiek et al.'s \(2011\)](#) integrative model (Figure 2), the core competency of interpersonal skills underlies all four aspects of the problem-solving framework (e.g. sustainability transition strategies, complex problem constellations, future scenarios and sustainability visions). The factor analysis results of this study show several items that reflect interpersonal skills loaded highly on the other factors. Thus, the journey toward sustainability necessitates collaborative efforts and diverse, innovative points of view. Therefore, it is clear that interpersonal skills are essential for achieving sustainability objectives.

The results of this study suggest that the measurement of key competencies in sustainability and the modeling of their relationships are more complex than portrayed in the literature but in other ways are more parsimonious. More research is required on this topic to validate the learning model and provide greater insight. For example, more attention should be devoted to assessing and developing measures of the core competencies concepts in terms of their construct validity and multi-dimensionality. As well, additional applications and tests of our proposed model of sustainability leadership competencies could help to assess the validity and generalizability of our findings.

Practical development and implementation of internship programs in sustainability

This paper provides a practical example of how an institution can carry out the principles avowed in its Institutional Sustainability Strategy. The principles of social responsibility, engagement, experiential learning, capacity-building, diversity, and entrepreneurialism can be executed by transforming the campus into a learning lab. Students need experiential learning outside the classroom to make sustainability come alive. Theoretical core competencies identified by [Wiek et al. \(2015\)](#) were put into practice through an internship program by connecting high school students with university interns who were earning a Master of Science in SEDV. Systems thinking, partially mediated by hands-on sustainable action plans, appears to help build anticipatory outcomes, such as dealing with uncertainty and predicting consequences of today's decisions and their effect on the planet in the future.

Concrete benefits to high school students and their communities

The results of this research show that the high school students gained a greater understanding of systems as well as sustainable actions by participating in the program. What cannot be readily measured is the passion and energy that developed within the high school students to become agents of change for their respective communities. As observed through the sustainability scale analysis of pre- and post-experience assessment, these local students became more confident to anticipate and embrace change in the future. However, it is not clear whether their enthusiasm to be agents of change in their community will be short-lived and fade after the SEDV interns leave or whether it will lead to long-term continuous improvement within their communities. The following two quotes illustrate the passion of the high school students who participated in the program that hopefully also reflect their long-term commitment to their sustainability visions and aspirations:

Nature is something really attractive and it is what gives us life; that is why we need to protect it so much.

The environmental problems affect the wellbeing and quality of life of everyone. Therefore, they should not depend upon the free will of people (whether people want to approach those problems or not). Citizens must be more aware of the problems. We must demand respect for the environment. The individual contribution of the citizens can be really great in some aspects.

Fulfillment of the United Nations sustainable development goals

The results of this research has illustrated that institutions of advanced learning can play a significant role in the fulfillment of the UN sustainable development goals, especially Goals 4 and 17. Goal 4 is to “ensure that all learners acquire the knowledge and skills needed to promote sustainable development” (United Nations, 2015, p. 15). The internships through community-based, experiential learning accomplished Goal 4 through the structure suggested in Goal 17, by “implementing effective and targeted capacity-building in developing countries” (United Nations, 2015, p. 27). By using their areas of strength, universities can identify opportunities to build capacity in emerging market economy countries. In this case, the opportunity presented itself through a North–South partnership through University of Calgary and nonprofit organizations. However, many other partnerships, alliances or cooperative arrangements are possible. Institutions as well need to reach out and welcome non-conventional ways of learning to become agents of change regarding sustainability education that will result in definitive outcomes.

Conclusions

This research has advanced knowledge by investigating the ways that university internships can help achieve the UN sustainable development goals through partnerships that bring education for sustainability to high school students in developing countries. By statistically testing a model of leadership competencies, based on previous work, our research has shown that both systems thinking that addresses complex problem constellations and sustainable actions that evolve from sustainability transition strategies are essential to develop anticipatory thinking for visions of a more sustainable planet in the future. This is consistent with the theoretical work of Capra (2007), Sterling (2010) and Orr (1991) and others that advocate not only for a strong theoretical background in sustainability competencies but also for action-oriented, community-based learning that is more closely tied to the development of

sustainable communities. Our research offers empirical evidence for the necessity of both approaches to education for sustainability.

Integrated within these competencies are the cultivation of interpersonal skills and normative thinking. University internships provide opportunities not only for the high school students that engage in the workshops but also for the university interns who provide the workshops and who learn to recognize how classroom theories and concepts can transform into practical, relevant projects that are appropriate for the local communities in which they work. Although the sample under study was relatively small, the results support the view that scholars of environmental education must be open to using a variety of learning methods that are underpinned with experiential learning to shape the visions and goals of the sustainability leaders of tomorrow. Moreover, while sustainable development is a complex, multifaceted concept, we suggest that the process can be broken down into realizable, measurable steps.

Although the opportunity for transformative change was evident in each of the communities when the SEDV student interns left, a longitudinal study involving participants in each of the communities would provide evidence to determine whether the extent to which their commitment to community transformation will have a lasting effect. Will the high school students be agents of change in each of their respective communities or will the energy wane shortly after the departure of the SEDV interns are important questions to be addressed in future research. Mobilizing high school students, with university interns as mentors, is a promising model for the future, especially where interdisciplinary and intercultural opportunities, as presented in this paper, are addressed.

Note

1. Details of the Workshop can be provided by the authors on request.

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