



Real-world learning opportunities in sustainability: from classroom into the real world

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Abstract

Purpose – Academic sustainability programs aim to develop key competencies in sustainability, including problem-solving skills and the ability to collaborate successfully with experts and stakeholders. These key competencies may be most fully developed in new teaching and learning situations. The purpose of this paper is to analyze the kind of, and extent to which, these key competencies can be acquired in real-world learning opportunities.

Design/methodology/approach – The paper summarizes key competencies in sustainability, identifies criteria for real-world learning opportunities in sustainability programs, and draws on dominant real-world learning models including project- and problem-based learning, service learning, and internships in communities, businesses, and governments. These components are integrated into a framework to design real-world learning opportunities.

Findings – A “functional and progressive” model of real-world learning opportunities seems most conducive to introduce students (as well as faculty and community partners) to collaborative research between academic researchers and practitioners. The stepwise process combined with additional principles allows building competencies such as problem solving, linking knowledge to action, and collaborative work, while applying concepts and methods from the field of sustainability.

Practical implications – The paper offers examples of real-world learning opportunities at the School of Sustainability at Arizona State University, discusses general challenges of implementation and organizational learning, and draws attention to critical success factors such as collaborative design, coordination, and integration in general introductory courses for undergraduate students.

Originality/value – The paper contributes to sustainability education by clarifying how real-world learning opportunities contribute to the acquisition of key competencies in sustainability. It proposes a functional and progressive model to be integrated into the (undergraduate) curriculum and suggests strategies for its implementation.

Keywords Experiential learning, Competences, Higher education, Problem solving, Curricula, Sustainable development

Paper type Research paper



1. Introduction

The emerging academic field that focuses on sustainability[1] addresses complex problems that are characterized by long-term implications and non-linear behavior; cut across economic, social, and environmental domains on local to global scales; and display high degrees of urgency and damage potential (Kates *et al.*, 2001; Clark and Dickson, 2003). These kinds of problems, which most often manifest as a conglomerate of problems, call for sophisticated solutions and extensive problem-solving processes. The new field takes on this challenge by using systems-thinking, anticipatory, normative, and strategy-building methods in participatory, deliberative, and adaptive settings (Bäckstrand, 2003; Komiyama and Takeuchi, 2006; Blackstock and Carter, 2007)[2]. With its “post-normal” revision of ontological, epistemological, and methodological paradigms, the sustainability field challenges basic assumptions, practices, and institutions of established disciplines. In their inaugurating article of “sustainability science” in *Science*, Kates *et al.* (2001) point out that the sustainability field differs considerably in terms of structure, methods, and content from science as commonly understood by the scientific community. Applied to higher education, sustainability programs challenge both, what is taught in these programs and how (Cortese, 2003). If our graduates are to cope creatively and successfully with society’s most difficult problems, they must be exposed as students to those problems, and higher education needs to find innovative ways to develop students’ capabilities (Rowe, 2007). Literature on education for sustainable development calls for pedagogical innovations that provide interactive, experiential, transformative, and real-world learning (Steinemann, 2003; Rowe, 2007; Sipos *et al.*, 2008). Re-emphasizing the classic pillars of education promoted by UNESCO in 1996[3]. UNESCO’s (2009) Bonn Declaration calls for building the capacity to turn knowledge into action for sustainable development; it also calls for curricula to be reoriented to meet this goal.

This paper explores real-world learning opportunities in undergraduate and graduate sustainability programs. The authors analyze the literature on sustainability education to determine how much real-world learning opportunities can contribute to building key competencies in sustainability. They emphasize integrating real-world learning opportunities into undergraduate sustainability education, but most of the insights also apply to graduate programs. This paper focuses on undergraduate education for four reasons. First, students consider undergraduate education as very important in preparing for their professional careers in general (Bradburn *et al.*, 2005), and apparently for careers in sustainability in particular[4]. Second, an increasing number of universities intend to educate not just a few specialists, but a new generation of scholars and professionals who will participate in sustainability transformations (Moore, 2005; Crow, 2009; Arima, 2009). Third, a majority of faculty members in sustainability programs experience the paradoxical situation of being responsible for training students in areas in which they themselves have not been trained. Teaching undergraduate courses in sustainability enables faculty members to familiarize themselves with new paradigms without “losing face.” Finally, professional sectors increasingly seek expertise in sustainability when filling positions from entry to senior level International Society of Sustainability Professionals (ISSP, 2009).

This paper discusses experiences with real-world learning opportunities at the School of Sustainability (SOS) at Arizona State University (ASU). ASU-SOS is the first school of sustainability in the USA. Its mandate is to train a new generation of scholars

and practitioners capable of developing practical solutions for the complex challenges of sustainability (<http://schoolofsustainability.asu.edu/> and <http://newamericanuniversity.asu.edu/>). Conducting problem driven, solution-oriented research and providing real-world learning opportunities are the school's guiding principles.

2. Key competencies in sustainability

Because the discourse on competencies in sustainability has been documented and analyzed in a number of publications over the past few years (de Haan, 2006; Sterling and Thomas, 2006; Sipos *et al.*, 2008; Barth *et al.*, 2007; Wiek *et al.*, n.d.), this section briefly summarizes the key sustainability competencies[5]. A consensus has developed that sustainability education should include a variety of capacity-building pathways that engage “head, hands, and heart” (Bloom *et al.*, 1964; Orr, 2002; Sipos *et al.*, 2008). In a simple model, three clusters of key competencies can be differentiated:

- (1) The strategic knowledge cluster integrates systemic, anticipatory, normative, and action-oriented competencies, which each include content and methodological knowledge (de Haan, 2006; Grunwald, 2007; Wiek, 2007). The cluster includes competence in analyzing and understanding the status quo (current state) and past developments (history); creating future scenarios and sustainability visions; assessing current, past, and future states against value-laden principles of sustainability; and to developing strategies to move from the current state towards a sustainable future. Important in this cluster is competence in dealing with diversity of opinion, perspective, fact, preference, and strategy.
- (2) The practical knowledge cluster involves competencies necessary for “linking knowledge and action for sustainable development” to bridge the “knowledge-action gap” (van Kerkhoff and Lebel, 2006). Implementation skills, a critical component of “Gestaltungskompetenz” (implementation competence), require hands-on experience in putting knowledge into practice, and thereby testing the validity and robustness of action-oriented (strategic) knowledge about sustainability transitions and transformations (de Haan, 2006). Experiencing the opportunities in and constraints of various decision-making contexts (e.g. government and business) with respect to sustainability activities is prerequisite to designing and implementing successful sustainability initiatives at any scale.
- (3) The collaborative cluster involves competencies necessary to work in teams and in different knowledge communities (de Haan, 2006; Barth *et al.*, 2007; Sipos *et al.*, 2008). This cluster includes competence in engaging with stakeholders[6] establishing consistent vocabularies, and facilitating participatory research and decision making in collaboration with experts from academia, industry, government, and civil society. de Haan (2006) also argues for nurturing empathy and compassion in sustainability education, and is echoed by Barth *et al.* (2007). The motive for solving sustainability problems stems from a sense of solidarity with people and the natural environment. It is difficult to imagine making the effort necessary to accomplish the goals of sustainability in the absence of that motive.

3. The contribution of real-world learning opportunities to sustainability education

3.1 The concept of real-world learning opportunities in sustainability

The importance of real-world learning opportunities in sustainability has been clearly stated by the British Department of Education and Skills (2007): “Our students won’t just be told about sustainable development, they will see and work within it: a living, learning place in which to explore what a sustainable lifestyle means.” To integrate real-world learning opportunities into sustainability programs, faculty and staff can draw on a variety of models, including project- and problem-based learning (Blumenfeld *et al.*, 1991; Barron *et al.*, 1998; Dale and Newman, 2005), service learning (Jacoby, 1996; Fourie, 2003), and internships (Linn *et al.*, 2004). These models have in common a focus on real-world problems, and they expose students to the corresponding real-world settings in communities, businesses, and governments. Table I summarizes the different learning outcomes, activities, types of interaction, degree of linking theory and practice, and impacts of these models[7].

Not all real-world learning opportunities are appropriate for academic learning in sustainability programs: while some opportunities are more appropriate for extracurricular activities others are less suitable for sustainability, either because their relation to key features of sustainability has not been considered or because there is no relation at all. However, the functions of traditional models of real-world learning concepts are being reconsidered. Ward and Wolf-Wendel (2000), for instance, argue for a shift in perspective in service learning from “for the community” to “with the community”, and allude to the notion of “mutual learning.” Ward and Wolf-Wendel’s (2000) ideas suggest the potential to transform traditional models of real-world learning so that they account for key features of sustainability without sacrificing their typical outcomes (e.g. career development in internships, teaching, and learning in service learning). To identify real-world learning opportunities in sustainability and within an academic program, the authors follow Rowe’s (2007) criteria (Brundiens and Wiek, n.d.):

	Project-based learning	Service learning	Internship
Outcomes: what students learn/benefit	Collaborative problem-solving capacity	Education and teaching capacity	Professional working experience; career development
Practices: what students do	Collaborating with partners to develop solution approach	Educating people	Assisting or working on a professional project
Interaction with stakeholder	Two-way knowledge generation (co-production)	One-way knowledge transfer (students to community)	One-way knowledge transfer (employer to student and student to employer)
Integration of theory and practice	Explicit, supervised by faculty and stakeholder	Implicit, not supervised by faculty	Implicit, not supervised by faculty
Impacts on world	Systemic innovation	Support of social innovation and change	Modular innovation

Table I.
Overview of key differences among dominant models of real-world learning formats

- they address an actual sustainability problem/challenge, ideally brought to a higher education institution by community, business, administration, and/or campus partner(s);
- they provide students with the opportunity to apply the concepts and methods learned in the classroom to address the sustainability problem;
- they involve academic supervision by professors, as well as collaboration with community, business, administration, and/or campus partner(s) to develop a scientifically sound and socially robust solution approach; and
- they strive to produce a workable contribution to solutions, so that students understand how they can have a positive impact on the world.

These criteria are compatible with so-called transacademic (e.g. transdisciplinary, participatory, and community based) research and educational approaches. A common feature of these approaches is that scholars (here students, professors) collaborate with non-academic experts and laypersons (here community partners, stakeholders) in all phases of a research project. They engage as different but equal partners (different regarding expertise and experiences; equal regarding rights and obligations), producing outcomes that are scientifically sound, applicable, and respond to the needs and rewards structures of all parties (Scholz *et al.*, 2006; Hirsch Hadorn *et al.*, 2006; van Kerkhoff and Lebel, 2006; Wiek, 2007). It is a valuable educational experience for students to assess whether their preferred real-world learning opportunity complies with these criteria, and to what extent it could be framed accordingly.

3.2 Do real-world learning opportunities build key competencies in sustainability?

Evaluating the concept of real-world learning opportunities (Section 3.1) in the context of sustainability competencies (Section 2) is a first step toward aligning learning objectives (competencies) and learning formats (real-world learning opportunities) (Biggs, 1999)[8].

Real-world learning opportunities as defined here help students increase their understanding of sustainability problems (knowledge), and complement their methodological competence in applying problem-solving approaches (strategic competence cluster). Students critically reflect on, and negotiate with collaborating partners about, whether the proposed problem is a sustainability problem or can be reframed as a sustainability problem. Students negotiate, apply, and critically reflect on concepts and methods for problem solving (from systemically analyzing the problem to building solution strategies) in collaboration with their partners. Supported by academic supervisors and community project partners, these processes help students turn intellectual capability (concepts and methods) into practical competence. Students explore, recognize, and synthesize different knowledge claims and ways of knowing (Aikenhead, 2006) – a key competence for successful problem solving that is complementary to other key competencies.

Real-world learning opportunities allow students to gain hands-on experience in how to link knowledge to action for sustainability (practical competence cluster). According to the definition that the sustainability field is a solution-oriented field, real-world learning opportunities send students “where the rubber hits the road.” Linking knowledge to action requires students and their collaborating partners to ask critical questions (what works, what does not, why?) and give constructive feedback

(how could it work and why?). Students learn to develop sustainability strategies and programs in the actual context of existing processes, politics, or traditions. Exploring, evaluating, and negotiating the viability of solution approaches in the merciless light of this reality makes students aware of the powerful role of values, politics, and resources, and the difficult art of negotiation. Real-world situations force students to identify who is and who should be held accountable, to explore the difficulties related to holding people accountable, and to accept accountability for what students themselves did or did not accomplish with respect to the real-world learning project agreement. The notion of accountability is a distinctive added value of real-world learning opportunities, as regular classroom assignments usually do not involve collaboration between students and community partners (Bammer, 2005).

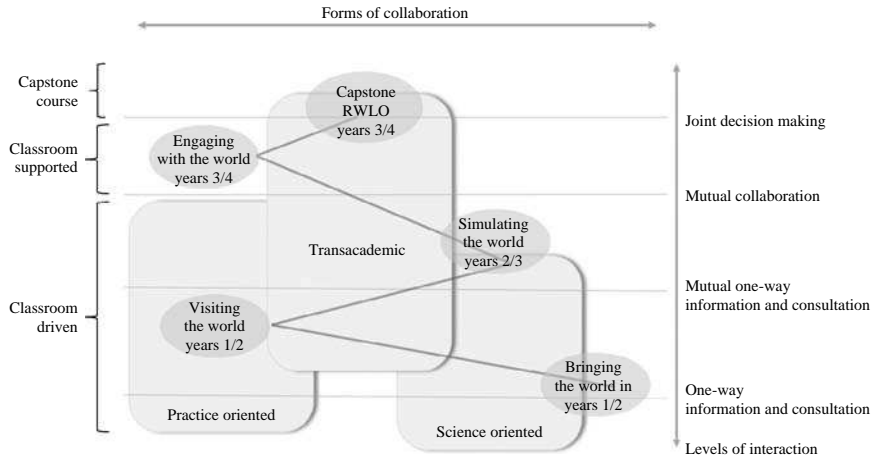
Real-world learning opportunities allow students to recognize and engage in different forms of collaboration at different degrees of intensity (collaborative competence cluster). Students evaluate participatory approaches and identify who needs to be involved and what level of interaction is adequate for the activity (Wiek, 2007). Students learn how to design and implement a collaborative process, build interpersonal skills, and reflect on their experiences. Given the contested nature of sustainability problems, students collaborate with experts and stakeholders who have different understandings of the problem and vision of its solution. Being a part of the professional and civic environment of these experts and stakeholders allows students to become familiar with different (sometimes conflicting) perceptions and values, and different (sometimes conflicting) processes of reasoning and decision making. Students begin to understand the different institutional contexts within which a sustainability problem exists and in how far this context influences which solution strategies are proposed and pursued by experts or stakeholders.

Real-world learning opportunities seem to be a suitable way for students to develop key competencies in sustainability. However, the “typical” differences among real-world learning opportunities (e.g. internships, service learning, and project-based learning) indicate that any of these three opportunities is likely to help students develop some key competencies but not others (Table I). Therefore, students (and their professors) need to be aware of which key competencies they need to develop and which real-world settings provide the appropriate opportunity to do so. A real-world learning opportunity that does not comply with all criteria spelled out in Section 3.1 might still serve as a “stepping stone” on the way of building students’ competencies in sustainability.

3.3 Sequence and formats of real-world learning opportunities in a sustainability program

Although real-world learning opportunities seemingly align well with key competencies in sustainability, the devil is in the details. The design and implementation of the learning opportunity largely determine whether the opportunity provides a real learning experience. This consideration, combined with the experience of a number of loosely structured, real-world learning opportunities, has led to ASU-SOS “functional and progressive” model of integrating real-world learning opportunities into the undergraduate curriculum (Figure 1). The goal is to prepare undergraduate students for the capstone experience, which is a graduation requirement. The model accounts for the diverse functions real-world learning opportunities fulfill, and for the sequential process of building sustainability competence through real-world learning opportunities.

Figure 1.
ASU-SOS' "functional and
progressive" model for
building sustainability
competence through
real-world learning
opportunities



Preparatory, class based, real-world learning opportunities are integrated into some of the required courses for undergraduate students (and could be integrated into all courses). They demonstrate how key concepts of sustainability (e.g. problem features, principles, and problem-solving approaches) materialize in practice.

ASU-SOS uses the functional and progressive model to plan the number of preparatory and capstone real-world learning opportunities in proportion to the number of students, staff, and instructors, and to classify incoming requests from community partners according to their usefulness as real-world learning opportunities.

Figure 1 shows the progression of classroom based, preparatory real-world learning opportunities that should prepare students for their capstone. Ideally, the progression occurs over four years and is shaped by three factors: the role of instructors, the level of interaction, and the form of collaboration. As students build competencies, the role of instructors in designing and facilitating real-world learning in the classroom decreases, while the level of interaction between students and community project partners increases. Students increasingly explore different forms of collaboration and analyze how a specific form influences whether and how knowledge is produced and who is producing and using it. Independent of this progression, students may choose to engage in additional, extracurricular, real-world learning opportunities. Figure 1 shows a linear progression in which real-world learning opportunities are assigned in a specific year of a student's program. In reality, undergraduate classes are usually attended by students from different levels.

ASU-SOS has initiated the following classroom-based formats for real-world learning opportunities (Figure 1).

Freshman and sophomore years (years 1 and 2):

- Bringing the real-world into the classroom (addressing real sustainability problems in class): students are required to identify a real-world problem, evaluate whether and why it is a sustainability problem, perform a stakeholder analysis, and formulate a problem-solving approach (what, why, how, who). Drawing on the principles for sustainability assessments (Gibson, 2006), students are asked to analyze and weigh trade-offs, cascading effects, and unintended consequences.

Before undertaking their individual assignment (e.g. critical essay), students conduct the same assignment in teams and present their findings to the class. Example: students investigated the case of Jackson Street rezoning and development (City of Phoenix) from a broad sustainability perspective, referring to academic articles and project material such as letters to City Council, minutes from meetings, proposals from developers, etc.

- Visiting the real world (fieldtrips with and without stakeholder involvement): in fieldtrips with little or no stakeholder involvement, students experience the sustainability issue in the real world, exploring how sustainability issues discussed in classroom materialize or fail to materialize. This exposure to the real world is critical to informed reflection (e.g. for the USA, the experience of using the bus and walking in urban areas is an essential basis for reflection on transportation). Fieldtrips that involve stakeholders increase exposure of students to the real world and to its stakeholders and thereby add interactive components. Students are required to ask relevant questions in order to explore with stakeholders the sustainability dimensions of an issue on site, in particular, how things are done, by whom, and why. Example: students met with representatives of Central Arizonans for a Sustainable Economy (CASE) who gave them a tour through the Jackson Street neighborhood. CASE works with all stakeholders involved in the planning process.
- Simulating the real world (role games as dry-run activities, and peer-review activities): role games build on previous assignments, e.g. “bringing the real world into the classroom.” Using problem analysis and stakeholder-network identification, students participate in facilitated role games to experience the dynamics of communication, learn how to deal with various perspectives, and evaluate their skill level in communication and conflict resolution. Role games require introductory and debriefing sessions. Example: students simulated one of the meetings convened by the City of Phoenix on the topic of Jackson Street.

Junior and senior years (years 3 and 4):

- Engaging with the real world (student teams conduct a semester-long case study that is part of a regular course): ASU-SOS is experimenting with two kinds of case studies. The first uses the campus as a living laboratory for sustainability. ASU’s Office of Campus Sustainability provides a class with opportunities to support the creation and implementation of sustainable practices on campus (e.g. facilities, operations, purchasing). In collaboration with their campus partners, student teams turn the opportunity into a real-world learning project that will make a useful contribution to campus sustainability (e.g. collaborating with University Sustainability Practices and Recycling to develop a policy for ASU’s Homecoming Celebrations to implement the zero-waste vision of ASU). The project can unfold over several semesters, because new teams can continue the work initiated in previous semesters (the course is offered every semester). This would require students to conclude each project in such a way that it can be continued by the next team and be further developed, implemented, or monitored. The other case study type strives to link theory and practice with a semester-long, transacademic case study in which students collaborate with community partners (e.g. the Arizona Department of Water Resources, ADWR). Results from the case study should

inform action programs and policies (e.g. the revision of the drought monitoring and preparedness program as well as related policies against a sustainability framework). The course iteratively combines three elements: theoretical background (concepts, methods and content), transacademic collaboration between students and community partners (in the classroom and in the field), and individual assignments that foster students' understanding of the relationship between theory and experience (ethical and experiential part).

- Capstone real-world learning opportunity and course. The capstone is designed to recapitulate previous curriculum content and to apply it to real-world sustainability challenges in order to further build problem-solving competence. Ideally, undergraduate students would take their capstone in their junior or senior years[9]. By their senior year, students should have taken all prerequisites for the capstone, which combines a real-world learning opportunity with a capstone course (Figure 2).

The capstone concept is explained in more detail in the following section.

3.4 Capstone

ASU-SOS currently accepts a variety of real-world learning opportunities for students' capstone. In the future, students will be able to select their capstone from several options (research, internship, collaborative project). The course for the capstone will be an advanced and reflective course provided by faculty to embed students' real-world learning experience in a classroom and peer-mentored learning setting. In the capstone course, students will recollect, synthesize, and apply knowledge and skills related to their real-world learning project. The course will support students in self-directed learning, critical thinking, and building peer-mentoring capacity. Figure 3 shows that – similar to the classroom-based real-world learning opportunities – each capstone option

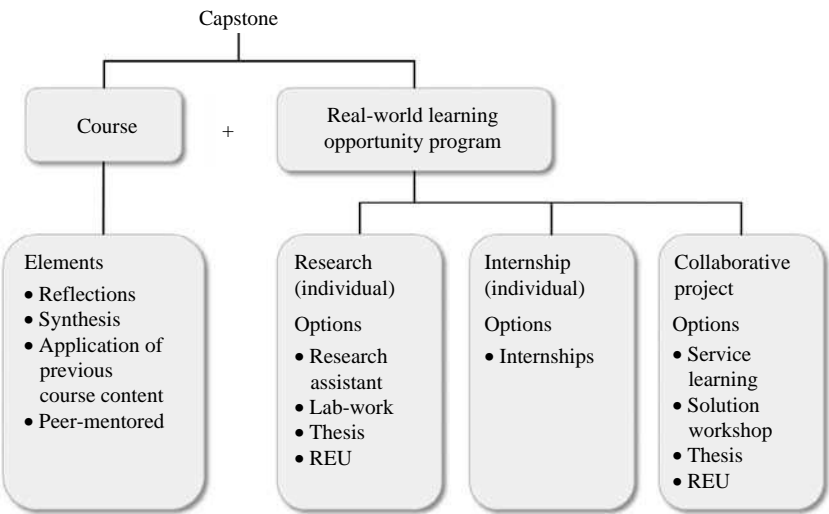


Figure 2.
Overview of the capstone,
comprising a course plus a
real-world learning
opportunity

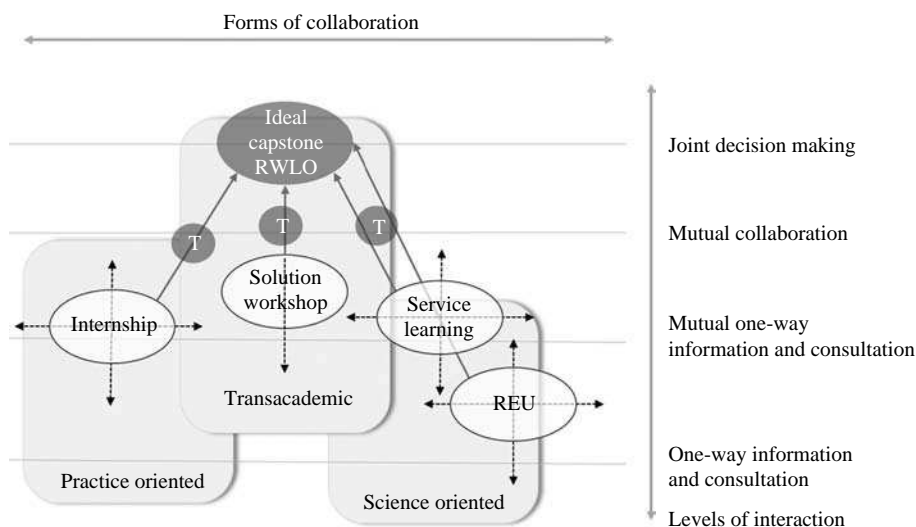


Figure 3. ASU-SOS' functional and progressive model, showing current positions of capstone options (dotted lines) and future transition paths (T) according to sustainability criteria

has its specific location in the functional and progressive model. This indicates that each capstone option is appropriate to help students develop some key competencies but not others.

Each capstone option currently involves a different set of key competencies. In the future, students will design their capstone option. They will be required to use three design principles: a project-based approach, a problem- and solution-oriented perspective, and the sustainability criteria described above in Section 3.1. This is critical to comply with the school's mission of advancing a genuine program in sustainability.

ASU-SOS has initiated and is developing the following real-world learning capstone options. ASU-SOS' Internship Program was based on traditional paradigms (focus on practical work and career development), with sustainability as an add-on feature. Experience and the effort to design a coherent capstone program are inspiring transformation of the internship model, while maintaining its focus: e.g. by framing the internship project with a sustainability problem, by identifying explicit links between theory and practice, and by increasing communication related to these activities between student and employer.

The goal of real-world learning opportunities in the research program is to enhance students' research skills. Capstone opportunities will derive from regular research activities (i.e. research assistantships, thesis projects, and laboratory work). The research program builds on Research Experiences for Undergraduates (REUs) programs funded by the National Science Foundation (for more detail see: www.nsf.gov/funding/pgm_summ.jsp?pims_id=5517&from=fund). In REU programs, undergraduate students work as research assistants to faculty members. In addition to their paid work, students contribute to research projects by undertaking their own independent research project. Students learn the process of rigorous research by being part of a research project (and often, team), and by working with the faculty mentors who guide their independent research. At ASU-SOS, students will extend the REU by implementing principles

of transacademic research in their real-world research project (e.g. identifying stakeholders, presenting their project to stakeholders, and integrating stakeholder feedback into the design and process of their research). The multidisciplinary and peer-review components of the capstone course enlarge the mandate to communicate science to broader audiences by requiring students to establish a dialogue with multidisciplinary and transacademic audiences.

Instead of conducting an individual project in the internship or research programs, ASU-SOS students can choose a Collaborative Project Course that includes Service Learning (in preparation), Solution Workshops (in place), and Study Abroad (in place but undergoing revision). In these courses, the real-world learning opportunity is divided into several sub-projects that are assigned to student teams. While working on a group project with their community project partners, students have to coordinate and integrate the services they provide to their partners (e.g. in the service learning) or synthesize results to create a coherent and comprehensive product (e.g. in the Workshop). In these Collaborative Project Course, student teams will work on their real-world learning opportunity in collaboration with their community project partners. In the supplementary capstone course, students will reflect on this experience and share it with students who have chosen real-world learning options from the internship or research programs.

4. Implementation challenges and coping strategies

ASU-SOS requires each of its undergraduate students (with a major in sustainability) to participate in a real-world learning opportunity as a capstone. How, then, can the school accommodate large numbers of incoming undergraduates and also provide high-quality sustainability education that gives value to community partners, stays within faculty and staff capacities, and keeps costs (money, time and energy) reasonable? Challenges and coping strategies are different for each group involved in real-world learning opportunities: students, faculty and staff, and community partners. Therefore, a program of real-world learning opportunities in sustainability in higher education must endeavor to design an integrated approach so that the opportunities provide benefits to each group.

From the university's perspective, the challenge is to develop extensive and rigorous opportunities (on campus or with local or distant partners) that:

- comply with the criteria identified for real-world learning opportunities in sustainability in academic programs, convey key competencies, and advance students' career trajectories;
- can be timed to academic semesters or summer and winter terms; and
- foster the integration of existing networks to help establish a regional "hub" at the university for a collaborative sustainability problem solving[10].

Universities need to find and provide incentives to faculty who are willing and prepared to supervise real-world learning opportunities. ASU-SOS has established a group of faculty and staff members to design an integrated program and process that deals with curricula, develops opportunities, evaluates expectations and outcomes, and advertises available opportunities to students. To promote staff and faculty participation, ASU-SOS works out schedules that allow group members to plan

real-world learning opportunities in all three programs ahead of time, and discusses rewards for such engagement in the promotion and tenure process[11].

Faculty members, in particular those with tenure homes in other departments, perceive challenges related to tenure reviews, their own disciplinary training and associated research and teaching experience, and the additional workload that goes with establishing and maintaining relationships with community project partners. Moreover, faculty members involved in sustainability studies are challenged to define their research and teaching in this vanguard. ASU-SOS offers faculty members the opportunity to provide input and feedback on tenure review, support structure, and curriculum design, thus ensuring faculty ownership of ASU-SOS' approach to real-world learning opportunities in sustainability.

Students worry to meet the requirements needed to graduate. They want clear information about "exactly" what they are required to do. It can be difficult to provide that kind of information when programs are in development. Holden *et al.* (2008) indicate that students are challenged by the self-directed learning approach that is expected of advanced students (at ASU-SOS, the capstone). Students come to sustainability programs with different backgrounds. A real-world learning program must therefore be flexible enough to respond to various levels of preparedness and find ways to leverage them for the benefit for all (e.g. through peer-mentoring). In addition to providing clear and comprehensive information, ASU-SOS will offer an introduction at the beginning of each semester that informs students about the real-world learning program (i.e. preparatory activities, key competencies and capstone), discusses the professional skills required to participate (e.g. project management), and helps students identify their real-world learning opportunity as a capstone and the key competencies they would like to work on.

Bouillon and Gomez (2001) describe the interest of community partners in working with students as wanting to contribute to students' education by providing a project to work on. But community partners also have expectations about outcomes and processes which need to be considered. And they are sometimes unfamiliar with collaborative ways to engage with scholars. Strategies for accommodating community-partner preferences emphasize professional and transparent communication, e.g. discussing with the community project partners their understanding of sustainability, their role in real-world learning opportunities, and their expectations regarding outcomes and processes. Presenting the pros and cons of working with students can encourage community project partners to actively participate in designing the learning opportunity. Clearly written documents help to detail issues, monitor progress, and facilitate communication among all parties involved. ASU-SOS has hired a former Internship Manager to set up its internship program, and will extend such professional management to its other capstone options.

5. Conclusions

Real-world learning opportunities can align well with key competencies in sustainability. However, students do not automatically build competencies when engaging in such opportunities. Opportunities need to incorporate three principles to be effective:

- (1) *Collaborative design.* Each real-world learning opportunity must be carefully designed and all partners involved need to agree on its various components.

Achieving agreement requires time for team-building and to clarify and negotiate roles, responsibilities, outcomes, and expectations. In the classroom-based preparatory activities, faculty or staff members find and arrange the real-world learning opportunity that students participate in and demonstrate ownership. In the capstone, students are expected to assume the responsibility for collaboratively designing the opportunity.

- (2) *Coordination.* The functional and progressive model requires that real-world learning opportunities build upon each other. To that end, the set of real-world opportunities needs to be coordinated between faculty who integrate preparatory activities into their regular courses, and faculty who provide and supervise capstone options.
- (3) *Integration in general introductory courses.* Because incoming students are usually unfamiliar with the concepts and practices of real-world learning, they need to be introduced to those models, methods, and tools. This could be done through integrating an introduction to real-world learning paradigms into a regular course, such as an undergraduate methods course or the general introductory course for freshmen. That way, faculty members who incorporate a real-world learning opportunity into their regular courses will not need to give students that introduction nor have to teach an additional course. Furthermore, it will be beneficial for students as the time otherwise used for introduction is now available for work on the real-world learning activities.

At many universities, real-world learning opportunities are as new as sustainability programs (usually only few years old). Exchange of experiences and mutual support among universities will be critically important to develop these pioneering efforts into sustainable academic structures and practices.

Notes

1. Some scholars articulate apprehension regarding the term “sustainability science” (Hirsch Hadorn *et al.*, 2006). Even if used in a broad sense including natural sciences, social sciences, and humanities, other important fields addressing sustainability issues such as engineering, design, and planning are not sufficiently captured and recognized under the term “science.” With the formulation used above, we propose to overcome all of these demarcations as the field develops its genuine program beyond disciplinary anchoring (Wiek *et al.*, n.d.).
2. We use the term “sustainability science” in a broad sense including natural sciences, social sciences, and humanities. Yet, we argue that these categories become obsolete as sustainability science develops its genuine program beyond disciplinary anchoring.
3. Education throughout life is based on four pillars: learning to know, learning to do, learning to live together, and learning to be (UNESCO, 1996, pp. 20-1, 37).
4. The number of undergraduate students enrolled in the Major in Sustainability at Arizona State University has increased from 181 (Fall 2008) to 551 (Fall 2009).
5. We focus here on key competencies that specify the genuine education in sustainability. This does not imply that “regular” competencies would not be relevant, but it puts emphasis on those competencies that are essential for sustainability and are not in the mainstream of traditional academic education.

6. We will use the terms “stakeholders” and “community partners” synonymously referring to the non-academic partners who collaborate as a project partners in real-world learning opportunities.
7. The table summarizes typical differences. Proposals to revise some of these paradigms have led to convergences (Ward and Wolf-Wendel, 2000).
8. An important element of Biggs (1999) “constructive alignment” is the evaluation, i.e. how we measure and evaluate whether students achieved the learning objectives and whether the learning formats are supportive for this. We do not elaborate on evaluative issues in this paper.
9. Students can take several real-world learning opportunities during their studies. They are required to take one as a capstone. However, given the rapidly increasing numbers of students and the real-world learning program being under development, ASU-SOS does, at this time, not actively encourage students to take additional real-world learning opportunities.
10. Working with communities to positively impact and balance their sustainable development is an important element of ASU’s identity as a New American University. ASU-SOS’ program of real-world learning opportunities helps implementing some of ASU’s “Design Principles” (e.g. Leverage our Place, Transform Society, and Be Socially Embedded). ASU-SOS is in a good position to help creating a Regional Center of Expertise (Mader, 2009; Fadeeva and Mochizuki, 2007).
11. Apart from common support, e.g. administrative and logistic support, lesson plans, and informal brown-bag meetings for exchange and capacity building among faculty, ASU-SOS also provides staff in the role as so-called “Transacademic Interface Managers” who are in charge to help design the real-world learning opportunities and facilitate the collaboration between external partners, faculty and students (Brundiars and Wiek, in press).

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