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Learning while transforming: solution-oriented learning for urban sustainability in Phoenix, Arizona

Arnim Wiek and Braden Kay

Conventional educational settings struggle with enabling students to acquire competence in collectively solving sustainability problems. Such competence is best conveyed in real-world learning settings. Solution-oriented sustainability learning (SOSL) programs create and utilize such settings. Here, students directly contribute to sustainability-oriented transformations of cities, businesses, or government organizations, *while* building their proficiency in sustainability problem-solving. SOSL programs, however, often face obstacles such as lack of faculty capacity and insufficient resources. This article reports on experiences from SOSL courses in Phoenix, as part of the SOSL program in the School of Sustainability at Arizona State University. Addressing accomplishments and challenges, we offer constructive lessons to other universities on how to start or enhance SOSL courses and programs.

Address
Arizona State University, School of Sustainability, PO Box 875502, Tempe, AZ 85287-5502, USA

Corresponding author: Wiek, Arnim (arnim.wiek@asu.edu)

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Key competencies in sustainability as reference framework for sustainability education

Employers, educators, stakeholders from across society, and students themselves are recognizing the need for transformational changes in the ways students are educated in sustainability. The still applied 'sender–receiver,' 'knowledge acquisition,' and 'problem-centered' models of higher education leave students ill prepared for the professional tasks of solving real-world sustainability problems. These types of problems, ranging from climate change to childhood obesity and violent conflicts, require students to acquire an integrated set of problem-solving skills or competencies, far more than a body of knowledge. Hence, pedagogy needs to re-focus on teaching students *how* to think, rather than *what* to think, while letting students apply this thinking to real-world sustainability problems [1,2,3•]. Such a comprehensive set of six competencies has been proposed as including: systems-thinking competence, future-thinking or anticipatory competence, value-thinking or normative competence, strategic-thinking competence, interpersonal competence, and integrated problem-solving competence [4–7].

In case of urban sustainability, for example, graduates should be able to develop, test, implement, and evaluate strategies for redirecting and transforming unsustainable urban development trajectories toward sustainable future dynamics. This calls for integrated problem-solving competence combining various skills. Current state, past developments, and future trajectories of the city need to get analyzed, which requires systems-thinking and futures-thinking competencies. They also need to get assessed against sustainability criteria to identify crucial trajectories, which requires value-thinking competence. Strategic competence enables developing and adapting action programs — guided by visions of a sustainable future, which requires future-thinking competence. Facilitating the collaboration of urban stakeholders, including scientists, policy-makers, planners, and citizens is crucial for understanding the city's complexity, crafting sustainability visions, and developing transformational strategies that are credible, shared, and actionable — which requires interpersonal competence.

Solution-oriented sustainability learning (SOSL)

SOSL is competencies-based and experiential, which allows students 'learning while transforming.' As such, SOSL is quite similar to participatory action learning, problem-based learning, project-based learning, and other active learning approaches [1,2,3•,8,9]. A key feature is that learning shifts from passive, that is, instructor delivers and students receive, to *active*, that is, students deliver while instructor receives and provides feedback. Students investigate real-world sustainability problems and work on evidence-supported solutions by engaging with stakeholders and collaborating in small interdisciplinary teams coached by instructors. Despite the commonalities with problem-based and project-based learning, the term 'solution-oriented sustainability learning' has been introduced to adequately reflect the shift from problem-oriented to solution-oriented efforts (cf. [10,11]). The concept of solutions as adopted here does *not* mean to look for 'quick fixes' — instead, solutions are

conceptualized as *evidence-supported* strategies that match the complexity of the problems they address [12]. SOSL follows this approach by educating students in how to generate and implement such evidence-supported strategies for sustainability-oriented transformation. We have further developed the SOSL approach, also accounting for international contexts [13,14].

The key features of SOSL are:

1. *SOSL familiarizes students with real-world sustainability problems and solutions*. Sustainability problems are significantly harmful and urgent, highly complex, and cannot be solved by simple remedies. They do not fall in any specific topical area, discipline, or expertise. Solutions to these problems are transformation strategies with the special features of being evidence-based, adaptive, and integrated. SOSL offers full exposure to both problems and solutions, from building problem awareness to learning about effective solutions, and training collective problem-solving capacity. In the ideal case, students contribute to developing viable transformation strategies to specific sustainability problems ('learning while transforming').
2. *SOSL trains students in evidence-supported sustainability problem-solving*. SOSL employs and conveys procedural frameworks for sustainability problem-solving [15]. Students learn how to frame and analyze problems, how to analyze and evaluate solutions, as well as how to design and test solutions (key competencies in sustainability — integrated problem-solving competence linking systems thinking, future thinking, value thinking, and strategic thinking). Thereby, students engage in solution-oriented scientific inquiry, producing and processing multiple and diverse data and information. The emphasis on *evidence-supported* solutions demarcates SOSL from other experiential learning settings with stakeholder engagement, such as service learning and internships.
3. *SOSL trains students in teamwork and stakeholder engagement*. SOSL is organized in semi-professional settings. First, students conduct their work in small interdisciplinary teams, which allows students collaborating across different disciplines and areas of expertise. Second, students engage in participatory problem-solving settings, involving stakeholders and experts from business, government, and civic society in the project. Both settings are not optional but *required* by the problems to be addressed and the solutions to be crafted — as they call for pooling experiences and expertise, negotiating values and preferences, as well as creating ownership and accountability. Students facilitate and engage in various forms of collaboration and engagement (with coaching), which is the most direct way for students to acquire professional skills (key competencies in sustainability — interpersonal competence).
4. *SOSL is self-guided and supported training*. The principle of 'learning while transforming' indicates the *educational* mandate of SOSL. The primary objective is *not* to develop solutions, the settings are *not* fully professional, and the students are *not* left without academic guidance (as they are largely in internships, for instance). Instead, the goal is to successively build students collective problem-solving capacity (key competencies in sustainability). Thus, instruction, feedback, continuous reflection, and (peer) evaluation are crucial ingredients of SOSL. The training scheme benefits from careful design of all course phases, including preparation and post-course extension.
5. *SOSL is facilitated through a novel type of instructors*. In SOSL, course instructors serve as coaches and facilitators for learning. Key tasks are to provide useful frameworks and tools, enable access to experts and funds, facilitate stakeholder and team interactions, and to guide reflection and (peer) evaluation [16•]. Compilations of useful resources for SOSL [9] as well as institutional commitment [17] are crucial factors for instructors to succeed in SOSL.

SOSL for urban sustainability in Phoenix

SOSL opportunities were offered in the School of Sustainability at Arizona State University since its inception in 2008 and fully fleshed out into a SOSL program in 2009 [17]. The School of Sustainability was inaugurated in 2007 and is the first school of its kind in the U.S. with genuine undergraduate and graduate programs in sustainability. It has currently (November 2014) 283 undergraduate students (majors), 125 graduate students (across the four master programs and the PhD program), and 30 appointed faculty. The school incorporates the design aspirations of Arizona State University as a 'New American University', including *Leverage Our Place*, *Transform Society*, and *Be Socially Embedded* (http://newamericanuniversity.asu.edu).

From its first inception, the SOSL program has incorporated courses developing solution options to *urban sustainability problems in Phoenix*. These SOSL projects were fostered by Arizona State University's 'New American University' aspirations and the School of Sustainability's commitment to urban sustainability teaching and research efforts that ought to positively impact communities in the Phoenix metropolitan area. With urban problems in focus, the SOSL program has joined national and international efforts. Urban sustainability problems pose daunting challenges and thus have been increasingly addressed in experiential educational projects over the years (e.g., [18–21,22•,23•]).

The majority of SOSL courses on urban sustainability have been offered through the *Urban Sustainability Transition Lab* in Phoenix, facilitated by a research group in the School of Sustainability at Arizona State University [24••].