**Appendices**

**Appendix 1: Current Learning Outcomes (LOs) of Flagship Sustainable Food Systems Undergraduate Programs in North America.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **University of Minnesota: Major in Food Systems** | **Montana State University: Sustainable Food and Bioenergy Systems Major** | **University of Rhode Island: Sustainable Agriculture and Food Systems** | **UC Davis: Sustainable Agriculture and Food Systems (Learning Objectives framed akin to LOs)** | **University of British Columbia: Land, Food, and Community Series** |
| 1. Foundational understanding in one or more bodies of knowledge related to food systems. 2. The ability to perceive, feel, think, and act systemically to address complex food-system challenges.2a. Systems Thinking2b. Problem Solving2c. Ways of Knowing2d. Ethics and Values2e. Self-Empowerment3. Foundational competence in communication regarding complex food systems challenges.3a. Effective Communication3b. Civic Engagement and Citizenship | 1. Be capable of systems thinking. 2. Have problem-solving skills. 3. Have practical skills. 4. Be capable of critical thinking. 5. Be effective communicators. 6. Have developed agency, or the capacity to make choices and act in a society framework. 7. Have a body of knowledge related to SFBS concepts.  | 1. Appraise the integrated nature of agricultural & food systems.2. Explain the scientific basis and interdisciplinary approaches used in the study of SAFS.3. Examine the dynamics of diversity, equity, access, and security in relation to elements in the food system.4. Discuss the different ways in which food is harvested, produced and used in different cultures.5. Evaluate which management practices are used in the sustainable production of food at scales from local to global.6. Evaluate the role of sustainable agricultural and food systems in producing healthy food that is equitable & accessible to all.7. Evaluate the interrelatedness between sustainable agriculture and food systems and culture, welfare, economy, and policy from the local to the global scales.8. Create local & global solutions to a wide variety of complex challenges related to sustainable agricultural and food systems using interdisciplinary approaches & teams.  | 1. Systems Thinking: Students are competent in the analysis of complex systems, integrating societal, environmental and economic perspectives. 2. Students reflect systems thinking in a deepening understanding of complexity, holistic approaches, and how the parts relate to the whole.3. Experimentation and Inquiry: Students formulate questions, investigate current knowledge gaps, develop sound research design, learn current research methods and perspectives, experiment with new approaches to scientific inquiry, and integrate scientific and practical knowledge.4. Interpersonal Communication: Students work in collaborative teams, present information for varied contexts and audiences, negotiate approaches and viewpoints and take leadership roles on important issues.5. Values: Students reflect critically on their own values and examine different paradigms and perspectives, seeing beyond objective data to understand how values shape commerce, research, policy and action in sustainable agriculture and food systems.6. Strategic Management: Students work to collectively design and implement interventions, anticipating future scenarios and adaptively managing information, human and natural resources for maximum impact.7. Civic Engagement: Students work to make a difference in the civic life of their communities, through both political and non-political processes. As part of a larger social fabric, students consider social problems to be at least partly their own; make and justify informed judgments; and take action when appropriate.8. Personal Development: Students seek deeper understanding of their own and thinking and learning processes. They can tolerate ambiguity, respecting those with differing opinions and beliefs, while setting firm standards for behavior and holding themselves and others accountable. Students work to promote open expression of individuality and diversity within the bounds of courtesy, sensitivity and respect. | 1.Use systems approaches to analyze food systems issues involved in building healthy, sustainable communities, both locally and globally.2. Select, evaluate and integrate inter-disciplinary evidence relating to food systems issues.3. Plan, implement and evaluate actions to address local and global food systems challenges.4. Collaborate and communicate effectively as members of diverse stakeholder teams.5. Critically reflect on personal growth, learning and responsibilities as professionals addressing food systems issues. |

**Appendix 2:** **Initial Content Analysis of Five Undergraduate SFS Programs in the U.S. and Canada, Meaning Units per Codes.**

|  |  |
| --- | --- |
| **Code** | **% Meaning units per code of total meaning units** |
| **Systems thinking** | 10% |
| **Interdisciplinarity** | 12% |
| **Experiential learning** | 7% |
| **Collective action\*** | 17% |
| **Critical reflection\*** | 14% |
| **Self-reflection\*\*** | 3% |
| **Open-ended case inquiry** | 11% |
| **Other** | 26% |

\* Identified as extensive themes. \*\* Underrepresented theme.

**Appendix 3: Refined Content Analysis of Five Undergraduate SFS Programs in the** **U.S. and Canada, Rating of Congruence of Coding Scheme with LOs of Analyzed Programs on a Scale from 0 (no congruence) to 2 (absolute congruence).**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Category** | **Condensed meaning unit** | **MSU** | **UBC** | **UMN** | **UCD** | **URI** |
| **Systems thinking** | Systems approach | 2\* | 2 | 2 | 2 | 0 |
| Holistic approach | 1 | 1 | 2 | 2 | 1 |
| Alternative models for food system change | 0 | 1 | 0 | 2 | 0 |
| **Interdisciplinarity** | Multi-, inter- and transdisciplinary approach | 2 | 2 | 1 | 0 | 2 |
| **Critical reflection** SubcategoryCritical thinking | Examination of diverse sources  | 2 | 2 | 2 | 2 | 0 |
| Consideration of different perspectives and worldviews | 1 | 1 | 2 | 2 | 1 |
| Consideration of power relations | 2 | 1 | 0 | 2 | 1 |
| Consideration of current events | 2 | 0 | 0 | 0 | 0 |
| **Critical reflection** SubcategoryResearch skills | Mastering of research methods | 0 | 2 | 2 | 2 | 0 |
| Identification of research questions | 0 | 2 | 0 | 2 | 0 |
| Research analysis | 0 | 2 | 0 | 2 | 0 |
| **Critical reflection** SubcategorySelf-reflection | Awareness of own learning processes | 0 | 2 | 2 | 2 | 0 |
| **Civic engagement** Subcategory Food system assessment | Analysis of FS processes and outcomes | 1 | 2 | 1 | 1 | 2 |
| Design of FS interventions | 2 | 2 | 0 | 2 | 1 |
| Assessment of FS interventions | 1 | 2 | 1 | 2 | 0 |
| **Civic engagement** SubcategoryCollective action | Engagement in community work | 0 | 2 | 2 | 2 | 1 |
| Service learning | 2 | 0 | 1 | 1 | 0 |
| Implement FS change  | 0 | 2 | 1 | 1 | 1 |
| Active role in society | 0 | 2 | 1 | 2 | 0 |
| **Practical skills** | Sustainable agriculture | 2 | 0 | 0 | 0 | 2 |
| Food distribution and marketing | 2 | 0 | 0 | 0 | 0 |
| **Communication skills** SubcategoryAcademic communication | Effective written, oral and media communication  | 2 | 2 | 2 | 0 | 0 |
| Nonverbal communication | 2 | 0 | 0 | 0 | 0 |
| **Communication skills** SubcategoryTeam skills | Effective collaboration  | 2 | 2 | 2 | 1 | 0 |
| Leadership | 0 | 0 | 2 | 2 | 0 |
| **Professional attitude** | Problem-solving | 2 | 0 | 2 | 0 | 0 |
| Respect for values of diverse stakeholders | 0 | 2 | 2 | 2 | 0 |
| Self-confidence | 2 | 0 | 0 | 0 | 0 |
| Promotion of individuality and diversity | 0 | 0 | 0 | 2 | 0 |
| Entrepreneurial attitude | 2 | 0 | 0 | 0 | 0 |
| Compassion | 0 | 0 | 2 | 0 | 0 |
| **Knowledge** | Food systems | 2 | 2 | 0 | 0 | 1 |
| Sustainability | 2 | 0 | 0 | 0 | 1 |
| Human nutrition, food safety | 2 | 0 | 0 | 0 | 1 |
| Bioenergy | 2 | 0 | 0 | 0 | 0 |
| Ecology | 2 | 0 | 0 | 0 | 1 |
| Organic and local food production | 2 | 0 | 2 | 0 | 1 |
| Plant and animal science | 2 | 0 | 0 | 0 | 2 |
| Economics | 2 | 0 | 0 | 0 | 1 |
| Food policy | 0 | 0 | 0 | 0 | 2 |
| Marketing | 0 | 0 | 2 | 0 | 0 |

\* We assigned the number 2 when the meaning unit was literally addressed in the respective institutional LOs, the number 1 when it was partially or indirectly addressed, and 0 when there was no congruence.

**Appendix 4: Results of Surveys of SFS Education Experts Expressed as Rating of the Relevance of a LO and Percentage of Respondents’ Choices regarding one Preferred Framing of the Respective LO.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Learning Outcome** | **Rating\*** | **Options** | **Overall****(%)****(n=45)** |
| **Systems thinking** | 8.9 | **Analyzes complex problems using a systems approach.\*\*** | **69** |
| Analyzes food systems issues using a holistic approach. | 1 |
| Using a systems approach, (the student) compares and assesses alternative models for food system change. | 30 |
| **Interdisciplinarity** | 9.2 | **Analyzes food systems issues using multi-, inter- and trans-disciplinary approaches.** | **66** |
| Analyzes food systems issues examining different perspectives and worldviews. | 34 |
| **Critical reflection, Subcategory Critical thinking** | 9.5 | Examines and evaluates different sources and perspectives. | 14 |
| Evaluates sources of information for accuracy and bias. | 23 |
| Understands how values shape commerce, research, and policy. | 19 |
| **Evaluates sources of information considering current events.** | **44** |
| **Critical reflection, Subcategory** **Research skills** | 9.5 | Applies adequate research methodologies in FS related disciplines and has the capacity to interpret findings. | 20 |
| **Investigates current knowledge gaps, applies correct methodologies, integrating scientific and practical knowledge.** | **48** |
| Analyzes and critically evaluates arguments and evidence. | 32 |
| **Critical reflection, Subcategory Self-reflection** | 8.1 | **Contemplates their own thinking and learning processes and preferences when working with a community.** | **60** |
| Considers the values and knowledges of diverse stakeholders in the FS. | 40 |
| **Civic engagement, Subcategory** **Food system assessment** | 8.4 | **Analyzes components, processes and outcomes of a FS, as well as concepts behind it.** | **65** |
| Assesses a FS and designs and evaluates interventions in a FS. | 17 |
| Assesses and designs FS interventions.  | 18 |
| **Civic engagement, Subcategory Collective action** | 9.0 | **Plans, implements, and evaluates actions to address local and global FS challenges.** | **89** |
| Implements service learning to address FS challenges. | 5 |
| Implements FS change. | 0 |
| Has the skills to make a difference in the civic life of a community. | 6 |
| **Practical skills** | 8.5 | **Has a solid understanding of best practices in sustainable agricultural production.** | **43** |
| Implements best practices in sustainable agricultural production. | 28 |
| Knows how to produce food. | 3 |
| Is capable to assess the effect of food production on distribution and commercialization and vice versa. | 12 |
| Has a solid understanding of food marketing and distribution. | 14 |
| **Communication skills, Subcategory Academic communication** | 7.7 | **Communicates effectively in speaking, formal writing, and through digital media tools.** | **57** |
| Applies effective and professional written and oral communication skills. | 31 |
| Applies effective verbal and nonverbal communication skills. | 12 |
| **Communication skills, Subcategory Team skills** | 9.3 | **Interacts and collaborates effectively with the community.** | **65** |
| Provides leadership in FS interventions.  | 23 |
| Is proficient in communication skills in collaborative groups. | 11 |
| **Professional attitude** | 8.0 | **Solves problems professionally and can perform teamwork, knowing how and when to collaborate.** | **80** |
| Solves problems professionally and shows respect for values of diverse stakeholders | 4 |
| Is self-confident and promotes individuality as well as diversity. | 8 |
| Has an entrepreneurial and passionate working attitude.  | 8 |

\* Rating on a scale from 0 (no approval) to 10 (highest approval).

\*\* The overall most selected LO framing in bold letters.

**Appendix 5: Glossary of Pedagogical Strategies to Enhance SFS Education**

**Capstone Projects (LOs 6-8)**

To enhance the students’ transition to professional life, most SFS programs require capstone courses or similar experiences. Capstone courses usually emphasize problem-based learning but take varied forms, including seminars, practicum experiences and internships, projects, and issue-based discussion groups (Kiener et al., 2014). In the MSU program capstone course, the students are assessed relative to their team skills (leadership, professionalism, and contributions to project outcomes) through their performance on a semester-long team project. This team project most often involves a multi-disciplinary, community-based challenge and student teams collectively identify project objectives and deliverables at the beginning of the semester. The project culminates with teams leading a public presentation on outcomes and deliverables. Assessment input is gathered from community partners, program faculty, and student peers. Both UMN and [UBC](https://lfs350.landfood.ubc.ca/community-projects/) programs have capstone experiences that connect interdisciplinary student groups with external stakeholders to collaboratively address a community-identified food system issue. During one semester, student groups are required to submit a proposal, implement project activities, evaluate outcomes and disseminate results and findings back to community partners.

**Case Studies (LOs 1-4, 7)**

Case studies are an efficient pedagogical strategy to enhance systems thinking, critical reflection, and analytical skills in general (Herreid and Schiller, 2013; Wei, 2015). A case study deals with issues that have been faced by real people at a delimited location and time. It typically centers on a decision that was (or has to be) taken by stakeholders with different perceptions and interests related to the case. These real and particularized cases are presented to the students from different points of view in the form of facts and diverse opinions. In most case study exercises, students have to argue for their preferred solution to the case (Barnes et al., 1994). Case study approaches can be applied in the classroom, related to outdoor research, and in a flipped classroom (Herreid and Schiller, 2013). Short problem-based case studies can even demand practical skills in developing tangible solutions (Wurdinger and Marlow, 2005). At UBC, students participate in food system case study analysis through on-line resources. The UBC Centre for Sustainable Food Systems created [open-source case studies](https://ubcfarm.ubc.ca/teach/case-studies/) that highlight campus food assets and includes peer-reviewed articles as supplementary readings, guided questions for discussion, and place-based activities to support accessible experiential learning opportunities.

Socio-environmental case studies are a particular form of case studies based on socio-environmental synthesis, which focuses on connections between humans and nature from a systems perspective to deepen transdisciplinary analysis skills (among other LOs) by integrating existing knowledge, data, and methods from diverse disciplines (Wei, 2015). For SFS education, socio-environmental case studies preferably result in open-ended inquiries including stakeholders beyond academia. At MSU, a socio-environmental case study was successfully applied in two courses (Ebel and Thornton, 2019).

**Community-based Participatory Action Research (LOs 7, 8)**

Community-based participatory action research (and the similar but more teaching-centered community-initiated student-engaged research, bring together undergraduate students, university researchers, and community organizations. The existence of campus-community partnerships, for example with local NGOs, is a precondition for their successful implementation. In community-based participatory action research, (organized or individual) community members actively identify issues for scientists- and students can participate in both the identification and especially the research, where they work together with community members and instructors in gathering, processing, and interpreting data as well as in organizing public events related to the project (Greenberg et al., 2019).

**Community Arts Projects (LO 8)**

Collaborative or community arts refer to artistic activities rooted in a specific community in which participants decide, organize, and practice the arts in response to their ideas and lives. Thereby, community arts connect art and education to culture and community. Such projects involve students experientially, kinetically, intellectually, and aesthetically. They also strengthen team and interdisciplinary skills. Community-arts projects can have multiple approaches and emphasis including participatory video and photography, collaborative ethnography, community cultural development, digital storytelling, folklore, cultural and citizen journalism, Indigenous media, and PhotoVoice projects (Haviland, 2017; Schlemmer, 2017).

**Community-engaged Teaching and Learning, CETL (LO 8)**

CETL is an umbrella term that includes diverse pedagogical activities such as service-learning, participatory action research, certain forms of experiential learning, study abroad programs with community engagement components, and even online programs. Its characteristic is the formal nexus between curricular activities and community needs. This is achieved through an alignment between course LOs and needs identified by a collaborating off-campus community (Morton et al., 2020).

**Concept Mapping (LOs 1,2)**

A concept map is a graphical representation of the relationship among concepts and ideas, along with the ways they are connected or influence one another. In socio-environmental synthesis, which is frequently used in SFS education, they have emerged as a common practice. The mapped concepts (visualized as nodes) include internal or external (individual and organizational) stakeholders of a food system, as well as social dynamics and environmental factors that affect this system. The relationship between these concepts is portrayed in the form of lines, which can evolve to arrows or vectors if they describe the causal forces between nodes. Action phrases can be requested to describe the relationship between the two connected nodes. Most concept maps are designed as networks of diverse interacting factors, but linear, circular, “hub”, or “tree” maps also exist. The first step for using concept maps in the classroom is the definition of the key question represented in the center of the map. Subsequently, students (usually as teams) develop a preliminary map, discuss it, update it with field research or literature review (where appropriate), and discuss it again with a broader audience before developing a final map. Concept maps stimulate systems thinking as they provide a visual means to explore the complexity of a given system. They can be used at different levels of complexity and applied in case studies as well as for resuming content. They are also powerful tools for facilitating group work. Most revealing are open-ended questions that allow students to construct their own map structure (Vanides et al., 2005; Deaton et al., 2016).

**Conversational Method of Gathering Indigenous Knowledge (LO 3)**

This research method gathers knowledge based on the oral storytelling tradition. It encompasses open-ended and semi-structured interview questions to prompt conversation with key informants about food system practices such as wild food procurement and consumption where the informants and the student researcher co-create knowledge (Kovach, 2010). The tool can be applied for student field research and is not limited to interacting with indigenous communities but is appropriate for every environment where conversations and storytelling are still prevailing.

**Critical Reading (LO 2, LO 5)**

Pre-class reading is a common practice in higher education but numbers of undergraduates seriously engaging in these assignments are often low. In contrast, critical reading stimulates the students’ processing of information and their response. Therefore, the selected readings must be relevant to their reality, concerns, and interests so that they can raise vital questions and problems from the text; that they can test their interpretations against previous knowledge or experience; that they are able to examine their assumptions and the respective implications; and that they use what they have read to communicate effectively with others or to develop potential solutions to a problem. Therefore, in critical reading, students are asked to identify and describe the purpose of why the reading selection was allegedly made by the instructor (and invited to participate in the selection of readings). In the processing of the reading, the instructor should encourage reflections about connections between the text and the students’ existing cultural knowledge and experience. A respective question could be “What experiences in my internship support, confound, or refute the information presented from this reading?” Other tasks include interpretation of evidence (for case studies), challenging assumptions, and applying the read information. The reading/writing prompt should be assigned when an assignment is given, not after the reading (Tomasek, 2009). Students can respond to these tasks in numerous ways such as online discussion boards, in-classroom group discussions, creative summaries including visual illustrations, or even role plays (“How would you summarize the article for your 5-year old nephew?). Sometimes, instead of assigning readings for homework, **read-aloud activities** can be helpful as reading aloud a text of 500 words or less can focus the students’ attention during a long class. In a **half-class**, the class is divided into two equal parts of which one part receives the reading material and studies it. The other half is simultaneously having a lecture on the same issue. Then, groups are switched, ending with a recap by pairs of members of opposite groups (Marotta and Hargis, 2011).

**DEAL (LO 5)**

DEAL (Describe, Examine, Articulate Learning) is a critical reflection model and serves to process learning from multiple perspectives. The final goal is reflective writing or learning-while-writing. The basis for the DEAL model is a concrete learning experience, for example, a case study, a service-learning experience, internships, or experiential learning. The model asks for the writer to describe the learning experience in three sequential steps: Description of learning experiences in an objective and detailed manner; examination of those experiences (based on specific learning goals of the course, which permits students to bridge the learning experience to the larger academic curriculum); and articulation of learning, including goals for future action (Ash and Clayton, 2009). DEAL is frequently applied in diverse types of civic engagement. Examples of prompts in this field include “What was I trying to accomplish in that activity?”, “How did I see power being used during my internship?”, or “What changes does my experience suggest are needed: within myself, within others, and within our communities?” (Ziomek-Daigle, 2017).

**Debates** **(LOs 2, 3)**

In-class debates cultivate the active engagement of students and help develop critical reflection and communication skills as well as the consideration of diverse ways of knowing. Debates are more structured and complex than common classroom discussions. Disagreement is encouraged and the debating parties search for inconsistencies in the argumentation of their counterparts. Opposing viewpoints are stressed by an appointed moderator, an experienced student, or the instructor. To increase the participation and commitment of all students, diverse debate arrangements with pedagogical intentions have been developed: In the **meeting-house** format, each team gives it's opening argument, and then the rest of the class questions the debaters or offers comments. The moderator ensures that each side receives an equal amount of questions. **Four-corner debates** mean that students contemplate their opinions of a statement and then move to one of the four corners of the room, which are labeled “strongly agree,” “agree,” “disagree,” and “strongly disagree.” The students of the same corner then develop arguments for their position. After each group defends its position, the students may switch corners. In a **fishbowl debate**, the students are divided into three groups: experts for each side of an issue and the remaining students as the audience. A circle of chairs in the center of the classroom to create the fishbowl. Each side has a turn discussing the issue with their fellow group members while sitting in the fishbowl, and then the audience group has their turn in the inner circle. This is repeated several times. Finally, in **think-pair-share debates**, students first reflect individually. Then they work in pairs to create lists of reasons to support both sides of an issue. Next, two pairs work together to come to a consensus. The size of the groups increases constantly until a class-wide consensus is achieved (Kennedy, 2009).

**Deep-learning Classroom Activities (LOs 2, 5, 7)**

Deep-learning is based on higher-order cognitive skills such as holistic synthesis and critical reflection but also trains communication and problem-solving skills. It stimulates metacognition to construct long-term understanding, to internalize the acquired skills, and to raise the students’ attention in class. Numerous short deep-learning activities exist, which can be integrated into almost any type of class or lecture and are mainly focused on individual student work (please see interactive group techniques for team exercises). Examples of deep-learning classroom activities include **one-sentence summaries** (students summarize a topic in one sentence), **one-minute papers** (students have one minute to write about a specific question), **advice letters** (a letter of advice to future students on how to be successful students in that course), **tabloid titles** (students develop a tabloid-style headline to illustrate the current topic), or **truth statements**, where the instructor asks students to list out “It is true that...” statements on the current topic (VanGundy, 2008; Yew et al., 2016).

**Electronic Media Communication and Literacy Training (LO 5)**

In an expanding age of online media, electronic media communication and literacy training such as designing and developing websites, social media, podcasts, videos, or blogs, as well as curriculum activities to understand science communication, policymaking, and networking online are relevant communication skills that have to be trained in diverse courses (Kuehne et al., 2014). Potential activities to train online media communication include student projects and presentations on YouTube, interactive video quizzes, group wiki projects, and wiki class notes, blogs (also in the form of electronic role plays, where students develop the blogs of a fictitious character), and reports from the filed using Twitter or other social media (Watkins, 2005).

**Experiential Learning (LOs 4, 6)**

Since it is not realistic that students become experts at every practical skill across the food system, the goal is to learn how to access resources and eventually master at least one craft with a certain degree of routine. Engaging in farming, processing foods, developing culinary capabilities, practicing nutrition education, working in laboratories, conducting community-based participatory research, advocating for policy development, and practicing business management and marketing are all feasible learning experiences that can be implemented throughout a SFS curriculum. This experiential learning should dovetail with a discussion about practical skills built and then embedded in further classroom activities. Ideal places for a first practical experience are student farms or kitchens, where horizontal knowledge co-construction (collective experiencing and development of knowledge among equal parties rather than the expert transmission of abstract theory) can occur (Parr and Trexler, 2011) and which allow students to enhance their practical knowledge in the form of small, innovative experiments. Especially at an initial stage of practical skill development, learning from mistakes (and unlearning old habits) is more valuable for students than perfecting experimental design (Cunningham and Dawes, 2016). Experiential learning does not only enhance practical but also team skills. During the MSU campus farm practicum, team skills are assessed through a collaborative on-farm project where the students’ leadership skills, professionalism and overall contributions to the team projects are assessed through both peer and instructor feedback.

**Farm-based Authentic Research Modules in Sustainability Sciences (FARMS) (LO 3, LO 6)**

FARMS are place-based research projects that test sustainability solutions for managing agricultural systems. Specific management practices are identified through community engagement with local food system stakeholders. Students are guided through the process of inquiry and are called to synthesize scientific evidence from their primary research and the literature coupled with input and perspectives from local food system stakeholders (Ahmed et al., 2017).

**In-depth Multi-day Field Courses (LO 1, 2)**

In-depth multi-day field courses train critical reflection among students. These courses can be described as case studies with active research activities on a field trip: Students are first exposed to a variety of perspectives and then asked to develop solutions to issues, or respond to journaling prompts, which force students to develop empathy and recognize views that may come into contrast with their assumptions and knowledge (Wiedenhoeft et al., 2003; Roberts et al., 2019).

**Interactive Group Techniques (LOs 2, 6)**

Interactive group techniques increase the students’ deep learning, enhance teamwork, facilitate solving complex tasks, encourage self-reflection, and stimulate creativity as well as tolerance within the students. They are more effective in smaller groups. Interactive group techniques also work very well in collective action projects (Szitar, 2014). Such techniques can be used to achieve all eight of our adaptable LOs but primarily train critical reflection and team skills. Some interactive techniques are designed for pairs and small settings, others for larger teams. Examples of numerous available group techniques include the **forced debate** where a class is first divided among their position on an issue and then, each side must defend their opponent’s point of view (commonly, each student can only speak once). This technique also works in pair-arrangements. In **peer reviews** of writing assignments, the students exchange drafts with a partner who should not correct the text in terms of style and grammar but outline strengths and problems in the content. In the **psychoanalysis** technique, students get into pairs and interview one another about a recent learning experience. It may include questions like “How did your beliefs change after learning about this topic?” or “How will your decisions change?”. In **jigsaws** (group experts), one of the most popular dynamics in SFS education, students are divided into groups which are all given different topic. The students then study information about this topic (or implement field research) to become “experts”. Finally, the groups are remixed with one planted “expert” on each topic, who now teaches the new group (Carpenter, 2006; VanGundy, 2008; Szitar, 2014).

**Internships (LO 4, LO 6)**

Internships are an excellent strategy in this regard, also because they can help foster team skills and intercultural sensibility. One study showed that organic farm internships enhanced classroom learning and that joint fieldwork also advanced their skills and professional attitude in leadership, decision making, personal initiative, and communication (Reeve et al., 2014). However, an internship or practicum is only effective if the worksites are meticulously selected and if there is constantly mentoring through a course instructor (Simons et al., 2012). In MSU’s off-campus internships, mentors are asked to provide feedback through a post-internship evaluation on aspects of leadership, professionalism, and contributions to the organization’s outcomes and culture.

**One-to-one Relational Meetings (LO 5)**

One-to-one Relational Meetings serve to open a public relationship with another person and to get to the root of that other person’s self-interest and belief system through listening to this person’s anecdotes, experiences, passions, and tribulations. They usually involve a 40-50 minutes face-to-face meeting between one student (not a group of students) and another person, which is initiated by an appointment. During this meeting, the other person’s self-interests, ideas, motivations, and visions for their institutions and communities should be explored. However, one should not attend the meeting with a prepared list of questions. Conversation topics include the other person’s family (where the person grew up, their parents, etc.), education, work, hopes, and dreams, as well as frustrations. About 80% of the meeting time should be spent listening to the invited person. One-to-one Relational Meetings demand a developed set of interpersonal and listening skills as they should not convert into a two-way conversation or small talk on the hand, neither into a counseling session, negotiation, or quantitative interview on the other hand. Hence, they should be meticulously practiced in the classroom before sending the students out to the field (Fretz, 2010; Boyte and Finders, 2016).

**Participatory Writing (LO 5)**

Participatory writing involves students collaborating with members of a partnering community organization or another stakeholder group to create a formal written piece on a jointly selected food system topic that includes visual elements (Clughen and Hardy, 2011).

**Power Mapping (LOs 1, 2, 8)**

Developing inventories and maps is an effective community-engaged pedagogical approach to teaching systems thinking, critical reflection, and collective action via student exposure to diverse stakeholder perspectives. Maps are useful to narrow and clarify the dynamics of a complex and broad issue into something concrete and workable. Power maps, a special type of concept map, should be developed by as diverse as possible student teams. They are visual representations of all the stakeholders (any person, party, organization, or institution who are connected to or involved in an issue) that consti­tute a problem or project (Hildreth, 2014). Power mapping is not a specific and exact analysis technique but rather a family of methods for assessing power relationships (Noy, 2008). In the classroom application of power-mapping, students interview stakeholders who are identified as holding some level of power related to the issue being addressed, to learn their perspective on the issue (Boyte and Finders, 2016). To develop the map, the students list all individual or organizational actors (formal and non-formal decision-makers) involved in the specific power issue (pre-mapping). The list may then evolve to a power matrix, which includes the range of actions of the diverse stakeholders, quantifies their power-level, and describes whom they are interacting with. Pre-mapping concludes in the drawing of a preliminary power map. Most important is a constant discussion within the mapping team. In the subsequent research phase, the team members research the actual power and interests of the identified stakeholders. They report their finding to the team and the preliminary map is updated with field information (re-mapping). The eventually resulting power map is not a geographical map, but a sketch of the stakeholder groups involved in the analyzed issue, how they are interacting and where their power overlaps. The shape of the map depends on the issue as well as on the interviewees’ perception (Schiffer, 2007; Hildreth, 2014). Power mapping allows students to critically reflect on where power resides in the food system and how authority, privilege, and oppression in the food system play out in the daily lives of others. It can also be the starting point for subsequent action plans (Hildreth, 2014).

**Public Narrative (LOs 6,7)**

Developing leadership and “bridging” to a community on behalf of social change often requires telling a new, public story, or adapting an old one. This skill is exceptionally important for students who want to engage professionally in collective action. A public narrative is a communication tool that helps break the ice with a community and increase the commitment to a common issue. Every public narrative includes three stories: a story of self (the speaker), a story of us, and a story of now. Credible and authentic public work requires giving a public account of oneself: The story of self is a way to share one’s values by providing lived experience. It is constructed around personal choice points. The story of us provides values that the speaker shares with the target community. It uses collective (often historical) choice points (choices made, challenges faced, outcomes achieved, and lessons learned). Finally, stories of now articulate contemporary challenges and coming choices (Ganz, 2011). Instructors can train public narratives by first providing their public narrative, then having students practicing in the classroom, and finally letting them narrate to an external audience.

**Rich Pictures (LOs 1, 2)**

Rich pictures of food systems is a systems-thinking tool that is associated with the soft systems methodology (Avison et al., 1992). A rich picture is a graphic image that portrays key elements, events, relationships, forces, ideas, and values in a complex situation. It makes little to no use of words, using images and symbols in relation and context to depict the essence of a complex situation, including the essential dynamics of the situation and the experience and perspective of all major stakeholders (Bell and Morse, 2013; Cadieux et al., 2016). Competence in food systems analysis via rich picture implies the ability to work collaboratively to create such a picture, to identify and depict a narrative that describes the system’s history and trajectory, to carry out these analytic tasks intentionally and systematically, and to reflect critically on process and outcomes of the effort (Francis et al., 2017). Many particular curricular activities support food system analysis via rich pictures: Interviews with participants in a food system are fundamental, as is the analysis of texts, symbols, and other communicative activities of participants, to infer the essential understanding of a situation from the point of view of particular participants. Elicitation of storylines describing the genesis and history of a food system, its present state and significance, and potential future pathways is a key task in rich picturing (Avison et al., 1992; Bell and Morse, 2013).

**Roleplays (LO 4)**

Experiential learning does not necessarily have to occur outdoors or in a lab. It can be introduced in the classroom as well, for example, in the form of game simulations such as roleplays (Wurdinger and Marlow, 2005). For a roleplay in SFS education, the instructor develops a case-like scenario and assigns roles for a play, preferably an open-ended situation where students have to solve a concrete problem by interacting as stakeholders (with as different points of view as possible) in a simulated meeting (for example, a community town hall, a press conference, or a jury trial). Depending on the complexity of the play, students may be asked to develop biographies of their alter egos or do research at home. In a role reversal, the teacher role-plays as a student, asking questions about the content, and the students (as collective teachers) answer the questions (Carpenter, 2006; VanGundy, 2008; Szitar, 2014).

**Service-learning (LOs 4, 6-8)**

Service-learning describes course-based teaching and learning strategy in which students participate in an organized service activity that meets identified community needs and subsequently reflect on the service activity (Bringle and Hatcher, 2000). This way, service-learning integrates meaningful community service with instruction and reflection to enrich the learning experience, enhance the students’ civic responsibility, and strengthen communities (Butin, 2010; Niewolny et al., 2016). It also helps deepen the relationships between programs and universities on the one hand and the local civic society on the other hand (Bringle and Hatcher, 2000). However, service-learning is a type of experiential learning (with elements of community-based and action research, among others) and the students’ learning experience is its central outcome. The often high expectations in the social justice outcomes of service-learning practices are not always achieved (Butin, 2010).

**Student-centered Guest Lecturing (LO 2)**

Guest lectures serve to improve and diversify student learning experiences. Traditionally, they are speaker-centered. In student-centered guest lecturing, student interactions with the speaker (a scholar, industry expert, or community member) are stimulated, enhancing their critical reflection on an issue. Students first study the course content and then work in groups to determine questions for the guest speaker. The speaker is then interviewed in front of the class by an on-site course representative. The instructor should act as a facilitator to create an environment where students can freely deepen their understanding of the subject matter. Student-centered guest lecturing also works in online environments (Li and Guo, 2015).

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