

Supporting the design of sustainability-related higher education: Pedagogical method mixes and their effectiveness drivers

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Abstract

This paper aims to investigate eight pedagogical methods that are discussed and used in the context of sustainability education (i.e. lectures, case studies, debates, group discussions, in-class role plays, consulting, research and service learning projects) in terms of their manifestations on nine so-called pedagogical impact variables suggested to drive teaching effectiveness. Manifestations were determined by means of a two-stage online Delphi survey conducted with experts from the field of sustainability education. Results reveal that all pedagogical methods except lecture have positive manifestations for all impact variables with variations in the degree and that a mixed picture is present for lectures. By showing in detail which method is suitable for what and how well, the results offer important insights that can assist with the design of teaching or, more concrete, the compilation of course method mixes.

Keywords: Sustainability education; pedagogical methods; teaching effectiveness; teaching effectiveness drivers.

1. Introduction

Against the background that higher education (HE) institutions are called to prepare their graduates to be able to tackle sustainability challenges (UNESCO, 2017), a considerable amount of literature can be observed that deal with suitable pedagogies for sustainability-related teaching. Within this context, different pedagogical methods such as real-life consultancy projects (Molderez & Fonseca, 2018) or service learning (Halberstadt et al., 2019) are recommended. However, HE courses usually involve several methods that might touch different or similar drivers of effectiveness, and a clever combination of methods is important to increase the effectiveness of courses. This paper therefore compares different potentially applicable methods and analyses their pedagogical effectiveness drivers. It shows the results of a Delphi

study in which experts from the field of sustainability education evaluated selected methods in relation to a set of so-called pedagogical impact variables. The latter represent factors that are linked to pedagogies and suggested to influence/drive the effectiveness of sustainability-related HE. In the following, these methods and variables will be presented (ch.2). Then insights into the Delphi study will be given (ch.3), and its results will be shown (ch.4) and discussed (ch.5).

2. Included pedagogical methods and pedagogical impact variables

This study presents the manifestations of eight pedagogical methods used and discussed in the field of sustainability education (e.g. Bustamante et al., 2022a; Figueiró & Raufflet, 2015; Lozano et al., 2019) in relation to nine pedagogical impact variables developed by the authors. The methods comprise, for example, lectures, in-class role plays as well as service learning projects. The impact variables include, inter alia, the degree of student participation/activeness and emotional involvement as well as the degree of stakeholder integration and multi-sensory experiences. Table 1 and 2 provide definitions for all included methods and impact variables.

3. Methodology

Between March and September 2022 a Delphi survey was conducted with a pool of overall ten experts from the field of sustainability-related education. The experts were predominantly female and the majority of them were functioning as professors or associate professors in HE institutions of different types mainly located in Europe. Teaching experiences of experts were covering a variety of subjects, including, e.g., CSR and sustainable management, business law, banking and sustainable finance instruments, sustainability accounting and reporting, intercultural management as well as engineering for sustainability development. The experts were selected either on the basis of their presence in an extensive literature search conducted on the topic of sustainability-related teaching and information gathered in subsequent internet searches or based on knowledge through joint participation in a research project on the effectiveness of sustainability-related HE. The Delphi survey consisted of two rounds (final $N_{\text{round1}}=10$ and $N_{\text{round2}}=7$). In each of the rounds, experts were requested to complete an online questionnaire and were provided with an additional document with information on the variables contained in the survey (especially definitions of pedagogical methods and impact variables). In both online questionnaires experts were asked, among other, to evaluate the influence/impact of each presented pedagogical method on each included pedagogical impact variable by using a scale ranging from “-3” (indicating a strong negative influence), over “0” (indicating no influence), to “+3” (indicating a strong positive influence). In the second round, experts were requested to provide these ratings taking the pooled assessments of the participants of the first round (presented by their averages) into consideration.

Table 1. Definitions of included pedagogical methods. Source: Bustamante et al. (2022b).

Method	Definition
Case study	Case studies are "written summaries or syntheses of real-life cases that require students to tease out the key issues involved and to identify appropriate strategies for the resolution of the 'case'. ... A 'case' should be a complex problem written to stimulate classroom discussion and collaborative analysis, and be a student-centered exploration of realistic and specific situations." (Alt et al., 2020, p. 62).
Debate	A debate is an activity which involves "two groups of students put[ting] forward opposing arguments on an issue" (Cotton & Winter, 2010, p. 47).
Group discussion	Group discussion "is a free verbal exchange of ideas between group members or teacher and students" (Sajjad, 2010, p. 10), "a give-and-take dialogue that encourages students to enrich and refine their understanding" (Alvermann & Hayes, 1989, p. 306). It can involve the whole class (whole-group discussion) or separate groups within the class (small-group discussion) and take place in written as well as oral form (Jahng et al., 2010).
In-class role play	In-class role plays (e.g. Board Meeting Game) are an active learning and teaching technique, considered to be a part of interactive simulation whereby participants act out the role of a character in a particular situation following a set of rules (Dingli et al., 2013; Rao & Stupans, 2012).
Lecture	Lecture is "a method of teaching by which the instructor gives an oral presentation of facts or principles to learners and the class usually being responsible for note taking, usually implies little or no class participation by such means as questioning or discussion during the class period" (Good & Merkel, 1959, as cited in Kaur, 2011, p. 10).
Service-learning project	A service-learning project (for the community) is a method where "students engage in activities intended to directly benefit other people, where the activities are integrated with learning activities in an intentional and integrative way that benefits both the community organization and the educational institution" (Hayes & King, 2006, as cited in Lozano et al., 2017, p. 8).
Sustainability-related consulting project	A sustainability-related consulting project is a "learning by doing" method where students work on solving real business and environmental [or rather sustainability-related] problems by developing practical recommendations for a real organisation (Segal & Drew, 2012, p. 1). In their role as consultants, students assist with diagnosing the client's situation and finding and implementing solutions (Butler, 2018, p. 1-4).
Sustainability-related research project	A sustainability-related research project is a student's own scientific endeavor to answer a sustainability-related research question (under the guidance of a faculty mentor) that can take the form of primary empirical research, secondary data analysis, or meta-analysis (Rutgers University, n.d.).

Table 2. Definitions of included pedagogical impact variables. Source: Bustamante et al. (2022b).

Impact variable	Definition
Degree of student participation/activeness	The degree of student participation/activeness describes how much opportunity students have to be active and to engage in the learning process (based on Prince, 2004).
Degree of student collaboration/group work	The degree of student collaboration/group work describes how much opportunity students have for working/ interacting in social constellations (e.g. group, team, community) to solve shared tasks (based on Strijbos, 2016), hereby enabling mutual learning and co-production of knowledge.
Degree of student emotional involvement ¹	The degree of student emotional involvement describes the degree of evoking an emotional connection of students with the material or contents being learned (based on Immordino-Yang & Faeth, 2010).
Degree of student (self-)reflection	The degree of student (self-)reflection describes how much opportunity is given to students to critically reflect on their knowledge, experiences, assumptions, beliefs, values, personal roles, attitudes, or responsibilities in relation to sustainability issues (based on Cotton & Winter, 2010; Svanström et al., 2008).
Degree of experience of real-life situations	The degree of experience of real-life situations describes how much opportunity is given to students for collecting firsthand experiences in real-world settings focused on solving actual sustainability problems/ challenges (based on Brundiers et al., 2010).
Degree of inter-/transdisciplinarity	The degree of inter-/transdisciplinarity describes how much opportunity students have to transfer and recombine concepts and methods from different disciplines and create holistic solutions beyond single disciplines when exploring sustainability topics (based on Greig & Priddle, 2019).
Degree of stakeholder integration	The degree of stakeholder integration describes how much opportunity is given to students to identify stakeholders and their demands, to interact with them, and to consider their expectations in finding solutions within tasks during the course work (based on Plaza-Úbeda et al., 2010).
Degree of integration between theory and practice ¹	The degree of integration between theory and practice describes how much opportunity is given to students to apply and reflect theoretical knowledge in practical contexts and, vice versa, to reflect and interpret practical experiences before the background of theoretical knowledge (based on Gerstung & Deuer, 2021; Pham, 2011; Woo et al., 2012).
Degree of multi-sensory experiences ²	The degree of multi-sensory experiences describes the degree of engaging students through providing a combination of visual, auditory, tactile, gustatory and/or olfactory stimuli and linking it to relevant academic objectives (based on Baines, 2008).

¹ Updated definition compared to Bustamante et al. (2022b)
² Newly introduced variable and definition compared to Bustamante et al. (2022b)

A few other changes were included in the second compared to the first survey round: Based on the feedback of experts that the impact evaluation depends on the concrete settings, possible scenarios for each teaching method were developed and provided together with the definitions of methods in the second round. Moreover, based on expert opinions related to pedagogical impact variables, the definitions for the “degree of emotional involvement” and “degree of integration between theory and practice” were updated in the second round and the “degree of multi-sensory experiences” added, replacing another suggested impact variable. Finally, several teaching method definitions were updated.

4. Findings

Table 3 presents the manifestations of the eight pedagogical methods investigated in this study in terms of the nine above introduced pedagogical impact variables. Overall, a positive influence can be observed for the majority of cases with variations in the degree, showcasing that some methods are particularly strong with respect to some variables: Consulting and service learning projects seem to have an especially high positive influence on all of the variables; debates, group discussions and in-class role plays contribute highly to participation/activeness, collaboration and emotional involvement of students; research projects to students’ participation/activeness; and case studies to the integration between theory and practice. The findings provide indications for impactful method mixes, e.g., the combination of a case study with group discussions and an in-class role play within one single course. Results show a slightly negative influence of the method lecture on four impact variables. However, negative values are only slight and standard deviations are high, indicating that experts differ in their opinions. Finally, mixed expert opinions can also be observed in relation to other cases, for example, the influence of debates on the experience of real-life situations or of group discussion on the integration of stakeholders.

5. Discussion and conclusion

The present paper aimed at assessing eight pedagogical methods in terms of their influence on nine pedagogical impact variables in order to support the design of sustainability-related HE courses. The results of a two-stage online Delphi survey indicate that case studies, debates, group discussions, in-class role plays, consulting, service learning, and research projects have consistently positive manifestations and that these vary in degree. The presented matrix reveals the strengths of methods in terms of their influence on variables that are suggested to drive the pedagogical effectiveness of teaching and hereby facilitates the compilation of impactful method mixes. In regard to lectures mixed expert opinions can be observed that underline the controversial debate in the literature on this method. Limitations of the study include the limited number of included pedagogical methods, the relatively small sample of experts participating

Table 3. Manifestations of teaching methods on pedagogical impact variables.

		IV1	IV2	IV3	IV4	IV5	IV6	IV7	IV8	IV9
Case study	Mean	1.86	1.14	1.00	1.43	1.57	1.43	1.14	2.00	0.29
	Std. Dev.	.90	1.07	1.00	0.79	0.53	0.79	0.90	0.00	0.76
Debate	Mean	2.14	2.00	2.14	1.71	1.29	1.14	0.71	1.00	0.57
	Std. Dev.	1.21	0.82	0.69	0.76	1.70	0.90	1.80	0.58	1.13
Group discussion	Mean	2.43	2.43	2.29	1.86	1.00	1.14	1.00	0.86	0.57
	Std. Dev.	0.53	0.53	0.49	0.90	1.00	0.90	2.00	1.35	1.13
In-class role play	Mean	2.57	2.43	2.14	1.43	1.29	1.29	0.86	1.43	1.57
	Std. Dev.	0.79	0.53	0.69	1.27	1.70	1.11	0.90	1.62	0.98
Lecture	Mean	-0.57	-0.29	1.43	1.29	-0.71	1.00	-0.14	1.00	0.00
	Std. Dev.	1.99	1.80	0.98	0.76	2.21	0.82	1.77	0.82	0.58
Service-learning project	Mean	2.86	2.29	2.71	2.43	2.86	2.14	2.71	2.86	2.14
	Std. Dev.	0.38	0.49	0.49	0.53	0.38	0.38	0.49	0.38	0.90
Sustainability-rel. consulting project	Mean	2.00	2.29	2.29	2.00	2.71	2.29	2.57	2.71	2.29
	Std. Dev.	2.24	0.76	0.95	0.82	0.76	0.49	0.79	0.49	0.76
Sustainability-rel. research project	Mean	2.71	1.00	1.71	1.71	1.71	1.57	0.71	1.71	0.57
	Std. Dev.	0.49	1.53	0.95	0.76	0.49	0.98	1.11	1.70	0.79

IV1: Degree of student participation/activeness; IV2: Degree of student collaboration/group work;
 IV3: Degree of student emotional involvement; IV4: Degree of student (self-)reflection;
 IV5: Degree of experience of real-life situations; IV6: Degree of inter-/transdisciplinarity;
 IV7: Degree of stakeholder integration; IV8: Degree of integration between theory and practice;
 IV9: Degree of multi-sensory experiences

<= 0	> 0 - < 1	1 - < 2	>= 2
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in the Delphi survey, and the subjectiveness of experts' evaluations that are influenced by their own experiences and teaching contexts (going beyond the teaching scenarios presented to them). Future research should enrich the database, complete the teaching methods overview and/or add other research methods to provide even more meaningful results.

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