

Stefan T. Siegel¹, Claudio Sidler² & Bernadette Dilger³

Sustainability Education 101. Insights into the Development, Implementation, and Evaluation of an Online Academic Development Course

Abstract

Higher education institutions face mounting pressure to integrate sustainability into teaching, yet instructors and academic developers frequently lack evidence-informed beliefs and practices to address this transversal agenda. This article presents *Sustainability Education 101* (SE101), an eight-hour online academic development course co-developed at the University of St.Gallen that equips university instructors across disciplines with conceptual frameworks, practical design tools, and structured reflection. SE101 is grounded in constructive alignment, generative learning, and critically reflective practice; it introduces sustainability concepts and instructional design models and scaffolds the redesign of participants' own courses. Drawing on qualitative content analysis of 21 course submissions from two institutions, the study examines which course elements participants perceived as supportive or impeding and how they applied SE101's contents and tools in course design. Findings indicate that the Educational Design Canvas most consistently supported perceived professional learning, while cognitive load and institutional constraints were the most salient reported impediments. Participants reported broadened sustainability conceptions,

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- 1 Corresponding Author; University of St.Gallen, Institute of Business Education and Educational Management; stefan.siegel@unisg.ch; ORCiD 0000-0002-7065-1306
 - 2 University of St.Gallen, Institute of Business Education and Educational Management; claudio.sidler@unisg.ch
 - 3 University of St.Gallen, Institute of Business Education and Educational Management; bernadette.dilger@unisg.ch

aligned course prototypes with sustainability competencies, and identified discipline-specific entry points. The article contributes a practice-based model for academic development in complex, transversal domains and discusses implications for faculty professionalization and education for sustainable development.

Keywords

sustainability education; academic development; higher education; constructive alignment; educational design

Nachhaltigkeitsbildung 101. Einblicke in die Entwicklung, Implementierung und Evaluation eines hochschuldidaktischen Online-Kurses

Zusammenfassung

Hochschulen stehen zunehmend in der Verantwortung, Nachhaltigkeit in der Lehre zu verankern; vielen Lehrenden fehlen jedoch evidenzinformierte Überzeugungen und Praktiken für dieses transversale Anliegen. Der Beitrag stellt *Sustainability Education 101* (SE101) vor, einen achtestündigen Online-Selbstlernkurs zur hochschuldidaktischen Weiterbildung, entwickelt an der Universität St.Gallen. SE101 beruht auf Constructive Alignment, generativem Lernen und kritisch-reflexiver Praxis, führt in Nachhaltigkeitskonzepte und didaktische Modelle ein und begleitet die nachhaltigkeitsorientierte (Um-)Gestaltung eigener Lehrveranstaltungen. Auf Basis einer qualitativen Inhaltsanalyse von 21 Kurseinreichungen aus zwei Hochschulen untersucht die Studie, welche Kurselemente die Teilnehmenden als förderlich oder hinderlich wahrnahmen und wie sie Inhalte, Modelle und Werkzeuge des Kurses in ihren Lehrentwürfen anwendeten. Das Educational Design Canvas unterstützte das professionelle Lernen am konsistentesten; wahrgenommener Cognitive Load und institutionelle Rahmenbedingungen erschwerten die Umsetzung. Die Teilnehmenden berichteten ein erweitertes Nachhaltigkeitsverständnis, richteten ihre Entwürfe an Nachhaltigkeitskompetenzen aus und identifizierten fachspezifische Anknüpfungspunkte. Der Beitrag skizziert ein praxisbasiertes Modell für die hochschuldidaktische Weiterbildung in komplexen, transversalen Themenfeldern.

Schlüsselwörter

Nachhaltigkeitsbildung, Hochschuldidaktik, Weiterbildung, Constructive Alignment, Educational Design

1 Introduction and Theoretical Background

Higher education institutions face mounting pressure to respond to planetary polycrisis (Fanning & Raworth, 2025). Sustainability has migrated from institutional rhetoric into accreditation frameworks and curriculum reform agendas, yet policy visibility has not facilitated pedagogical change on a scale (Sterling, 2025). Many university instructors struggle to translate institutional commitments into workable teaching practices, hampered by structural and individual barriers such as conceptual ambiguity, environmentally narrow framings, and limited experience with sustainability-related and competency-oriented course design (Wals, 2025).

Sustainability is not a discrete subject that can be attached to an existing syllabus; it is a transversal concern that demands instructors rethink their pedagogical assumptions rather than merely extend their content (Siegel, 2025; Siegel, 2026). Pettig and Singer-Brodowski (2025) distinguish three notions of education for sustainable development (ESD): an instrumental orientation (ESD 1) focused on transmitting defined sustainability content; an emancipatory orientation (ESD 2) that fosters critical, reflexive capacities; and a transformative orientation (ESD 3) that positions education itself as a site of socio-ecological change. Most institutionalized efforts remain at ESD 1; ESD 2 and especially ESD 3 remain underdeveloped. Established competence frameworks such as that of Brundiers et al. (2021) identify what teachers and learners should be capable of but say comparatively little about how instructors can design constructively aligned learning environments to develop these competencies (Barth & Rieckmann, 2012; Wilhelm et al., 2019).

Academic developers are well positioned to address this gap, provided they have access to evidence-informed formats suited to the complexity of sustainability education (Singer-Brodowski et al., 2025). Generic formats treat sustainability as a content add-on rather than a lens that reorganizes the logic of course design. Practice-based courses that are both theoretically grounded and systematically evaluated remain rare. Empirical evidence on such formats for university educators is similarly limited, stemming largely from reviews of professional development initiatives

(Mulà et al., 2017) and from evaluations of individual staff development courses (e.g., Barth & Rieckmann, 2012).

This article presents SE101, approx. an eight-hour online academic development course co-developed at the University of St.Gallen, grounded in constructive alignment (Biggs et al., 2022), generative learning (Fiorella, 2023), and critically reflective practice (Brookfield, 2017). Its central scaffolding tools, the *Educational Design Canvas* and the *Pedagogical Pattern Navigator* for ESD (Dilger, 2023), are described in Section 2.3. As a self-paced format, SE101 follows a multiplier logic: building faculty capacity across disciplines reaches student learning indirectly but at scale.

The study draws on 21 course submissions from two institutions, analyzed via qualitative content analysis (Kuckartz & Rädiker, 2023), and pursues two research questions:

RQ1: *Which aspects of SE101 do participants perceive as supportive or impeding their professional learning?*

RQ2: *How do participants apply SE101's contents, frameworks, and tools when designing sustainability-oriented courses?*

2 Development and Description of SE101

2.1 Institutional Context and Course Goals

SE101 was co-developed by the *Centre for Learning and Teaching in Higher Education* and the *Delegate for Responsibility and Sustainability at the University of St.Gallen*, first offered in blended format in May 2022 and in 2023 redesigned as a self-paced online course. It targets university instructors across disciplines regardless of prior engagement with sustainability education and is promoted through academic development networks. Successful completion yields a certificate recognized within academic development programmes.

The overarching goal is to support instructors in fostering sustainability in their teaching and to strengthen their professionalization (Brundiers et al., 2021). It aims to raise awareness of sustainability's relevance, support reflective engagement with adequate methods, and provide practical orientation for course design. Learning objectives address knowledge, skills, and attitudes ("knowing, acting, being"; Sipos et al., 2008) and are derived from faculty needs assessments and established competence frameworks. Suppl. 1 details the learning outcomes.

2.2 Design Principles

SE101 rests on three mutually reinforcing design principles.

Competency Orientation and Constructive Alignment

Learning objectives, activities, and assessments are constructively aligned (Biggs et al., 2022), with sustainability competencies (e.g., systems thinking or integrated problem-solving) as the organizing framework (Brundiers et al., 2021; European Commission, 2022).

Generative Learning and Transfer Orientation

Learning activities aim at cognitively activating participants through demanding design tasks, as generative processing drives durable learning (Fiorella, 2023). Transfer is promoted by requiring participants to apply theoretical inputs to their own teaching contexts; scaffolding tools (e.g., worked examples, templates, advance organizers) help with managing the associated cognitive load.

Critically Reflective Practice

Building on Brookfield (2017), the course encourages participants to examine underlying assumptions (Siegel, 2025), normative tensions, and professional responsibilities, engaging with the reflexive and transformative demands of ESD 2 and ESD 3 (Pettig & Singer-Brodowski, 2025).

2.3 Course Structure and Core Tools

SE101 comprises two sequential modules combining conceptual grounding with applied instructional design (estimated workload: eight hours). Suppl. 2 provides an overview of the course structure and exemplary materials.

Module 1 – Foundations of Sustainability Education (approx. 4 hours) introduces central sustainability frameworks, including planetary boundaries (Rockström et al., 2023), and situates higher education within processes of socio-ecological transformation (Sterling, 2025). Participants gain a structured overview of competence frameworks (e.g., Brundiers et al., 2021), teaching and learning activities (e.g., Rieß et al., 2022), and aligned assessment formats (e.g., Wilhelm et al., 2019); content is delivered through curated multimedia resources (e.g., short videos, infographics, selected texts).

Module 2 – Sustainability Education Design Challenge (approx. 4 hours) moves from knowledge acquisition to applied course redesign. Participants develop a sustainability-enhanced course or teaching-unit prototype grounded in their disciplinary and institutional context. The module is scaffolded by two complementary tools. The *Educational Design Canvas* is a structured working template and advance organizer that guides participants through aligning sustainability-oriented learning goals, teaching activities, and assessment formats (Suppl. 3). The *Pedagogical Pattern Navigator* is a structured collection of pedagogical patterns: documented, reusable solutions to recurring teaching design problems. Each pattern links sustainability competencies with suitable teaching and assessment formats; participants select and adapt patterns matched to their disciplinary context and institutional constraints (Dilger, 2023).

To complete SE101, participants submitted their design canvas and a reflection paper (max. 2 pages), both receiving written expert feedback from the course developer.

3 Research Design and Methods

3.1 Study Design and Purpose

The study pursues a dual purpose: 1) generating transferable insights into how academic development courses can support sustainability-oriented faculty professionalization and 2) informing the iterative development of SE101. It adopts a qualitative case study design, treating SE101 as a bounded educational intervention. The study is developmental-evaluative in character.

The analysis was led by the course developer and main author. This dual role is common in design-based research and the scholarship of teaching and learning but introduces interpretive risk, mitigated through the measures described in Section 3.3.

3.2 Sample and Data Collection

Data stem from online course implementations at two institutions: the University of Regensburg ($N = 17$) and the University of St.Gallen ($N = 4$), yielding a total of $N = 21$. All participants submitted both the canvas assignment and the reflection paper. Course design, learning objectives, assignments, and assessment criteria were identical across sites; data were therefore pooled. The reflection papers averaged approx. 464 words ($SD = 126$, Range: 238–744).

Participants were predominantly early-career researchers (research associates: $N = 14$; doctoral students: $N = 3$; postdocs: $N = 3$; $N = 1$ not stated) and represented a range of disciplines, including education and teacher education ($N = 5$), medicine ($N = 4$), management and economics ($N = 6$), and fields such as information systems, psychology, and physiotherapy (see Suppl. 4). The majority were female ($N = 14$). Participation was voluntary; courses were completed between October 2024 and March 2026.

3.3 Data Analysis

For RQ1 and RQ2, course design prototypes and reflection papers were analyzed in *MAXQDA 2026* using qualitative content analysis (Kuckartz & Rädiker, 2023). Deductive categories were derived from Hawelka’s (2019) *Teaching Analysis Poll* (TAP) coding framework for perceived supports and impediments (RQ1) and from the instructional design principles underlying SE101, *competency orientation* and *constructive alignment* (Biggs et al., 2022), for RQ2. The inductive strand captured themes not anticipated by these frameworks (e.g., disciplinary transfer constraints, institutional dissonance, conceptual reframings). Trustworthiness was supported by a documented audit trail and peer debriefing with a student assistant. Both design principles were explicit learning content of SE101 and are embedded in the *Educational Design Canvas*; participants thus knew the criteria later applied in the analysis.

4 Findings

4.1 RQ1 – Perceived Supports and Impediments to Professional Learning

Analysis of the 21 reflection papers yielded a markedly asymmetric pattern: supportive aspects were named frequently and across the full participant range, while impeding and ambivalent aspects were comparatively rare. Table 1 summarizes the main findings (codebook: see Suppl. 5):

Table 1. Main Supportive and Impeding Aspects of SE101 as Perceived by Participants ($N = 21$)

Aspect	Val.	N	Representative quote
Actionable content and method repertoire	S	18	“These methods provided concrete, actionable insights” (UR_09)
Conceptual broadening of sustainability	S	15	“significantly broadened my understanding ... well beyond environmental topics alone” (UR_02)
Competency orientation as pedagogical reorientation	S	14	“sustainability education is about developing competencies ... rather than simply transferring knowledge” (HSG_04)
Hands-on design challenge	S	13	“through a practical project, we were able to apply what we had learned directly ... this made the learning experience particularly lasting” (HSG_01)
SE feasible across disciplines	S	12	“how naturally sustainability themes can be integrated into any discipline, including finance” (UR_03)

Openly available tools and materials	S	9	“one of the few [online courses] that offers concrete takeaways that can be useful for my career as an educator” (HSG_03; Insertion St.S)
Fixed curriculum and assessment constraints	I	6	“this course is most suited to teachers who have a completely free hand in what they teach” (UR_01)
Input volume / cognitive-motivational overload	I/A	2	“the volume of input and testing tasks ... made the course feel like an obligation” (UR_04)
Absent disciplinary SE tradition as barrier and potential	I/A	2	“sustainability has been almost entirely absent from medical education until now, making it both more essential and more difficult to integrate” (UR_06)

Note. Val. = valence (S = supporting; I = impeding; A = ambivalent); *N* = number of participants naming the theme; Aspects named once are reported in the text only.

Supporting Aspects

The most frequently coded supportive aspect, named by 18 of 21 participants, was the actionable orientation of course content. The *Educational Design Canvas* was central to this perception, described as translating constructive alignment into a workable design procedure (“a clear, structured way to translate abstract concepts of sustainability education into concrete teaching design”; UR_02). It was named as impactful in thirteen reflection papers, the single most cited course element.

A self-reported conceptual broadening, the shift from an environmental to a multi-dimensional understanding of sustainability, was coded across fifteen papers and often described as unexpected; several participants had expected a content-focused introduction and encountered pedagogical frameworks. Fourteen participants reported a related reorientation toward competency-based teaching, organized around what students should be able to do, know, and value rather than just know. Participants further described sustainability integration as feasible across disciplines (including cardiac surgery, data analytics, and English linguistics), often with explicit surprise; nine additionally valued the openly available tools and materials for enabling self-directed engagement.

Impeding and Ambivalent Aspects

The most frequent impediment, named by six of 21 participants, was fixed curricula and assessment conditions: module handbooks prescribed content, examination formats constrained assessment design, and disciplinary gatekeeping required permissions not yet granted. Cognitive and motivational overload was named by two participants, with one case coded ambivalently, pointing to a tension between depth and manageability. Participants from clinical and natural-science disciplines described a double conceptual load: sustainability frameworks and instructional design concepts in parallel (Table 1). Three singletons (missing peer exchange, institutional dissonance, overly basic content for one environmental economist) are noted but do not constitute patterns.

4.2 RQ2 – Reflection of SE101’s Instructional Design Principles in Course Design Prototypes

For RQ2, the 21 *Educational Design Canvases* were analyzed as design products. Each canvas was assessed against two instructional design principles structuring SE101: *competency orientation* (CO; Brundiers et al., 2021) and *constructive alignment* (CA; Biggs et al., 2022). Each prototype was classified as strongly, partially, or not reflected. Table 2 reports the distribution:

Table 2. Reflection of SE101’s Instructional Design Principles in Course Design Prototypes ($N = 21$)

Instructional design principle	Strongly reflected	Partially reflected	Not reflected
<i>Competency orientation</i> (CO): named sustainability competencies functioning as the organizing design logic	7	6	8
<i>Constructive alignment</i> (CA): learning outcomes, activities, and assessment coherently connected around a sustainability challenge	6	11	4

Note. Category labels describe the quality of reflection evident in the prototype, not the participant’s intent.

Sustainability-related Competency Orientation

Seven prototypes demonstrated strong competency orientation, with explicitly named sustainability competencies structurally organizing the design. HSG_01 referenced three GreenComp competencies and justified their selection against the growth assumptions of the finance curriculum; UR_02 used five competencies for English linguistics; HSG_04 named systems thinking, futures thinking, and ethical evaluation as organizing competencies for a course on digitalisation and AI and carried them through to assessment design. Only HSG_01 explicitly attributed competencies to a recognized framework (GreenComp; European Commission, 2022); the other six used terminology consistent with Brundiers et al. (2021) without citation.

Six prototypes showed partial competency orientation: competency terms appeared but remained vaguely formulated or structurally peripheral, appended parenthetically to knowledge-based objectives rather than functioning as design logic. Eight showed no competency framing, with knowledge-only objectives (“understand”, “know”) or rather vague skills language rather than sustainability competencies.

Constructive Alignment

Six prototypes demonstrated strong constructive alignment, with the sustainability challenge constraining outcome formulation, outcomes shaping activity selection, and activities determining assessment design. HSG_02 mapped three competency-based objectives to distinct activity formats (systems thinking to a Model UN simulation, critical thinking to a case study, problem-solving to an institutional research paper) with weighted assessment. UR_05 matched three methods to three competencies, with a poster conference, for instance, assessing content and collaborative process.

Eleven prototypes showed partial alignment: competencies, activities, and assessment appeared in the relevant sections, but at least one link remained implicit: activities without stated connection to competencies, or assessments not mapped to outcomes. Four showed no coherent alignment: objectives incompatible with the listed activities, or assessment absent altogether.

CA and CO tended to co-occur: prototypes naming competencies as organizing logic also built coherent alignment chains, while knowledge-only objectives indicated the absence of both principles.

5 Discussion

Three patterns warrant discussion:

Conceptual reframing is necessary but not the endpoint. The self-reported shift from an environmental to a multidimensional understanding of sustainability is a central learning outcome and a prerequisite for further integration. Yet the course designs predominantly display features of ESD 1 and ESD 2, while the transformative orientation of ESD 3 is largely absent (Pettig & Singer-Brodowski, 2025); whether they mark a development cannot be determined, as no baseline of participants' prior designs exists. ESD 3 demands engagement with potential myths in and about sustainability education (Siegel, 2026) and value conflicts and with sustainability as genuinely contested terrain (Costa et al., 2025); future iterations should therefore add targeted elements, such as structured value-conflict scenarios.

Constructive alignment was realized to markedly different degrees. One plausible, yet tentative, interpretation links this spread to prior instructional design experience: participants from fields with a curriculum design tradition could treat SE101 as an elaboration of existing knowledge, whereas those from clinical and natural-science backgrounds reported a double conceptual load (Section 4.1), which cognitive load theory associates with shallower processing (Paas & Sweller, 2014). As prior didactic knowledge was not assessed, this reading rests on disciplinary affiliation; it nonetheless suggests differentiated entry points for participants with and without instructional design experience. Foregrounding generative learning activities, such as elaboration and application tasks, is a further option derived from theory (Fiorella, 2023) rather than from the present findings.

Institutional constraints were the most salient reported barrier to implementation. Six of 21 participants, a minority yet the largest impediment group, reported that fixed curricula, mandatory assessment formats, and approval processes limited the implementation of their prototypes. For them, individual conceptual change and design competence are necessary but not sufficient for curricular integration. Practically, SE101 could frame the design challenge from the outset as a prototype for institutional advocacy and equip participants to make the case for curricular change. Sustained pedagogical change requires support structures (e.g., peer networks, mentoring, institutional incentives) that extend beyond a single course (Barth & Rieckmann, 2012; Holst et al., 2024).

SE101 nonetheless demonstrates what a structured, evidence-informed online format can achieve. The *Educational Design Canvas* functioned as a conceptual bridge between abstract competence frameworks and concrete pedagogical decisions. The Pedagogical Pattern Navigator's contribution cannot be appraised from the present data: few participants referenced it explicitly, and it did not emerge as a distinct theme (Table 1).

Four methodological limitations bound these claims. The sample is small ($N = 21$) and self-selected, likely overrepresenting motivated instructors with an interest in the subject; the absence of pre/post comparisons restricts inferences about learning gains; and the positionality of the course developer as analyst introduces interpretive risk that peer debriefing only partially mitigates (Reinmann, 2019). In addition, all data are self-reports or certification-relevant products, so social desirability cannot be ruled out; claims about conceptual broadening rest on participants' self-descriptions. Whether broadened conceptions also manifest in the canvases is a question for future research, as is replication with broader samples.

6 Conclusion

Sustainability education in higher education will not advance through declarations alone. It requires faculty who can translate institutional commitments into coherent, competency-oriented teaching, and academic developers equipped to support that translation (Sterling, 2025).

SE101 demonstrates that such formats are achievable. Participants reported a broadened understanding of sustainability beyond environmental framings, designed course prototypes with explicit attention to constructive alignment, and identified entry points even in fields without a sustainability education tradition. The prototypes display features of ESD 1 and of the reflexive, competency-oriented ESD 2 (Pettig & Singer-Brodowski, 2025). The *Educational Design Canvas* proved central to this process; the role of the *Pedagogical Pattern Navigator* requires targeted evaluation.

Limits remain. Eight hours may prompt a reported shift in conceptual framing; it does not suffice to develop the values-oriented, transformative capacities of ESD 3. Cognitive overload and institutional constraints further restrict transfer into sustained pedagogical change. Academic development, however well-designed, cannot substitute for structural reform at the meso and macro levels (Barth & Rieckmann, 2012). It can, however, create the conditions under which sustainability integration becomes a shared institutional practice rather than a function of individual goodwill.

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Supplements

Supplement 1: Detailed Learning Outcomes of SE101
<https://osf.io/6mu93/files/qc8zv>

Supplement 2: Explainer Videos of the Self-learning
Course Sustainability Education 101:
<https://osf.io/6mu93/files/u9txa>

Supplement 3: Advanced Organizers
and Educational Design Tools within SE101
<https://osf.io/6mu93/files/w9z7y>

Supplement 4: Sample Description
<https://osf.io/6mu93/files/h64w3>

Supplement 5: Dataset for Analyses / Coding Table
<https://osf.io/6mu93/files/47nr6>