Check for updates

RESEARCH ARTICLE

Teaching off-track: Contributions of interdisciplinarity and sustainability in teacher education. First insights from the AGIR project

[version 1; peer review: 1 approved, 1 approved with reservations]

Cédric Vanhoolandt[1], Amélie Anciaux[2], Camille Calicis[1], Charlotte Dejaegher[1]

[1]University of Namur - Faculty of Educational and Training Sciences, IRDENa,Namur, 5000, Belgium
[2]Pôle académique de Namur, Namur, 5000, Belgium

v1 **First published:** 24 Aug 2026, **6**:304
https://doi.org/10.12688/openreseurope.22083.1
Latest published: 24 Aug 2026, **6**:304
https://doi.org/10.12688/openreseurope.22083.1

Abstract

Background

In the context of growing socio-environmental crises, higher education institutions are increasingly expected to integrate sustainability across curricula through interdisciplinary and interinstitutional approaches. This study presents the initial findings from the preclinical phase of the AGIR project, a collaborative action research initiative involving four higher education institutions in the French-speaking part of Belgium. This project aims to support the development of sustainability education in teacher training programs.

Methods

Grounded in a design-based research approach, this study focuses on an interdisciplinary course on sustainability education designed for prospective secondary school teachers. A mixed-methods research design was implemented, drawing on the Action Competence in Sustainable Development (ACiSD) framework to examine students' relevant knowledge, willingness to act, capacity expectations, and outcome expectancy in relation to sustainability. Quantitative and qualitative data were collected to capture the cognitive and affective dimensions of student learning.

Results

Open Peer Review

Approval Status ? ✓

	1	2
version 1 24 Aug 2026	? view	✓ view

1. **Jordan King**, The University of Tennessee, Chattanooga, USA

2. **Svanborg Rannveig Jónsdóttir**, University of Iceland, Reykjavik, Iceland

Any reports and responses or comments on the article can be found at the end of the article.

The findings indicated that interdisciplinarity constitutes a significant pedagogical lever for enhancing student engagement and perceived capacity to act in relation to sustainability issues. Participants reported an increased willingness to engage with sustainability-related challenges and greater confidence in their capacity to contribute meaningfully. However, persistent difficulties were observed in relation to conceptual knowledge, particularly regarding some pillars of sustainable development as well as in students' outcome expectancy.

Conclusion

These initial results provide practical insights for the design of transformative learning experiences in sustainability education within teacher training. They highlight the value of interdisciplinary and collaborative frameworks, particularly within the social sciences and humanities, while also pointing to areas requiring further pedagogical attention to strengthen the conceptual understanding and perceived effectiveness of action.

Keywords
Interdisciplinarity, Sustainability, AGIR Project, Teacher Education, Ergonomy

This article is included in the COST Actions gateway.

Corresponding author: Cédric Vanhoolandt (cedric.vanhoolandt@unamur.be)

Author roles: Vanhoolandt C: Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Resources, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Anciaux A**: Conceptualization, Funding Acquisition, Investigation, Project Administration, Resources, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Calicis C**: Data Curation, Formal Analysis, Resources, Visualization, Writing – Original Draft Preparation; **Dejaegher C**: Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Resources, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: This project has received funding from the European Union's Framework Programme for Research & Innovation as part of the COST Action [CA21166 Social Sciences and Humanities for Transformation and Climate Resilience], as supported by the COST Association (European Cooperation in Science and Technology). The AGIR project was funded by ARES under grant PRW65 (Plan de Relance de la Wallonie), supporting the creation of a research chair in education for sustainable development in higher education in Wallonia.
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Copyright: © 2026 Vanhoolandt C *et al*. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

How to cite this article: Vanhoolandt C, Anciaux A, Calicis C and Dejaegher C. **Teaching off-track: Contributions of interdisciplinarity and sustainability in teacher education. First insights from the AGIR project [version 1; peer review: 1 approved, 1 approved with reservations]** Open Research Europe 2026, **6**:304 https://doi.org/10.12688/openreseurope.22083.1

First published: 24 Aug 2026, **6**:304 https://doi.org/10.12688/openreseurope.22083.1

1. Introduction

In an era marked by climate urgency and socio-environmental crises, education systems are under growing pressure to play a critical role in fostering sustainability competencies and systemic thinking as they are responsible for preparing tomorrow's citizens (Barthes & Lange, 2024; Mokski et al., 2023; Serrano-Bedia & Perez-Perez, 2022).

Schools have gradually integrated environmental concerns into their curricula (Boeve-de Pauw & Van Petegem, 2018; Napawan et al., 2017). Specifically, three overlapping approaches have shaped educational practices: environmental education (EE), rooted in activism; education for sustainable development (ESD), which emphasizes civic competencies for action; and climate change education (CCE), which focuses on the urgency of climate threats (Gibert, 2020; Lange, 2014; Sauvé, 2001).

Despite the implementation of these educational paradigms and the support of international frameworks such as the UN Sustainable Development Goals (SDGs), embedding sustainability across university and higher education institution (HEI) curricula remains a complex and uneven process (Sass et al., 2021). Literature highlights critical limitations in existing practices: (1) efforts based solely on factual knowledge can demobilize students and produce counterproductive effects (de Beer de Laer, 2021; Ojala, 2015); (2) Students frequently feel powerless to act and experience a psychological distance from environmental problems (Morin et al., 2022; Sass et al., 2021); (3) higher education particularly suffers from a disconnection between theory and actionable solutions, with limited participatory opportunities and insufficient links between knowledge and real-world engagement (Curnier, 2017; Zamora-Polo & Sánchez-Martín, 2019). Recent studies (e.g., Ducol et al., 2022) underscore the rising diversity in student perceptions, needs and expectations regarding ESD, which calls for the implementation of differentiated pedagogical strategies that can effectively address this complexity.

This emphasizes a critical challenge for higher education: how to move beyond knowledge transmission toward pedagogies that foster hope, agency, and transformative practices (Stevenson et al., 2016). Yet such pedagogical innovations remain marginal in higher education, under-supported, and rarely institutionalized. A lack of ergonomic fit—usefulness, usability, and acceptability (Alexandre et al., 2018; Renaud, 2020)—limits their adoption. Moreover, systemic constraints, institutional routines, and cultural norms hinder sustainable innovation (Carton & Valiorgue, 2023; Cèbe & Goigoux, 2007).

In this context, a shift from fragmented and discipline-specific approaches toward more cohesive, interdisciplinary, and contextually grounded strategies is increasingly necessary (Boeve-de Pauw & Van Petegem, 2018). This perspective resonates with the Social Sciences and Humanities for Transformation and Climate Resilience (SHiFT) initiative, *Universities for Sustainability.* This underscores that fostering meaningful transformation within HEIs requires more than technical fixes or isolated environmental actions. It calls for interdisciplinary and interinstitutional collaborations rooted in the critical contributions of the Social Sciences, Humanities, and Arts (SSH&A) (SHiFT, 2025). Within this intellectual landscape, the "Accompagner et Garantir la pérennité de l'Implémentation de bonnes pratiques interdisciplinaires Résilientes[1]" (AGIR Project) seeks to explore how interdisciplinary and interinstitutional dynamics can meaningfully contribute to embedding sustainability education within HEIs.

Anchored in the academic ecosystem of Namur (Belgium), the AGIR project – funded by ARES[2] – brings together four complementary institutions (UNamur, HEPN, HEAJ, and Hénallux), alongside civil society actors. It aims to co-construct a flexible and actionable pedagogical framework to support educators in integrating sustainability into their courses, drawing on both empirical feedback as well as theoretical models from SSH&A. By adopting an action-research approach (Roy & Prévost, 2013), the AGIR project aspires to address locally grounded academic and institutional needs, while contributing to broader conversations on pedagogical change, as called for by SHiFT's mission.

Specifically, this article focuses on the preclinical phase of the AGIR project, which aims to identify current teaching practices and barriers to interdisciplinary sustainability education in higher education. It presents a case study of a single course, outlining the conceptual framework, methodological approach, and first insights.

2. Conceptual framework

The origins of sustainable development (SD) can be traced back to the 1960s and 1970s, when environmental degradation and resource scarcity began to raise serious concerns (Du Pisani, 2006). Landmark publications such as the Club of

[1]Could be translated into "*Fostering and Sustaining Resilient Interdisciplinary Best Practices*"
[2]Academy for Research and Higher Education, which oversees higher education and research in the French-speaking community of Belgium - https://www.ares-ac.be

Rome's report *Limits to Growth* (Meadows et al., 1972) employed systems modeling to project that unchecked economic and demographic growth would exceed the planet's ecological limits within decades. In the 1980s, the Brundtland Report (1987) formally introduced the concept of SD, defining it as: *"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* It acknowledged the necessity of balancing environmental protection, economic development, and social equity. This framework marked the beginning of a shift in thinking, from short-term exploitation to long-term ecological balance and has since shaped international policy and educational initiatives.

With the adoption of the 2030 Agenda for SD by the United Nations (UN) in 2015, the global community agreed upon 17 SDGs to address the world's most urgent challenges. The UN calls for uniform SD at the global, local and individual levels (UN, 2015). Those 17 SDGs require the implementation of targets aimed at eradicating poverty, protecting the planet and improving the quality of life for all citizens. The literature highlights how SD is a relevant necessity for humanity (Patuelli & Saracco, 2023). To promote understanding and coherence across sectors and scales, these goals were structured around five pillars known as the "5 Ps" of SD. These pillars provide not only a thematic framework for action, but also a normative foundation upon which educational initiatives and policy efforts must align to foster systemic change (Tremblay et al, 2020). The "planet" pillar focuses on risks of ecological degradation and climate change. Issues such as poverty, hunger, dignity, and equality are incorporated in the "people" pillar. "Peace" pillar regards peaceful, just and inclusive societies, "Prosperity" pillar includes economic, social and technological progress in harmony with nature and "Partnership" pillar points at the need for solidarity and participation of all people and nations (UN, 2015).

While these frameworks provide a global orientation, the key question for education is how to translate them into competencies that enable concrete action. In this regard, the concept of *action competence* has been central. Indeed, individuals or groups with action competence possess the skill to seek out information about possible actions they can take to contribute to solutions (Jensen & Schnack, 2006). This skill is an essential element of Action Competence in SD (ACiSD), which refers to the capacity of individuals or groups to engage with complex, sustainability-related "wicked problems" (Boeve-de Pauw & Van Petegem, 2018; Sass et al., 2020). This competence is understood as the capacity not only to act, but to do so intentionally, with the aim of contributing to solutions for complex socio-environmental challenges (Hungerford & Volk, 1990; Stern, 2000). ACiSD is composed of four interrelated subconcepts: relevant knowledge, willingness, capacity expectations, and outcome expectancy (Sass et al., 2020). Relevant knowledge (K) refers to a holistic and conceptual understanding of SD issues, encompassing the interconnected dimensions of the five pilars (UN, 2015). Willingness (W) denotes a deep-seated personal motivation to engage, persist, and overcome potential obstacles in contributing to change (Moeller & Grassinger, 2013; Vallerand, 2015). Capacity expectations (CE) relate to self-efficacy—the confidence in one's own or one's group's ability to take meaningful action (Bandura, 1977; Breiting et al., 2009). Finally, outcome expectancy (OE) involves the belief that such actions will have a tangible, positive effect (Jensen & Schnack, 2006).

Finally, addressing the multifaceted and systemic nature of sustainability issues requires an epistemological and pedagogical shift toward interdisciplinarity (Dillon, 2008). As several authors argue (e.g., Repko & Szostak, 2020), fragmented disciplinary approaches are ill-suited to grasp the complexity of "wicked problems" that cut across environmental, social, and economic domains. Interdisciplinarity allows learners to develop integrated understanding of sustainability challenges and to design more coherent pedagogical responses. In this context, ESD has emerged as a growing field of research and practice, focusing not only the transmission of knowledge but also on transforming values, identities, and professional postures (Lange, 2014; Sauvé, 2001). However, despite conceptual advances, ESD implementation often suffers from limited integration across curricula and a lack of pedagogical support (Carton & Valiorgue, 2023; Cèbe & Goigoux, 2007).

In this exploratory case study, we seek to examine how a newly developed interdisciplinary course on ESD contributes to the development of students' action competence. More specifically, we aim to understand how students' relevant knowledge, willingness, capacity expectations and outcome expectancy change from the start to the end of the semester.

3. Material and methods

3.1 Bridging action-research and institutional diagnosis

The AGIR project is conceived as an action-research initiative structured around five main phases. Drawing on didactic engineering (Artigue, 1988; Thouin, 2014) and design-based research (Gorard et al., 2004), it ensures iterative development and contextual relevance through a sequential process comprising: a preclinical study, a modeling, an exploratory testing, a definitive testing, and a long-term implementation.

The preclinical study (Phase 0) combines a literature review with an institutional diagnosis to map current teaching practices, analyze students' action competences and learning outcomes, and identify structural as well as pedagogical

barriers to ESD. The insights gained during this phase inform the development of a prototype teaching framework structured as a decision tree (Phase 1). This tool is intended to guide instructors in identifying suitable pedagogical strategies and anticipating institutional constraints, thereby facilitating the contextualized integration of sustainability principles in their courses. The framework will be piloted in Phase 2 by a small group of instructors, followed by broader implementation and evaluation in Phase 3. Finally, Phase 4 aims to support long-term implementation through regional dissemination.

In particular, the focus of this work is the project's initial phase, the preclinical study, which serves as the basis for the overall process.

3.2 From institutional diagnosis to case study

Mapping existing ESD initiatives across the four HEIs constitutes a complex and demanding task. In two of the institutions (HEAJ and HEPN), the absence of clear institutional mechanisms rendered the identification of sustainability-related initiatives particularly challenging. To address this gap, a systematic keyword-based analysis was undertaken, using terms such as *environment*, *climate*, and *sustainable development* to screen all course grids and program descriptions offered by these institutions. By contrast, at Hénallux, teachers are required to self-report which SDGs their courses addressed, resulting in 274 course records being tagged—although this information relies exclusively on teacher declarations (Anciaux & Picquot, 2025). At UNamur, instructors may voluntarily add a "sustainability" tag to their course descriptions, with 171 such courses identified to date. Here too, however, the system depends entirely on self-reporting. These four cases illustrate the diversity of approaches across institution, and efforts are currently underway to standardize the mapping process.

As the objective of the preclinical study is to identify current teaching practices, student learning outcomes, and barriers to interdisciplinary sustainability education, this study presents a case study of a course entitled "Teaching through Interdisciplinarity – The example of SD" [KF208] (course TTID-SD). It has been selected on two main criteria: (1) its inclusion in a new joint degree program offered by two partner institutions (Hénallux and UNamur) of the AGIR project and (2) its content explicitly refers to interdisciplinarity and the SDGs.

3.3 Case study description

The course TTID-SD consists of 37.5 hours of lectures and 15 hours of practical sessions. It is offered in the second year of the bachelor cycle of a Master's program in Secondary Education, preparing future teachers of modern languages, social sciences, experimental sciences, mathematics, French (mother language), and related subjects, for grades 5 to 9.

The course is organized around three main thematic modules: (1) interdisciplinarity, which introduces student to the concept and its implication for teaching, (2) sustainable development, which explores the key dimensions and debates surrounding the concept; and (3) education for sustainable development, which examines pedagogical approaches to integrating sustainability principles into teaching practices.

Practical sessions (N = 5), facilitated by two teaching assistants, support the co-construction of an interdisciplinary educational project, using conceptual tools, curricular references, and experiential resources gathered during a fair featuring non-profit organizations engaged in experiential ESD.

Assessment is project-based, including both formative and summative components, culminating in a presentation in front of a jury.

3.4 Participants and data collection

The study sample consists of 31 participants (46.7% female) at the initial measurement and 41 participants at the follow-up measurement, out of 43 students regularly attending the course activities during the 2024–25 academic year. Participants are young adults with a relatively homogeneous age group, having a mean age of 21.5 ($\pm$ 1.3) years and are all proficient in French.

The course was co-taught by two teachers. The first one [teacher1] holds a PhD in educational sciences, with a research focus on science didactics and pedagogical innovation. The second [teacher2] holds a PhD in educational sciences, specializing in didactic of the language of schooling and the design of professional training. Both teachers are co-authors of the present study and were directly involved in the course's design and implementation.

The evaluation of this course was conducted through a longitudinal explanatory sequential mixed methods design (Creswell, 2012). The study included two data collection points: an initial and a follow-up measurement.

- Initial measurement

  a) *Self-report questionnaire* (ACiSD-FR, Vanhoolandt et al., 2025) of 44 items on a 5-points Likert scale, ranging from *strongly disagree* to *strongly agree*, consisting of a contextualized French adaptation of the ACiSD-Q (Sass et al., 2021) [Appendix 1]

  b) Course objectives as declared by teachers

- Follow-up measurement

  a) *Open-ended survey* about students' perceptions of their learning (knowledge, willingness to act, capacity expectations and outcome expectancy) [Appendix 2]

  b) *Focus group* (FG) about students' perceptions of their own learning [Appendix 3]

  c) *Semi-structured interviews* about teachers reported pedagogical practices related to sustainability [Appendix 4] Figure 1 presents the methodological framework.

To limit potential power imbalances, student data were collected by a researcher who was not responsible for teaching or assessing the course.

3.5 Data analysis

- Initial measurement

Descriptive statistics and correlation analyses were conducted using R (R Core Team, version 4.4.1 "Race for Your Life"). Cronbach's alpha was calculated ($\alpha = 0.89$; 44 items; N = 86) and a principal component analysis (PCA) was computed, suggesting strong internal reliability (Vanhoolandt et al., 2025).

A qualitative content analysis was conducted on the course objectives as declared by teachers. The analysis involved identifying recurring themes and categories related to interdisciplinarity, SD, and ESD.

- Follow-up measurement

Open-ended survey responses, FGs discussions, and semi-structured interviews with teachers were analyzed using categorical content analysis (L'Écuyer, 1987). A deductive approach was applied using a predefined category tree comprising 12 categories (3 P's × 4 subscales). Frequencies of occurrences per category were counted, and trends were

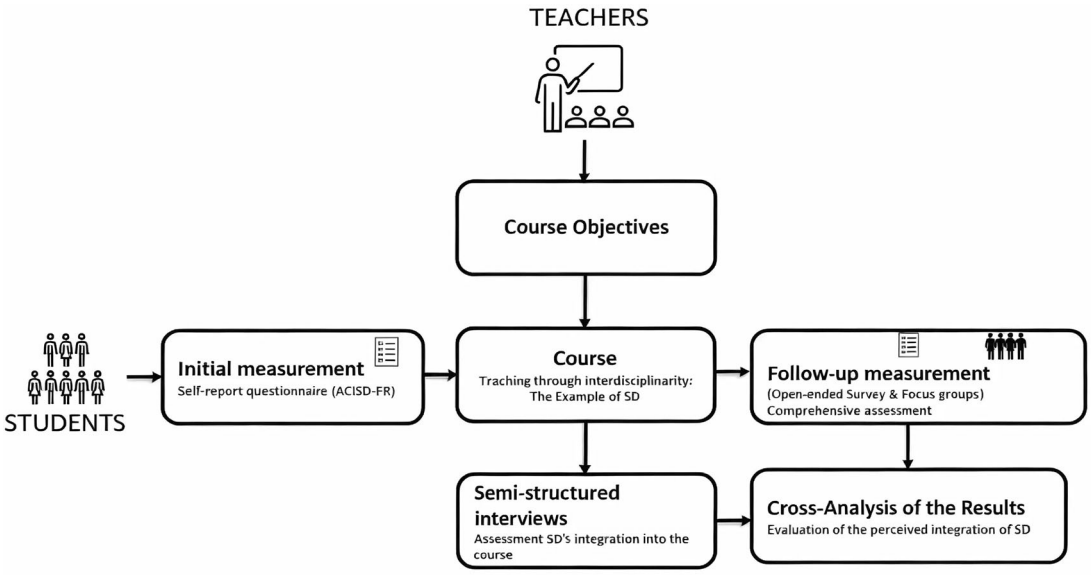


Figure 1. Methodological framework.

illustrated with representative excerpts. Cohen's kappa was calculated for Knowledge ($\kappa = 0.68$, $p = <.001$), Willingness ($\kappa = 0.70$, $p = <.001$), Capacity Expectations and Outcome Expectancy ($\kappa = 0.71$, $p = <.001$). These values suggest that the coding scheme was applied reliably across raters.

4. Results

4.1 Initial measurement

The course objectives are threefold: (1) the acquisition of theoretical knowledge, (2) the development of pedagogical skills, and (3) the cultivation of a critical civic mindset. As Teacher 1 explains: *"An objective is to raise their awareness of ESD through their role as teachers, so that they can raise awareness among their future students as a form of civic education that goes beyond their specific disciplinary teaching"*. This holistic pedagogical framework offers a meaningful lens through which to interpret participants' self-assessed readiness to engage with SD, as reflected in the quantitative measures presented below.

Table 1 presents means and standard deviations for four dimensions: Knowledge, Willingness to act (Willing), Capacity expectancy and Outcome expectancy. These are reported both overall (General) and across three subscales: People, Peace and Planet. No gender-related differences were observed.

Although the mean of all dimensions ranged between 2.50 and 3.15 (on a maximum of 4), inter- and intra-dimensional differences emerge. It therefore seems relevant to examine these differences in detail.

1. Knowledge dimension

   The highest score is found in the *People* subscale (3.15 ± 0.36), indicating stronger knowledge about social and human-related issues (e.g., human rights, equity). Conversely, the *Planet* subscale shows the lowest score (2.56 ± 0.47), suggesting a relatively lower level of knowledge regarding environmental issues. The general score (2.86 ± 0.37) reflects a moderate level of knowledge overall.

2. Willingness to act

   A similar pattern emerges: *People* has the highest willingness score (2.97 ± 0.60), while *Planet* is the lowest (2.50 ± 0.49). This could indicate that participants are more motivated to act on social or human-related issues than on environmental challenges.

3. Capacity expectancy

   Scores are relatively consistent across subscales, but *People* again stands out with the highest score (2.94 ± 0.82), suggesting a greater confidence in one's own ability to contribute to social causes. *Planet* scores the lowest here as well (2.70 ± 0.68), possibly reflecting a sense of helplessness when it comes to environmental action.

4. Outcome expectancy

   Participants show moderate expectations regarding the results of their actions, with fairly close scores across the subscales. Once more, *Planet* is at the bottom (2.60 ± 0.81), which may indicate skepticism about the actual

Table 1. Results of the four dimensions and three subscales.

Subscale	N	Knowledge (M ± SD)	Willing (M ± SD)	Capacity expectancy (M ± SD)	Outcome expectancy (M ± SD)
General	11	2.86 ± 0.37	2.77 ± 0.42	2.83 ± 0.68	2.69 ± 0.84
P1 (People)	4	3.15 ± 0.36	2.97 ± 0.60	2.94 ± 0.82	2.75 ± 1.09
P2 (Peace)	3	2.87 ± 0.69	2.85 ± 0.42	2.83 ± 0.79	2.73 ± 0.94
P3 (Planet)	4	2.56 ± 0.47	2.50 ± 0.49	2.70 ± 0.68	2.60 ± 0.81

Notes: N: number of items; M: mean; SD: standard deviation

impact of environmental actions. The overall score (2.69 ± 0.84) suggests moderate belief in the effectiveness of personal or collective actions in general.

The data seems to show a clear trend: participants feel more informed, motivated, capable and optimistic when it comes to *People*-related issues, whereas the *Planet* subscale consistently scores lowest across all dimensions. This may highlight a need to strengthen education and empowerment initiatives focused on environmental awareness and action. This gap can be partly attributed to the scientific complexity and abstract nature of certain environmental concepts, which Teacher 1 himself describes as "*perhaps a little less clear.*" Furthermore, understanding these concepts requires a level of scientific literacy that students are still in the process of developing. According to Teacher 1's hypothesis, this challenge is compounded by the fact that participants come from diverse academic backgrounds, mostly non-scientific, and are presumed to have an initial knowledge level comparable to that of a final-year secondary school student.

In addition, a correlation matrix was computed to analyze the relationships between the three dimensions and the four subscales. This matrix, presented in Table 2, provides a detailed overview to identify potential interdependencies across dimensions and subscales.

The strong correlations for CE (i.e. r = 0.54, r = 0.75 and r = 0.80) and for OE (i.e. r = 0.56, r = 0.57 and r = 0.80) suggest a high degree of stability in both self-efficacy beliefs (CE) and expected outcomes (OE) across subscales. This indicates that these motivational beliefs are generalized and coherent**,** regardless of the subscales (People, Peace or Planet).

The moderate correlations for K (r = 0.40 and r = 0.44) and for W (r = 0.36) point to greater variability in knowledge and willingness to act, which may reflect domain-specific attitudes or learning effects. Participants appear to feel more informed or motivated in some subscales (e.g., People) than in others (e.g., Planet).

The strong correlation between CE and OE in all contexts (i.e. r = 0.59 for P1, r = 0.50 for P2 and r = 0.66 for P3) suggests that feeling capable (CE) is closely associated with expecting positive results (OE). The weak correlations between K and W indicate that perceived knowledge is relatively independent from motivational and expectancy beliefs. This suggests that participants may have knowledge without necessarily feeling capable or motivated to act, highlighting what is often referred to as a potential knowledge-action gap.

Some correlations are notably weaker in the *Planet* (P3) subscale (i.e. 0.43 vs 0.63 and 0.70). This may reflect a lower integration of motivational constructs within environmental concerns, potentially due to lower personal engagement with ecological issues or less impactful educational content related to *Planet.*

4.2 Follow-up measurement

The post-course categorical analysis revealed a total of 35 occurrences across the four dimensions of the ACiSD framework: Conceptual Knowledge (12), Willingness to act (9), Capacity Expectancy (9), and Outcome Expectancy (5). These were distributed across two subscales —People (9) and Planet (12)—as well as general, non-specific responses (14) and detailed in Table 3.

1. Knowledge dimension (K)

   A total of 12 student contributions were coded under this category. Responses revealed a heterogeneous level of conceptual understanding of SD. While some students reported gaining new insights—particularly through concrete examples such as "*consumption statistics* "—others, especially those from programs in geography, history and social sciences, perceived the content as repetitive. As a student noted: *"So this topic, we see it all the time."* [Student 2, FG 4] Another added, *"I already knew that meat consumption was higher, but seeing the actual numbers reminded me—and that really made me want to look for alternatives."* [Student 1, FG 4] The *Planet* subscale stood out the most: *"We got a lot of questions about water consumption, environmental impact, etc. So even though the activity was meant for the pupils, it also raised our own awareness because we kept repeating the numbers."* [Student 1, FG 4] This reveals a constant effort of teachers to deepen students' understanding of SD, particularly with regard to the environmental ("Planet") dimensions. Teachers have endeavored to provide a fundamental scientific and historical context — going beyond a superficial awareness — as reflected by Teacher 1: "*I brought in a whole series of scientific facts […] to bring it in a bit as a proven fact because it doesn't seem relevant to me to debate whether climate change exists or not*"

Table 2. Correlation matrix of the four dimensions and three subscales.

	K.P1	W.P1	CE.P1	OE.P1	K.P2	W.P2	CE.P2	OE.P2	K.P3	W.P3	CE.P3
K.P1	–										
W.P1	.63 ***	–									
CE.P	−.09	.27	–								
OE.P	.17	.40 *	.69 ***	–							
K.P2	.26	.14	−.42 *	−.11	–						
W.P2	.02	.21	−.09	.08	−.70 ***	–					
CE.P2	−.22	−.19	.54 ***	.36 *	−.34 (.06)	−.00	–				
OE.P2	−.12	.15	.50 ***	.57 ***	.28	.54 **	.50 **	–			
K.P3	.44 *	.53 **	−.15	.08	.40*	.37 *	−.36 *	−.07	–		
W.P3	.14	.36 *	.23	.20	−.04	.10	.05	.17	.43*	–	
CE.P3	−.20	.01	.75 ***	.50 ***	−.28	.09	.80 ***	.51 **	−.15	.24	–
OE.P3	.04	.26	.69 ***	.83 ***	−.16	.10	.49 **	.56 **	.25	.46 **	.66 ***

Note: Dimensions K: Knowledge; W: Willing; CE: Capacity expectation; OE: Outcome expectation.Statistical significance is indicated:
*p < .05;
**p < .01;
***p < .001

Open Research Europe 2026, 6:304 Last updated: 15 OCT 2026

Table 3. Occurrences of the four dimensions and three subscales – After the course.

Subscale	Total number of occurrences	Knowledge	Willing	Capacity expectancy	Outcome expectancy
Total number of occurences	35	12	9	9	5
General	14	6	3	5	0
P1 (People)	9	1	2	2	4
P2 (Peace)	0	0	0	0	0
P3 (Planet)	12	5	4	2	1

2. Willingness to act (W)

   Nine interactions were coded in this category, showing a marked divergence in students' willingness to act on sustainability issues. Some expressed little to no change in their personal habits, citing disinterest, a belief that they were already doing enough, or skepticism about individual impact. For instance, one student remarked, *"Personally, it won't change anything for me. I might pay more attention, but I'll still go to [my usual supermarket] and buy a mango from who knows where"* [Student 1, FG2]. Another stated, *"I already do enough, so it doesn't change much in my personal life."* [Student 5, FG4] In contrast, others reported increased awareness and a desire to adopt more sustainable behaviors: "*I even felt that one number really struck me, it was about the impact of meat consumption on CO2 emissions, for example, where the figures were given. […] It made me think and it makes me want to look for alternatives.*" [Student 1, FG4]*."* Once again, the *Planet* dimension is the most frequently cited, followed by *People.*

   The desire to raise awareness among others, particularly as future teachers, is a driving force for some like a student [Student 1, FG2]: "*I tell myself that I want to apply it in my classes."* This change is also supported by teachers' observations, who note the students' growing motivation to take action on both a personal and professional level. As Teacher 1 puts it: "*I found it interesting […] to see that they could […] also have an impact in relation to their future students*". This convergence highlights how educational strategies can effectively generate a willingness to engage in environmental challenges.

3. Capacity Expectations (CE)

   Fewer statements were coded under this category. A lot of students did not directly express perceptions of their own capacity or self-efficacy to take sustainability-related actions. Some students said they feel capable of taking action if they are placed in concrete situations (group work, practical activities). The ability to act on a human level (awareness, collaboration) stands out strongly, especially for the *People* dimension. For example, a student said "*We learned how to carry out joint projects. And that's probably the best way to get the message across, to give students the experience of carrying out a joint project like we did today.*" [Student 1, FG 4]. This point of view is echoed by teachers who report having heard students say things like: "*Afterwards, in my school, it's an activity I'll do again*" [Teacher 2], showing that these concrete approaches are perceived as particularly effective and transferable.

4. Outcome Expectancies (OE)

   Nine statements were also coded under this dimension. Students frequently expressed skepticism or cynicism regarding the effectiveness of individual actions in addressing large-scale sustainability challenges. Many questioned whether their efforts could have a meaningful impact compared to systemic issues or the actions of powerful actors. One student reflected, *"It's hard to commit to this project knowing that good intentions are fine, but money still matters more."* [Student 2, FG2]. A second added, *"I feel like I don't have the keys. And I feel like I'm not the only one who should make the effort. If I do it alone, it won't change the world.*" [Student 4, FG 4]. Students' express doubts about the effectiveness of their individual actions in the face of larger problems. This feeling is corroborated by the interview with Teacher 2*: "I felt this effect of saturation a little and pfff it's good, we've had enough".*

4.3 Student-perceived catalysts for change in ACiSD

To complement the structured analysis of ACiSD dimensions, this section explores the reported influences on the development of action competence in SD. Drawing from open-ended survey responses and focus group discussions, the analysis identifies key pedagogical, social, and experiential elements that students reported as influential in shaping their K, W, OE and CE.

First, interdisciplinary collaboration was consistently cited as a key learning lever. Many students emphasized the importance of working with peers from different academic backgrounds and appreciated the value of teamwork. As one respondent noted, *"Collaborating with people we don't usually work with was truly enriching"* [participant_18], while another highlighted *"The co-construction of our project with classmates from other sections."* [participant_37] Others pointed to *"Working with other sections"* [participant_13] and *"Creating the project and collaborating with another subject area"* [participant_36] as instrumental in shaping their understanding. Teacher 2 highlighted that *"the fact that [the] audience is so interdisciplinary was one of the biggest difficulties, and at the same time one of the best levers, because I think they feed off each other a lot"*.

A second major theme was the impact of concrete projects and hands-on activities. Students expressed how meaningful it was to engage in tangible, applied tasks. For example, one participant shared the pride of *"Completing the project and being an active participant in the evaluation,"* [participant_15] while another described *"The motivation to create a hands-on project."* [participant_22] These practical experiences made learning more authentic and allowed them to *"Reach a concrete outcome with other disciplines."* [participant_31].

The course's pedagogical methods and engaging learning formats also stood out, which include games, lab work, and innovative evaluation approaches. Learners appreciated *"Fun, game-based activities"* [participant_05] and *"The fact that there was an applied final evaluation instead of a written exam."* [participant_17]. Others mentioned the value of *"Lab work and small group sessions"* [participant_21] and *"Participation and hands-on work."* [participant_10] These active methods made learning both enjoyable and effective.

SDGs themselves were also frequently cited as a direct influence. Students mentioned *"Learning about the SDGs and creating an interdisciplinary project,"* [participant_03] as well as *"The SDG presentation and related activities,"* [participant_40] and even simply *"Everything we learned about the SDGs."* [participant_41] These responses suggest that the content of the course resonated with learners. Another element was the personal reflection and shift in mindset experienced by many students. Some mentioned how their attitude towards sustainability evolved, such as one student who shared, *"This course changed my perception: I now realize the value of acting at my own scale,"* [participant_26] and another who said, *"My personal drive to act for the environment … this course gave me new methods to do so and teach them."* [participant_25] These reflections point to a deep internalization of the course's messages.

Instructor input and events organized as part of the course also shaped learning. For instance, many students cited *"The sustainability fair,"* [participant_39] and *"Testimonies and theoretical inputs"* [participant_23] as helpful context for understanding course content. *"The teachers"* [participant_24] themselves were also directly mentioned as key to the learning experience.

Many students expressed a desire to adjust the balance between theory and practice in the course. Several found the theoretical content too heavy, *"There's too much theory compared to how we're evaluated."* [participant_37] *"The first courses were too abstract; more hands-on sessions would help."* [participant_36]. For these students, the final summative assessment appears to hold significant weight in their perception of the course, shaping their expectations and preferences for more directly applicable, practice-oriented learning experiences, *"We need more time and sessions to prepare our final project."* [participant_36] although this is not always feasible within the framework of a university-level course, which must also meet specific academic standards and learning objectives.

Some pointed to the structure or content of specific events, such as the fair, with mixed reactions. While many found it engaging, a few noted that some activities were not relevant or accessible: *"Some activities at the first fair were not very interesting."* [participant_28].

Finally, while several students suggested refinements, others explicitly stated they would not remove anything, emphasizing the overall strength of the course: *"I wouldn't remove anything—the course was really well designed."* [participant_25].

5. Discussion

Follow-up measurement reveals a mixed but generally positive dynamic in the development of action skills in favor of SD. While conceptual knowledge is well-established, particularly around environmental issues (Planet), the willingness to act varies, oscillating between skepticism and nascent commitment, with a strong sensitivity to interdisciplinarity and the human dimension (People). Expectations in terms of capacity for action remain unclear for many students, although concrete experience of collaborative projects seems to boost their confidence and motivation, as both students and teachers emphasize. On the other hand, realism or cynicism about individual impact in the face of persistent systemic challenges reveals a significant tension between ideal and reality.

5.1 Interdisciplinarity as a pedagogical lever

The cross-analysis of students' and teachers' perspectives shows convergence on several key dimensions of the ACiSD framework (Sass et al., 2021), particularly in Capacity Expectations and conceptual Knowledge. Both groups recognize the added value of interdisciplinary approaches, and students especially highlighted their motivational role.

Interestingly, the interdisciplinary format of the course was cited as a motivating and engaging factor, with students valuing peer exchanges across disciplines. They called for even more diverse collaboration, reflecting a strong Willingness (W) and Outcome Expectancies (OE) for interdisciplinary learning. These exchanges helped and fostered a sense of professional empowerment. This aligns with the idea that interdisciplinarity enables learners to construct more integrated representations of sustainability challenges (Repko & Szostak, 2020) and better anticipation of complexity in real-life teaching scenarios and of transformative educational practices (Lange, 2014; Sauvé, 2001). In the context of ESD, such approaches are particularly relevant for addressing "wicked problems" that span environmental, social, and economic domains (Boeve-de Pauw & Van Petegem, 2018). Moreover, the emphasis on collaboration and peer learning echoes the ACiSD framework's focus on Capacity Expectations and the belief in one's ability to act collectively (Sass et al., 2020).

5.2 Tensions and limits in the development of action competence in SD

A key tension appears around the theme of SD itself. Students report saturation and fatigue, describing the topic as overused and too abstract. This aligns with the literature showing that factual overexposure can reduce engagement (Ducol et al., 2022; Ojala, 2015; Sass et al., 2021).

While teachers anticipated this issue and tried to address it with experiential strategies (e.g., project-based learning, NGO partnerships), the impact on students' Willingness (W) remained uneven but with a shift in attitudes, confirming the importance of active and situated pedagogy (Boeve-de Pauw & Van Petegem, 2018).

5.3 From SD to ESD

Students initially struggled to differentiate SD and ESD, but pedagogical devices such as the "triangle of inaction", the "strong vs. weak ESD" debate, and controversial issue mapping helped clarify concepts and encourage reflection. This difficulty reflects a broader challenge in ESD implementation, where conceptual advances often fail to translate into pedagogical clarity (Lange, 2014; Sauvé, 2001). This is precisely why the AGIR project adopts a design-based approach (Gorard et al., 2004) which emphasizes iterative refinement of pedagogical tools through real-world use and teacher feedback.

ESD was more internalized when students co-designed lessons, a finding that confirms the importance of experiential and contextualized learning for developing both agency and pedagogical skills. It also echoes calls for active, participatory pedagogies that move beyond knowledge transmission to support identity formation and professional positioning (Boeve-de Pauw & Van Petegem, 2018; Hungerford & Volk, 1990). This is especially important considering their future role as educators and supports the importance of offering structured, reflective models that blend theory and practice. This transition from SD to ESD also underscores the relevance of the SSH&A, as emphasized in the AGIR project and the SHiFT initiative.

5.4 Perspectives

With this case study, the research has focused on the preclinical phase (Phase 0), analyzing sustainability-related teaching practices and barriers within a specific course context. It would now be relevant to consider extending this analysis to additional courses within the four HEIs involved in the AGIR project. Such an extension would enrich the diagnostic process by offering comparative insights into how interdisciplinary sustainability education is implemented across diverse disciplinary and institutional contexts in higher education.

Continuing the mapping phase is essential, as it will yield further insights to deepen the overall understanding of current ESD-related teaching practices. This evolving diagnostic will provide the basis for designing the prototype teaching framework, organized in the form of a decision tree.

Moreover, the use of the analytical tools and methodology in this study provides valuable insight into the ergonomic criteria of usefulness, usability, and acceptability (Alexandre et al., 2018; Renaud, 2020) —both from the perspective of educators and students. Their continued application within the AGIR research-action framework could support cross-course and cross-institution comparisons, as well as distinctions between teacher and student perspectives. It contributes to a more robust and context-sensitive foundation for the upcoming phases of the AGIR project.

In this way, the study contributes to ESD by supporting a better understanding of how teaching practices can be adapted to real-world constraints and user experience. It also highlights the relevance of SSH&A, which provide essential tools for analyzing educational practices, capturing lived experiences, and supporting iterative improvement in complex institutional settings.

5.5 Limits

One limitation of the present study lies in the use of a captive sample, consisting of students who were readily accessible to the research team. This may restrict the extent to which the findings can be transferred to other populations or educational settings. Although data collection was carried out by a research assistant during lectures, students were aware that their teachers were also involved in research related to sustainability. This awareness may have led to social desirability bias, potentially influencing how students responded and thus impacting the validity of the data.

Additionally, with regard to the themes addressed in the measurement tools, a more comprehensive approach that explicitly incorporated all five dimensions of SD – the 5 Ps– might have yielded different or more nuanced results.

6. Conclusion

This article has presented initial insights from the preclinical phase of the AGIR project, through the lens of a course designed to foster sustainability-related action competence in future teachers. Grounded in the ACiSD framework, the study illustrates both the promises and the challenges inherent in interdisciplinary approaches to sustainability education in higher education.

The findings reveal that, although students exhibit moderate conceptual understanding and willingness to act, their perceived capacity and outcome expectancy – especially regarding environmental dimensions – remain inconsistent. Key facilitators such as interdisciplinary collaboration and experiential learning have been identified, yet persistent tensions among knowledge acquisition, motivation, and perceived efficacy highlight the complexity of fostering genuine transformative learning in this field.

As an exploratory case study, this contribution does not seek to generalize but aims to contribute to the ongoing critical reflection within the AGIR project. The results underscore the imperative for continued and expanded research. Subsequent phases of the project will broaden the scope to include multiple courses and institutions, enabling a more comprehensive understanding of the conditions that support effective sustainability and the development of action competence.

Ethics and consent

No formal review by an ethics committee was sought before data collection. The study was assessed as minimal-risk, non-medical educational research involving adult participants. It did not involve vulnerable participants, medical or invasive procedures, biological samples, sensitive or high-risk data, or risks exceeding those ordinarily associated with research on educational experiences and teaching practices.

The ethical dimensions of the study were considered with reference to the institutional framework of the University of Namur and to the guidance provided through PINDARE, the inter-university research support platform of the CRef for the Wallonia-Brussels Federation of Belgium. The University of Namur has established a Committee for Ethics in Human Sciences, which acts as a local advisory body on ethical aspects of research in the human sciences, particularly when an ethical opinion is required by a funding body:

https://www.unamur.be/en/research/ethics/human-sciences

The PINDARE platform provides guidance and documentation on research ethics, including research involving human participants:

https://pindare.cref.be/fr/research-data-management/ethics/

The ethical considerations, procedures, and safeguards applied throughout the study were formally documented in an Ethics Self-Assessment Report, provided as Appendix 5 in the supplementary materials.

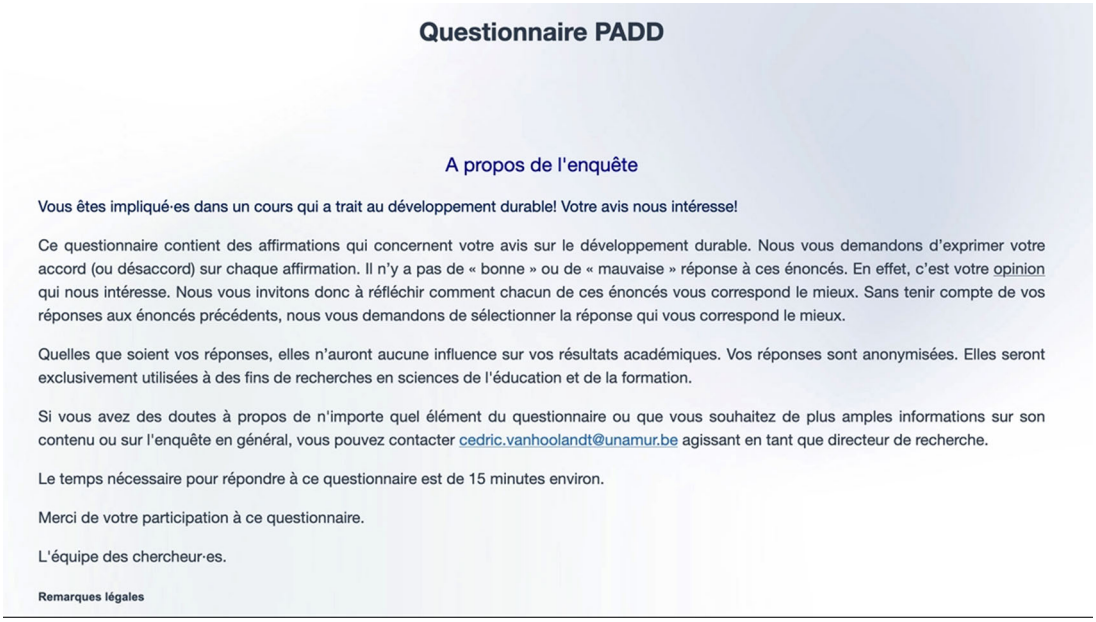


Figure 2. Consent information (in French, as the course was taught in French).

Informed consent was obtained from all participants before data collection. For the surveys, participants received clear and detailed information about the study within the online questionnaire and were required to indicate their explicit agreement before proceeding. Their consent was electronically documented within the questionnaire. The original French consent statement is reproduced in Figure 2, while the accompanying legal notices and a complete English translation are provided in Appendix 6.

For the focus groups and interviews, informed consent was obtained verbally by the researcher before data collection. Participants were informed about the purpose of the study, the voluntary nature of participation, the intended use of the data, their rights, and the measures taken to protect confidentiality. Each participant explicitly agreed to participate and to the audio recording, and this agreement was audio-recorded.

Verbal consent was used because the focus groups and interviews were conducted synchronously and audio-recorded. Each participant's explicit agreement was therefore documented within the audio recording. No additional independent witness was present during this procedure.

To limit potential power imbalances, student data were collected by a researcher who was not responsible for teaching or assessing the course. Participants were informed that participation or non-participation would have no effect on their academic results. Confidentiality was protected throughout data processing, analysis, and reporting, and all publicly shared datasets were de-identified before release.

Use of generative AI tools

During the preparation of this manuscript, the authors used the generative artificial intelligence tool ChatGPT (OpenAI, GPT-5.1) to assist with language editing. Specifically, the tool was employed to rewrite selected passages into academic English in response to prompts such as: "*Could you rewrite the following passage in academic English?*"

The authors also used the generative artificial intelligence tool Sonix.ai (https://sonix.ai/) during data collection to assist with audio transcription. Specifically, the tool was used to transcribe focus groups and interviews with the teachers to provide accurate verbatim transcripts of the discussions.

The tools were not used to generate scientific content, interpret data, draw conclusions, or create original ideas. All outputs were critically reviewed, edited where necessary, and validated by the authors, who take full responsibility for the content of the manuscript.

Data and Supplementary Material Availability

Zenodo. AGIR Project Dataset: Initial Observations in Teacher Education. https://doi.org/10.5281/zenodo.20832968 (Vanhoolandt et al., 2025).

This project contains the following underlying data:

- data_PRE_clean.csv: main dataset (PRE)
- codebook.txt: variable definitions and scales
- README.txt: dataset description
- open_ended_survey_POST.csv: responses to open-ended questions from participants collected via an online questionnaire (POST) (in French, as the course was taught in French)

The following appendices are provided as supplementary material:

- Appendix 1: ACiSD-FR survey (in French, as the course was taught in French)
- Appendix 2: Open ended survey (in French, as the course was taught in French)
- Appendix 3: Focus Group (in French, as the course was taught in French)
- Appendix 4: Semi structured interviews (in French, as the course was taught in French)
- Appendix 5: Ethics Self-Assessment Report
- Appendix 6: Informed Consent for Adult Participants

Data are available under the terms of Creative Commons Attribution 4.0 license (CC-BY 4).

Reporting guidelines

This study follows the FAIR data principles to ensure transparency and reproducibility of research outcomes.

- Findable: Metadata describing the study, its objectives, and methodology have been clearly and explicitly assigned to the dataset. The data are registered with a DOI (10.5281/zenodo.20832968) on the Zenodo platform, ensuring persistent identification and traceability.
- Accessible: All research materials, including datasets and the feedback questionnaire, are freely available on the Zenodo platform under an open license, without access restrictions.
- Interoperable: The datasets are provided in standard spreadsheet formats. The metadata and feedback form are shared in txt, csv and pdf format. All files are compatible with commonly used open-source software, such as LibreOffice Calc and other table or text editors, facilitating broad accessibility and usability.
- Reusable: The feedback questionnaire and the collected data can be reused by other researchers for similar pedagogical or sustainability-related studies.

Acknowledgements

The authors would like to thank Julie Dagnely and Virginie Meyer, who served as teaching assistants for the KF208 TTID-SD course during the 2024-25 academic year, for their valuable support.

They are also grateful to Charlotte Préat (HEAJ), Delphine Haesaerts (Hénallux), Christophe Reyners (HEPN), and Amélie Tonneau (UNamur), colleagues and research collaborators within the AGIR project, whose constructive discussions greatly enriched the preparation of this manuscript.

References

Alexandre B, Reynaud E, Osiurak F, *et al.*: **Acceptance and acceptability criteria: A literature review.** *Cogn. Tech. Work.* 2018; **20**(2): 165–177.
Publisher Full Text

Anciaux A, Picquot I: **Intégration des ODD dans les cours et les fiches ECTS [Conférence].** *Le rendez-vous essentiel de 2025 pour un enseignement supérieur durable, Bruxelles.* 2025, janvier 27.
Reference Source

Artigue M: **Ingénierie didactique.** *Recherches en didactique des mathématiques.* 1988; **9**(3): 281–308.

Bandura A: **Self-Efficacy: Toward a Unifying Theory of Behavioral Change.** *Psychol. Rev.* 1977; **84**(2): 191–215.
Publisher Full Text

Barthes A, Lange J-M: **L'éducation au développement durable: Entre internationalisation et effets locaux.** *Introduction. Revue internationale d'éducation de Sèvres.* 2024; **95**: 51–59.
Publisher Full Text

Boeve-de Pauw J, Van Petegem P: **Eco-school evaluation beyond labels: The impact of environmental policy, didactics and nature at school on student outcomes.** *Environ. Educ. Res.* 2018; **24**(9): 1250–1267.
Publisher Full Text

Breiting S, Hedegaard K, Mogensen F, *et al.*: *Action Competence, Conflicting Interests and Environmental Education – the MUVIN Programme.* Research Programme for Environmental and Health Education, DPU (Danish School of Education); 2009.

Brundtland GH: **Our Common Future: Report of the World Commission on Environment and Development.** *United Nations.* 1987.
Reference Source

Carton G, Valiorgue B: **Préparer l'enseignement supérieur de gestion aux défis énergétiques et écologiques de l'Anthropocène.** *Rev. Fr. Gest.* 2023; **49**(6): 101–126.
Publisher Full Text

Cèbe S, Goigoux R: **Concevoir un instrument didactique pour améliorer l'enseignement de la compréhension de textes.** *Repères. Recherches en didactique du français langue maternelle.* 2007; **35**(1): 185–208.
Publisher Full Text

Creswell J: *Educational research—Planning, conducting and evaluating quantitative and qualitative research.* Pearson; 2012.

Curnier D: **Éducation et durabilité forte: Considérations sur les fondements et les finalités de l'institution.** *La pensée écologique.* 2017; **1**(1): 252–271.
Publisher Full Text

de Bear de Laer H: **Quelles représentations sociales du changement climatique chez les jeunes ? Et quels impacts sur l'action?.** 2021.
Reference Source

Dillon P: **A pedagogy of connection and boundary crossings: Methodological and epistemological transactions in working across and between disciplines.** *Innov. Educ. Teach. Int.* 2008; **45**(3): 255–262.
Publisher Full Text

Du Pisani J: **Sustainable development – historical roots of the concept.** *Environ. Sci.* 2006; **3**(2): 83–96.
Publisher Full Text

Ducol L, Anciaux A, Catellani A, *et al.*: **Jeunes, Communication & Climat. Diversité des enjeux climatiques auprès des 15-24 ans en Belgique.** 2022.
Reference Source

Gibert A-F: **Éduquer à l'urgence climatique.** 2020.

Gorard S, Roberts K, Taylor C: **What kind of creature is a design experiment?.** *Br. Educ. Res. J.* 2004; **30**(4): 577–590.
Publisher Full Text

Hungerford HR, Volk TL: **Changing learner behavior through environmental education.** *J. Environ. Educ.* 1990; **21**(3): 8–21.
Publisher Full Text

Jensen BB, Schnack K: **The Action Competence Approach in Environmental Education.** *Environ. Educ. Res.* 2006; **12**(3–4): 471–486.
Publisher Full Text

Lange J-M: **Curriculum possible de l'Éducation au Développement Durable: Entre actions de participation et investigations multiréférentielles d'enjeux.** *Éducation relative à l'environnement.* 2014; **11**.
Publisher Full Text

L'Écuyer R: **L'analyse de contenu: Notions et étapes.** *In J.-Pierre. Deslauriers (Éd.), Les méthodes de la recherche qualitative.* 1987; 49–65. Presses de l'Université du Québec.

Meadows DH, Meadows DL, Randers J, *et al.*: **The limits to growth-club of rome.** 1972.

Moeller J, Grassinger R: *A Review of Passion Concepts and Their Overlaps with Commitment: Opening a Can of Worms* Friedrich Schiller University Jena; 2013. [PhD Thesis].
Reference Source

Mokski E, Leal Filho W, Sehnem S, *et al.*: **Education for sustainable development in higher education institutions: An approach for effective interdisciplinarity.** *Int. J. Sustain. High. Educ.* 2023; **24**(1): 96–117.
Publisher Full Text

Morin É, Therriault G, Bader B: **Le développement du sentiment de pouvoir agir des jeunes face aux changements climatiques à l'école secondaire.** *Éducation relative à l'environnement. Regards-Recherches-Réflexions.* 2022; **17-1**(1).
Publisher Full Text

Napawan NC, Simpson S-A, Snyder B: **Engaging Youth in Climate Resilience Planning with Social Media: Lessons from #OurChangingClimate.** *Urban Plan.* 2017; **2**(4): 51–63.
Publisher Full Text.

Ojala M: **Climate change skepticism among adolescents.** *J. Youth Stud.* 2015; **18**(9): 1135–1153.
Publisher Full Text

Patuelli A, Saracco F: **Sustainable development goals as unifying narratives in large UK firms' Twitter discussions.** *Sci. Rep.* 2023; **13**: 7017.
PubMed Abstract | Publisher Full Text | Free Full Text

Renaud J: **Évaluer l'utilisabilité, l'utilité et l'acceptabilité d'un outil didactique au cours du processus de conception continuée dans l'usage. Cas d'un outil pour l'enseignement de la lecture de textes documentaires numériques.** *Éducation et didactique.* 2020; **14-2**: 65–84.
Publisher Full Text

Repko AF, Szostak R: *Interdisciplinary research: Process and theory.* Sage Publications; 2020.

Roy M, Prévost P: **La recherche-action: Origines, caractéristiques et implications de son utilisation dans les sciences de la gestion.** *Recherches qualitatives.* 2013; **32**(2): 129–151.
Publisher Full Text

Sass W, Boeve-de Pauw J, Olsson D, *et al.*: **Redefining action competence: The case of sustainable development.** *J. Environ. Educ.* 2020; **51**(4): 292–305.
Publisher Full Text

Sass W, Pauw JB, Maeyer SD, *et al.*: **Development and validation of an instrument for measuring action competence in sustainable development within early adolescents: The action competence in sustainable development questionnaire (ACiSD-Q).** *Environ. Educ. Res.* 2021; **27**: 1284–1304.
Publisher Full Text

Sauvé L: **L'éducation relative à l'environnement.** *Une dimension essentielle de l'éducation fondamentale. C. Gohier et S. Laurin La formation fondamentale-Un espace à redefinir.* 2001; 293–318.

Serrano-Bedia A-M, Perez-Perez M: **Transition towards a circular economy: A review of the role of higher education as a key supporting stakeholder in Web of Science.** *Sustainable Prod. Consumption.* 2022; **31**: 82–96.
Publisher Full Text

SHiFT: **SHiFT Universities for Sustaibability—Concept Note.** 2025.
Reference Source

Stern PC: **Toward a Coherent Theory of Environmentally Significant Behavior.** *J. Soc. Issues.* 2000; **56**(3): 407–424.
Publisher Full Text

Stevenson KT, Peterson MN, Bradshaw A: **How climate change beliefs among US teachers do and do not translate to students.** *PloS one.* 2016; **11**(9): e0161462.
PubMed Abstract | Publisher Full Text | Free Full Text

Tremblay D, Fortier F, Boucher J, *et al.*: **Sustainable development goal interactions: An analysis based on the five pillars of the 2030 agenda**. *Sustainable Development*, 2020; **28**(6), 1584–1596.
Publisher Full Text

Thouin M: *Réaliser une recherche en didactique.* Éditions MultiMondes; 2014.

UN: **Transforming our World: The 2030 Agenda for Sustainable Development.** 2015.
Reference Source

Vallerand RJ: *The Psychology of Passion: A Dualistic Model.* Oxford University Press; 2015.
Publisher Full Text

Vanhoolandt C, Dagnely J, Meyer V, *et al.*: **Le changement, c'est demain: Utopie ou réalité concrète ? Étude des effets d'un dispositif de**

formation initiale des enseignants au développement durable axé sur l'interdisciplinarité. *Congrès international de l'AREF. Actualité de la Recherche en Éducation et Formation.* 2025, juillet.

Vanhoolandt C, Anciaux A, Calicis C, *et al.*: **AGIR Project Dataset and Supplementary Material: Initial Observations in Teacher Education.** [Data set]. *Zenodo.* 2026.
Publisher Full Text

Zamora-Polo F, Sánchez-Martín J: **Teaching for a better world. Sustainability and sustainable development goals in the construction of a change-maker university.** *Sustainability.* 2019; **11**(15): 4224.
Publisher Full Text

Open Peer Review

Current Peer Review Status: ? ✓

Version 1

Reviewer Report 15 October 2026

https://doi.org/10.21956/openreseurope.23897.r81748

© **2026 Jónsdóttir S.** This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

✓ **Svanborg Rannveig Jónsdóttir**
University of Iceland, Reykjavik, Iceland

Overall, this is a well written article/report. Even though it is a mixed methods study the article and findings are written in the quantitative framework and way of thinking, which to me is less appealing than the qualitative approach. Also, the questions asked for the reviewers are very quantitatively oriented – closed questions, yes-no questions with no option to explain.
However, I do not have a specific issue to pinpoint that could make the article´s qualitative nature clearer, so what I read was a convincing quantitative article with a bit of qualitative depth.

Minor suggestions - I suggest the authors consider:
1. On page four about the list (UNamur, HEPN, HEAJ, and Hénallux),
The reader wants to know what institutions these are - perhaps add another footnote to explain?
2. On page five there are headings on top of headings (this may be different traditions): I advise against heading following a heading - authors could easily add a sentence or two as an opening for the sub-chapters.
3. On page six the Course´s organization is explained but I would like to know: What about the lectures? are they on-line or on-site? and how long each? is there any sort of participation required of students as they unfold?

As I read the findings I repeatedly came to think about the affordances of innovation- and entrepreneurial education/ entrepreneurship education and how the pedagogy, approaches and tools of that area of education might provide enhancing ways to follow in this important and interesting project! Good luck with proceeding!

Is the work clearly and accurately presented and does it engage with the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

Are all the source data and materials underlying the results available?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I am a specialist in entrepreneurship education (innovation- and entrepreneurial education) and most of my research is in the qualitative tradition although I sometimes use quantitative data. My research is in education, teacher education and school practice on different levels of education from pre-school to university level.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 09 September 2026

https://doi.org/10.21956/openreseurope.23897.r79813

© 2026 King J. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

?

Jordan King
The University of Tennessee, Chattanooga, Tennessee, USA

The article provides a sound and comprehensive overview of the first phase of a broader project. The framing and engagement with different literature provides a strong backdrop for exploring the topic of interdisciplinarity, sustainability, and teacher training. Overall, the content is easy to follow, makes logical arguments, and relies on the evidence gained through the study to develop its findings and interpret them. I find that given the preliminary and exploratory nature of the study it is also well situated in terms of limitations for the findings and insights for further work.

While overall the article is well structured and thorough, I found there to be several areas that if addressed would benefit the overall presentation of the study. These all relate to a slightly more detailed description of some of the key elements of the study.

- First, more description should be given to the course activities and the intentionality and purpose of the interdisciplinary nature of these. As these are reflected upon in the findings and present a core aspect of the study, a brief but detailed description would be beneficial.
- Second, further explanation of the "how" and "why" of the design-based method is needed

to clarify how the results were determined and how they will further be used.
- Finally, particularly for the qualitative data, the prompts and process for obtaining reflection need to be more clearly articulated.

If these areas are addressed, I believe that this is a strong article that provides a foundation for further work while articulating relevant insights in the present.

Is the work clearly and accurately presented and does it engage with the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

Are all the source data and materials underlying the results available?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Sustainability education, teacher training, assessment, sustainability competencies

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.