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Engaging Students-as-Partners (SaP) to Explore Education for Sustainable Development (ESD) in STEM

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Abstract

Across the UK, universities pledge alignment with education legislation and global strategies such as NET2030. This case study evaluates a workshop exploring Education for Sustainable Development (ESD) in STEM curriculum. Grounded in a Students-as-Partners (SaP) framework, the workshop employed Mural and Mentimeter to examine the relationship between educational inequalities and how ESD principles can be applied to promote equity. Analysis of the data revealed key insights into barriers and effective learning methods. A recurring theme was disproportionate access to educational experiences, identified by 45% of students (n=23). Suggested improvements included participatory workshops and concept-based learning (CBL). While students recognised a wide range of sustainable resources, a common barrier was "too much noise from the university." Participants' understanding of sustainability, which includes social factors, highlights the need for a holistic ESD approach in curriculum design, moving beyond passive delivery toward transparent, co-created pedagogical models.

Keywords: *ESD, Students-as-Partners, STEM Education, educational equality,*

1. Introduction

Higher Education Institutions (HEIs) all over the UK are operating under a rapidly evolving mandate to embed sustainability into the student experience. Accreditation and professional bodies, such as the Quality Assurance Agency (QAA) and Advance HE, have recently updated their guidance to align with UNESCO's Education for Sustainable Development (ESD)

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frameworks, emphasising that sustainability must move beyond "green campus" operations and into the "Heart and Hand" of the curriculum (Zhou, 2025). This shift is reinforced in the UK by the Department for Education's (DfE) Sustainability and Climate Change Strategy, which recognises education as a primary driver for achieving the United Nations' (UN's) Sustainable Development Goals (SDGs) (Sjögren, 2019). Specifically, the DfE legislation mandates that by 2030, all learners must acquire the knowledge and skills needed to promote sustainable development, positioning HEIs as conduits of sustainable development, education and practice. To bridge the gap between high-level policy and learning and teaching practice, we recognise that students must see themselves as active partners rather than passive recipients of the ESD agenda. Quality education sets the foundations for which awareness, understanding and a commitment to sustainability are laid, to promote sustainable practices in daily life . The significance of sustainability in education only becomes apparent when the crucial role of education in shaping individuals' knowledge, skills and behaviours is considered. In recent years, the number of HEIs integrating sustainable principles has increased (Ankareddy et al., 2025), but approaches have centred predominantly on ecological and socioeconomic systems (Wamsler, 2020). Solely teaching these dimensions overlooks the critical role of personal values, empathy and cognitive capabilities, traits that are foundational to sustainable thinking yet frequently absent from STEM curricula (Ives et al., 2020; Wamsler, 2020). Central to bridging this gap is the Head, Heart, Hand (3H) model (Islam et al., 2022). While the "Head" represents cognitive engagement, the "Heart" and "Hand" encompass the affective and psychomotor domains often missing from traditional curricula. However, to move from *teaching* sustainability to *sustainable teaching*, HEIs must abandon siloed, top-down approaches in favour of collaborative, bottom-up co-creation, transforming students from passive learners into active drivers for inclusive, future-proof STEM education.

1.1. Rationale for Study

This case study is situated within a broader series of workshops delivered as part of a pilot project *Collaborative University Learning for Targeting Under-representation in Research and Education (CULTURE) GAPS in STEM* (R230557-207), funded through the Wellcome Trust Collaborative Cultures programme awarded to University of Strathclyde (Grant Number 228116/Z/23/Z). The workshop series aimed to address attainment gaps and structural inequities in STEM education by developing inclusive learning environments and amplifying student voices. Despite the universal call for multidisciplinary, learner-centred, sustainable education, implementation is often stifled by disciplinary silos, high-stakes assessment models and a lack of professional development (Krischler et al., 2019). This workshop series prioritises a students-as-partners model (SaP), moving beyond passive, didactic teaching to treat students as co-creators of pedagogical innovation (Peart et al., 2023). This paper focuses on the third instalment of the CULTURE-GAPS series: 'ESD in STEM', as there are international (UNESCO, 2020), national (Peart et al., 2023; QAA, 2023) and institutional initiatives for ESD

to be implemented in universities as part of Key Performance Indicators (KPIs) pledged to NET2030. Strathclyde's Sustainable Strategy (University of Strathclyde, 2024) KPI 15, 'for all education programmes to have level learning outcomes' aligns with the targets for Education 2030. As part of this case study, engagement with students was facilitated through Students Organising for Sustainability UK (SOS-UK), a student-led charity dedicated to placing students at the heart of education, to move ESD beyond an abstract 'Faculty buzzword'. By grounding the workshop in their grassroots, student-led philosophy, the team set out to translate global sustainability goals into a tangible, accessible discussion that resonated with the unique, lived experiences of STEM students. In line with ESD principles, this workshop created a Third Space, a non-coercive environment that bypasses traditional power dynamics to capture honest student perspectives. These perspectives are critical to bridging the disconnect between Faculty-led ESD delivery and student awareness. Through interactive, autonomous digital platforms, such as Mural and Mentimeter, we were able to engage participants in meaningful, collaborative discussions, mitigating 'social risk' by allowing them to critique institutional structures without fear of academic repercussions. This ensured the data reflected participants' perspectives authentically.

2. Methods

2.1. Student Design and Aims

This exploratory workshop involved a student-led focus group with a mixture of STEM students to collaborate on the integration of ESD principles and practices into curriculum. Specifically, our research questions (RQ) were:

RQ1: What is the baseline understanding of sustainability/ESD amongst participants?

RQ2: Which institutional resources do students recognise as sustainable, and what barriers impede accessibility?

RQ3: How do students prefer to engage with sustainability and ESD within their curriculum?

2.2. Ethical consideration

Ethical approval for this project was gained from the Strathclyde Institute of Pharmacy and Biomedical Sciences Ethics Committee at the University of Strathclyde (DEC130525). All participants provided written informed consent. Contributions via digital platforms were anonymised. Data from Mural and Mentimeter were stored on a secure University server accessible only to the research team.

2.3. Participant recruitment

Recruitment was student-led to minimise any coercive power dynamics, using posters across campus with a QR code and a Google Form for sign-up. The poster outlined the broad aims and structure of the study. The session was open to anyone interested in STEM education, sustainability and inclusivity. Participants were provided with information sheets, outlining the session and the purpose of the project upon arrival. Informed consent was gained prior to the participation. A total of 23 individuals participated, including 19 undergraduate students and 4 postgraduate researchers. While participants represented a range of academic stages and different discipline perspectives, the majority had backgrounds in biomedical science. It is important to note that some disciplines and demographic groups may have been underrepresented due to the voluntary nature of recruitment and scheduling constraints, which may limit the generalisability of findings to other STEM disciplines. A £20 voucher was provided to participants as an incentive for taking part. This aimed to ensure that involvement did not disadvantage participants for volunteering their time, especially those who may have incurred travel or scheduling costs.

2.4. Data Analysis

Quantitative Mentimeter responses were analysed via the platform's automated report. Qualitative Mural data was transcribed on to a structured Excel sheet and subjected to Braun and Clarke (2006) thematic analysis. Both primary researchers independently coded all data to generate initial codes, then collaboratively developed candidate themes. Where interpretive disagreements occurred, a secondary researcher provided adjudication to ensure analytical rigour. This dual-coder approach, with systematic consensus-building, enhanced the credibility and dependability of the findings.

3. Results and Discussion

The workshop captured a robust dataset across three series of questions. This submission focuses on the key insights from participants, from their initial understanding of what sustainability means to providing input for the integration of ESD principles into their curriculum.

3.1. Baseline Understanding of Sustainability

The first round of questions was designed to gain insight into participants' baseline understanding of sustainability. Most of the participants had a foundational awareness of sustainability, with initial definitions predominantly being "green-focused" (e.g., recycling, emissions). Participants also noted that sustainability is "very important" in STEM, although 60% reported that it was "not really" covered in their formal curriculum (Figure 1). This

disparity suggests a lack of transparency, where sustainability may be buried within learning material as part of a 'hidden' curriculum but remains unrecognised by students due to its broad and often ambiguous framing.

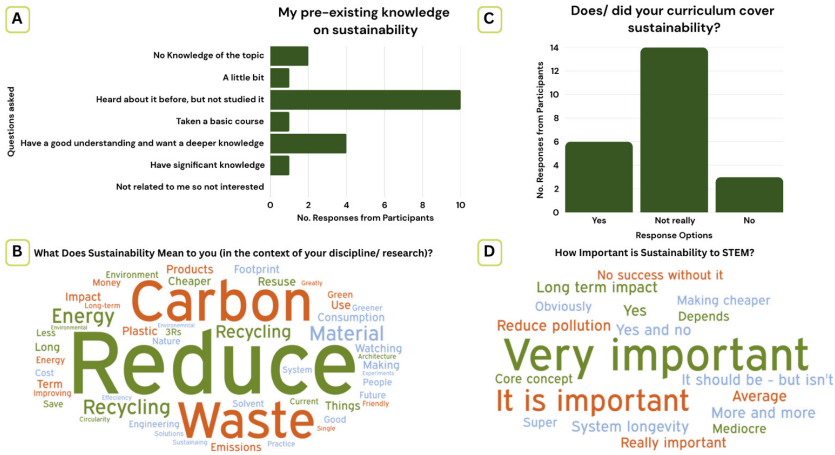


Figure 1. Responses to Initial Understanding of Sustainability. This figure shows the responses to the first four questions asked on Mentimeter. A) responses to the question 'My pre-existing knowledge on sustainability.' B) Word map generated from the question 'What does sustainability mean to you (in the context of your discipline/ research)?' C) Responses to the question 'Does/ did your curriculum cover sustainability?' D) Word map generated from the question 'How important is sustainability to STEM?' Each figure was generated from Mentimeter.com.

Results from later activities showed a shift toward understanding sustainability as a socio-institutional framework involving equality and access.

3.2. Identifying Barriers to Sustainable Resources

The second round of questions began with an introduction to the 3H model, outlining educational frameworks and encouraging reflection on previous experiences with 3H skills through their curriculum. When introduced to the 3H model, participants successfully mapped existing experiences to UNESCO-defined skills (Table 1) yet noted a lack of clarity regarding these educational frameworks. A core principle of ESD is equitable accessibility, often facilitated through institutional resources. By capturing student experiences with these tools, we aimed to understand the gap between static resource provision and authentic, inclusive engagement. When asked about accessing university resources, participant comments highlighted that the university creates a lack of clarity, making resources difficult to find, which was cited as "too much noise". Additionally, participants noted a perceived lack of empathy and a belief that support is only accessible at the "extreme end" of a problem, often coupled with long waitlists and digital accessibility issues. When brainstorming solutions, "Additions to curriculum" was the most prominent theme. Students advocated for integrating sustainability

into assessment criteria, actively promoting ESD frameworks and clarifying the umbrella of sustainability. However, there was concerns raised over curriculum overwhelm, highlighting a need for consideration. Other solutions included initiatives, such as university-wide recycling schemes inspired by external point systems, and improved accessibility to learning materials and university resources. These findings suggest that while awareness of sustainable resources is high, there is a significant deficit in 'resource literacy'. This resource literacy refers to the ability of students to efficiently navigate and engage with support mechanisms. The recurring theme of institutional 'noise' indicates that traditional, top-down communication strategies can overwhelm student agency.

Table 1. Participant Experience with 3H model.

Skill	Themes	Subthemes
Intellectual Engagement	Sustainability awareness and integration	Sustainability focus groups
		Sustainability component in dissertation projects
		Sustainability in LEAF applications
	Academic and assessment activities	MCQs
		Making protocols for upcoming researchers
Emotional Intelligence	Self-awareness and reflective practices	Lectures on research integrity and ethics
		Ethics class reflecting on accountability
	Interpersonal engagement and collaborative skills	PDP/ PDA
		Group projects
Practical Implementation	Ethics and regulatory awareness	Encourage awareness of chemicals used in lab
	Community outreach	Open day participation
	Practical hands-on experience	Presentations
		Practical projects related to sustainability
		Practical labs to bridge theory and knowledge gap
	Reflection and teamwork	Teamwork marking component of group projects

Note: The skill column refers to the three different umbrella terms of the 3H model. The theme column represents themes developed from participant experience. The subtheme column represents a concise list of the participants' reflections.

3.3. Preferred Engagement with Sustainability and ESD

The final round of questions centred on how participants would like to see principles of ESD embedded into curriculum. A majority of participants (80%) agreed that ESD teaching and learning methods belong in their curriculum, favouring active learning (e.g., workshops, practicals) over traditional lectures. A further 90% supported the assessment of sustainability

but rejected "high-stakes" traditional methods (MCQs, essays). Instead, they advocated for authentic, collaborative assessments such as project-based learning and case studies (Figure 2).

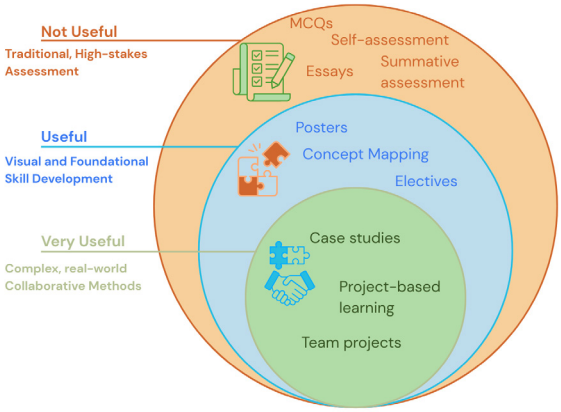


Figure 2. Thematic Map of Bullseye Activity. Overview of where participants placed their responses on the bullseye. Theme of traditional, high-stakes assessment as Not Useful methods. Themes of Visual and Foundational Skill Development as Useful. Themes of Complex, Real-world Collaborative Methods as Very Useful. Figure created on Canva.com.

4. Conclusion

The results indicate a clear student endorsement for formal ESD integration into their curriculum, provided it moves beyond passive instruction. Two unexpected insights highlight action points for facilitators to be conscious when embedding authentic methods of learning and teaching. Participants perceived mixed views on how important ESD is, which may undermine SaP initiatives. Whilst participants demonstrated enthusiasm for more content employing models reflecting ESD principles and practices, they fear "curriculum overload". To address this, integration of methods proposed as alternatives by participants, such as CBL and participatory workshops, should complement current curriculum through authentic embedment rather than being passively additive. Employing frameworks reflecting ESD key competencies (Parry & Metzger, 2023) and the key pedagogies for implementing ESD can support these initiatives. Ultimately, these findings align with the University of Strathclyde's KPI 15, suggesting that streamlining resource access and transitioning to "Heart and Hand" (emotional and practical) pedagogical models will improve both student engagement and institutional sustainability. Student demand for ESD integration is unambiguous, supported beyond this study by SOS-UK's Sustainability Skills Survey (SOS-UK, 2025). The question is not *whether* students value ESD, but *why* engagement remains concentrated among those already converted to its importance, and why institutional willingness to embed it meaningfully remains inconsistent. Student enthusiasm alone cannot drive curricular change; without staff commitment to moving beyond passive, content-heavy delivery, ESD risks remaining a

peripheral aspiration rather than an embedded practice. This dual disengagement, among students yet to see ESD's relevance and staff yet to prioritise its integration, risks ESD becoming an echo chamber rather than a catalyst for systemic change. The CULTURE-GAPS Third Space approach offers a scalable, replicable model for participatory ESD dialogue that could interrupt these patterns, broaden participation and ensure that the benefits of sustainable pedagogy extend to all students regardless of prior interest or awareness, not only those already positioned to advocate for it.

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