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Interdisciplinary sustainability curricula in Vietnamese higher education

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ABSTRACT

Interdisciplinary sustainability curricula are increasingly important for preparing university students to address complex social, economic, technological, and environmental challenges. However, the extent to which interdisciplinarity and education for sustainable development (ESD) are integrated into undergraduate curricula in Vietnamese higher education remains underexplored. This study examines this integration at four higher education institutions in Ho Chi Minh City, Vietnam. An explanatory sequential mixed-methods design was employed, combining survey data from 501 students and 107 lecturers, analysis of variance (ANOVA) of student responses across institutions, and semi-structured interviews with eight lecturers and eight students. The findings show that lecturers and students highly valued interdisciplinary sustainability education for developing holistic competencies, critical thinking, collaboration, social responsibility, and adaptability. However, their understanding remained uneven, while integration into learning outcomes, course content, teaching activities, assessment, and informal learning was still implicit and insufficiently systematic. Key barriers included limited curriculum guidelines, uneven lecturer capacity, inadequate resources, weak inter-faculty coordination, and insufficient external collaboration. The study recommends clearer institutional frameworks, professional development for lecturers, stronger stakeholder cooperation, and greater alignment between formal and informal learning.

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1. INTRODUCTION

Higher education is increasingly expected to prepare graduates for complex social, economic, technological, and environmental challenges. Within this agenda, education for sustainable development (ESD) has become central to curriculum reform because it links knowledge with values, skills, responsibility, and the capacity for informed action [1], [2]. Sustainability competencies such as systems thinking, anticipatory thinking, normative judgment, strategic action, collaboration, and integrated problem solving have been widely discussed as essential learning outcomes for students in contemporary higher education [3], [4]. These competencies cannot be adequately developed through narrow disciplinary training alone. Sustainability issues often cut across environmental, social, cultural, economic, technological, and ethical

domains, requiring students to work across bodies of knowledge and perspectives. Interdisciplinary education is therefore highly relevant because it helps learners integrate concepts, theories, methods, and forms of inquiry from different disciplines when engaging with complex problems [5], [6].

The need for interdisciplinary sustainability curricula is especially relevant in Vietnam. Vietnamese higher education institutions are undergoing curriculum reform in response to quality assurance requirements, outcome-based education, internationalization, digital transformation, and changing labor-market expectations. At the national policy level, the National Green Growth Strategy for the 2021–2030 period, with a vision to 2050, identifies green growth as a pathway for economic restructuring, growth model renewal, improved competitiveness, greenhouse gas reduction, and long-term transition toward a carbon-neutral economy [7]. The strategy also assigns the education sector the task of integrating green growth content into education and training programs and improving the capacity of teachers and educational managers [7]. These policy and workforce demands call for university curricula that move beyond discipline-based knowledge transmission and provide students with opportunities to connect academic learning with social responsibility, professional adaptability, and sustainability-oriented problem solving. However, in many programs, sustainability and interdisciplinarity still appear through selected courses, individual lecturer initiatives, extracurricular activities, or broad institutional statements rather than through coherent curriculum structures.

Previous studies have examined ESD, sustainability competencies, interdisciplinary learning, and curriculum integration in higher education. Competency-based approaches have clarified the kinds of knowledge, skills, values, and dispositions that students need for sustainability transformation [8]–[11]. Other studies have shown that sustainability learning is strengthened when it is connected to formal learning outcomes, active pedagogies, student projects, informal learning opportunities, and real-world engagement [12], [13]. In the Vietnamese context, research on ESD has suggested that implementation is shaped by national curriculum priorities, teacher preparation, institutional interpretation, and local educational practices [14]. International studies have also demonstrated that interdisciplinarity and sustainability can be integrated into higher education curricula through sustainability themes, service learning, curriculum design, course content, and different levels of curriculum transformation [15]–[20].

Despite this growing body of research, three gaps remain. First, sustainability education and interdisciplinary education have often been examined as related but separate areas, while less is known about how they are integrated simultaneously in undergraduate curricula. Second, empirical evidence from Vietnamese higher education remains limited, particularly evidence that brings together lecturer and student perspectives. Third, previous discussions have paid insufficient attention to the relationship between formal curricula, informal learning activities, and institutional support mechanisms. These gaps make it difficult to understand how interdisciplinary sustainability education is actually organized, experienced, and supported in Vietnamese universities.

This study addresses these gaps by examining interdisciplinary sustainability curricula at four higher education institutions in Ho Chi Minh City, Vietnam. The study is distinctive in three respects. First, it focuses on the intersection of interdisciplinarity and ESD rather than treating them as separate curriculum concerns. Second, it uses a mixed-methods design to combine survey evidence with interview data from both lecturers and students. Third, it considers both formal and informal curricula, together with the institutional conditions that enable or constrain implementation. The study contributes to the literature by extending understanding of interdisciplinary sustainability curriculum integration in an emerging higher education context. It also offers practical evidence for curriculum developers, lecturers, university leaders, and policymakers seeking to strengthen institutional frameworks, lecturer capacity, inter-faculty cooperation, stakeholder collaboration, and competency-based sustainability learning. Furthermore, the study is guided by the following research questions:

- How do lecturers and students perceive and understand interdisciplinary sustainability education in Vietnamese higher education? (RQ1)
- How are interdisciplinarity and ESD integrated into formal and informal undergraduate curricula? (RQ2)
- What facilitating conditions, barriers, and recommendations are identified for developing interdisciplinary sustainability curricula in Vietnamese higher education? (RQ3)

2. THEORETICAL AND CONCEPTUAL FOUNDATIONS

2.1. Interdisciplinary education and education for sustainable development

Interdisciplinary education and ESD share a common concern with learning for complex, real-world problems. Interdisciplinary education enables students to draw on more than one discipline in order to understand issues that cannot be adequately addressed from a single field of knowledge [5], [6]. ESD, meanwhile, emphasizes the formation of learners who can think critically, act responsibly, and participate in

social transformation toward more sustainable futures [1], [2]. When these two orientations are brought together, sustainability provides the social and ethical purpose of learning, while interdisciplinarity provides a way to organize knowledge, inquiry, and collaboration.

This relationship is important for higher education because sustainability challenges rarely fall within one academic boundary. Climate change, inequality, public health, responsible production, technological disruption, and community resilience require students to connect evidence, values, stakeholders, and possible consequences. For this reason, sustainability competence frameworks have moved beyond knowledge acquisition and now emphasize systems thinking, futures thinking, values thinking, strategic thinking, collaboration, critical thinking, self-awareness, and integrated problem solving [3], [4], [8], [9]. These competencies suggest that students need learning experiences that help them interpret complexity, examine assumptions, negotiate diverse perspectives, and consider the broader consequences of action.

From a curriculum perspective, ESD should not be reduced to adding environmental topics to existing courses. It involves decisions about what students are expected to learn, how learning is organized, how students engage with authentic problems, and how their competencies are assessed. Interdisciplinary education strengthens this process by encouraging students to work across conceptual and methodological boundaries. Together, ESD and interdisciplinarity support a curriculum orientation in which students learn not only about sustainability, but also through sustainability problems and for sustainability action.

2.2. Curriculum integration for sustainability competencies

Curriculum integration refers to the embedding of interdisciplinary and sustainability-oriented learning into the structure and experience of higher education. At the formal level, this includes program learning outcomes, course learning outcomes, syllabi, content, teaching and learning activities, assessment tasks, and quality assurance processes. At the informal level, it includes student clubs, volunteering, field trips, competitions, workshops, community projects, research activities, and other learning experiences outside formal assessment. Both levels are important because sustainability competencies develop through structured academic learning as well as through participation, reflection, collaboration, and engagement with real contexts [10], [12].

A curriculum that aims to develop sustainability competencies requires alignment among learning outcomes, pedagogical approaches, assessment, and institutional support. Previous studies have shown that active, collaborative, problem-based, project-based, case-based, and community-oriented pedagogies are more suitable for sustainability learning than content transmission alone [11], [17], [18]. These approaches give students opportunities to examine complex problems, consider competing values, integrate knowledge from different fields, and test possible responses. Course content remains important, but its educational value depends on how it is connected to learning tasks, assessment criteria, and opportunities for application.

The distinction between formal, informal, and hidden curricula also helps clarify how students encounter sustainability and interdisciplinarity in university life [21], [22]. Formal curricula make institutional intentions visible through program structures and assessed learning. Informal curricula can enrich these intentions through experiential and student-led activities, but their contribution may remain implicit if they are not connected to learning outcomes, guided reflection, or recognition. Hidden curricula, including institutional culture, everyday academic expectations, and the values conveyed through university practices, may either reinforce or weaken sustainability-oriented learning. Therefore, the integration of interdisciplinary sustainability education cannot be judged only by the presence of sustainable development goals (SDGs)-related content in courses. It also depends on the coherence among formal curriculum documents, informal learning opportunities, assessment practices, and the wider institutional environment.

2.3. Conceptual framework of the study

This study conceptualizes interdisciplinary sustainability curriculum integration through three interconnected dimensions. The first dimension is student competency development. This includes students' awareness, understanding, critical thinking, collaboration, social responsibility, and capacity to approach complex sustainability problems. The second dimension is curriculum integration. This refers to the incorporation of interdisciplinarity and ESD into learning outcomes, course content, teaching and learning activities, assessment, and informal learning experiences. The third dimension is institutional support. This includes curriculum guidelines, lecturer capacity, resources, inter-faculty coordination, leadership support, external partnerships, and mechanisms that encourage student participation.

These dimensions reflect the view that curriculum reform depends not only on lecturer interest or isolated course-level initiatives, but also on institutional conditions. Studies of sustainability teaching in higher education show that sustainability integration is often constrained when institutional commitment is not translated into curriculum structures, teaching practices, staff development, and organizational support [23], [24]. Interdisciplinary work may also be hindered by faculty boundaries, disciplinary traditions, workload, funding mechanisms, and weak coordination across academic units [25], [26]. Evidence from

emerging higher education contexts, including Vietnam, further indicates that sustainability integration depends on management support, faculty empowerment, stakeholder engagement, institutional frameworks, and resources [27].

The conceptual framework of this study therefore links learner development, curriculum integration, and institutional support. It assumes that interdisciplinary sustainability curricula become meaningful when students recognize the relevance of sustainability, when formal and informal learning experiences are aligned, and when universities provide the conditions that allow lecturers, faculties, students, and external partners to collaborate. This framework guides the analysis of lecturers' and students' perceptions, the current integration of interdisciplinarity and ESD into undergraduate curricula, and the facilitating conditions and barriers that shape curriculum development in Vietnamese higher education.

3. METHOD

3.1. Research design

This study employed an explanatory sequential mixed-methods design to examine the integration of interdisciplinarity and ESD into undergraduate curricula in Vietnamese higher education. In the first phase, quantitative survey data were collected from lecturers and students to identify general patterns in their awareness, understanding, perceptions of curriculum integration, facilitating conditions, barriers, and recommendations. Preliminary quantitative results then informed the qualitative phase by highlighting findings requiring further explanation, particularly the gap between high awareness and moderate understanding, uneven curriculum integration, and institutional differences. Semi-structured interviews were subsequently conducted to explain why these patterns occurred and how institutional and disciplinary conditions shaped implementation. Integration occurred by using the survey findings to refine the interview protocol and by merging quantitative and qualitative evidence during interpretation. This design was appropriate because it combined broad patterns with contextual explanations, thereby providing a more coherent account of interdisciplinary sustainability curriculum integration [28], [29].

3.2. Research setting and participants

The study was conducted at four higher education institutions in Ho Chi Minh City, Vietnam. The institutions were selected through purposive sampling because they represent different academic fields and institutional contexts, including social sciences and humanities, natural sciences, economics and law, engineering, and technology. This selection allowed the study to examine interdisciplinary sustainability curriculum integration across diverse disciplinary settings rather than within a single type of institution. A total of 608 participants took part in the survey, including 501 undergraduate students and 107 lecturers. Survey participants were recruited through convenience and voluntary sampling. Student participants received the survey link through class communication channels, email groups, class leaders, or lecturers. Lecturer participants received the survey link through faculty or department communication channels, email groups, or direct contact from the research team. Participation was voluntary, and all responses were collected anonymously. Among the student respondents, 298 were female and 203 were male. The student sample included participants from different years of study, with the largest groups being third-year, fourth-year, and second-year students. The lecturer sample included 58 female and 49 male participants from different age groups and institutional affiliations. Table 1 presents the demographic characteristics of the survey participants.

Table 1. Demographic characteristics of survey participants

Variable	Category	Students n (%)	Lecturers n (%)
Gender	Female	298 (59.48)	58 (54.2)
	Male	203 (40.52)	49 (45.8)
Student year	Year 1	51 (10.18)	—
	Year 2	132 (26.35)	—
	Year 3	152 (30.34)	—
	Year 4	150 (29.94)	—
	Other	16 (3.19)	—
Age group	30 years old or below	—	16 (15.0)
	31–40 years old	—	35 (32.7)
	41–50 years old	—	49 (45.8)
	51 years old or above	—	7 (6.5)
Institution	Uni A	169 (33.73)	27 (25.2)
	Uni B	119 (23.75)	20 (18.7)
	Uni C	108 (21.56)	33 (30.8)
	Uni D	105 (20.96)	27 (25.2)

In the qualitative phase, semi-structured interviews were conducted with 16 participants, including 8 lecturers and 8 students from the four institutions. Interview participants were selected purposively to provide information-rich perspectives on curriculum design, teaching practices, learning experiences, and institutional conditions. Student interviewees were mainly junior or senior undergraduate students, while lecturer interviewees had at least five years of teaching experience. The selection also considered variation in gender, discipline, institutional affiliation, and teaching or learning experience.

3.3. Research instruments

Two instruments were used for data collection: a questionnaire and a semi-structured interview protocol. The questionnaire was developed based on the literature on ESD, interdisciplinary education, sustainability competencies, and curriculum integration. It consisted of thematic groups measuring: i) awareness of the role of interdisciplinary and sustainability education; ii) understanding of interdisciplinary education, ESD, and the SDGs; iii) integration into learning outcomes, course content, and extracurricular activities; iv) favorable conditions for curriculum development; v) barriers to implementation; and vi) recommendations for improving interdisciplinary sustainability curricula. These domains were aligned with the research questions and the conceptual framework of student competency development, curriculum integration, and institutional support. The items were rated on a 5-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). Higher mean scores indicated stronger agreement or higher perceived levels of awareness, understanding, integration, facilitating conditions, barriers, or recommendations. Some items were used for both lecturers and students to allow comparison between the two groups, while other items were specific to lecturers because they concerned curriculum design, course development, and institutional implementation. Content validity was addressed through expert review. The initial questionnaire was reviewed by members of the research team and academic experts in higher education, curriculum development, and educational management. The review focused on item relevance, conceptual clarity, wording, and suitability for the Vietnamese higher education context. Revisions were made to improve the clarity of the items and their alignment with the research questions.

Construct structure was subsequently examined using exploratory factor analysis (EFA) separately for the student and lecturer questionnaires. Principal axis factoring was applied to each theoretically defined domain, and Promax rotation was used when more than one factor was retained. Sampling adequacy was evaluated using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity. Factor retention was based on eigenvalues greater than 1, factor loadings, and theoretical interpretability. Items with weak or unclear loadings were reviewed before the final factor solution was accepted. For the student questionnaire, KMO values ranged from 0.882 to 0.976, and all Bartlett's tests were significant at $p<0.001$. One-factor structures were obtained for awareness, understanding, perceived effectiveness, influencing factors, and recommendations, while current curriculum implementation produced two factors. The retained factors explained between 54.79% and 75.37% of the variance, with the two implementation factors jointly explaining 71.45%. For the lecturer questionnaire, KMO values ranged from 0.865 to 0.921, and all Bartlett's tests were significant at $p<0.001$. The analyses produced between one and four factors across the six domains, explaining between 60.70% and 78.73% of the variance, except for the revised recommendations domain, which formed one factor explaining 77.11%. Internal consistency was assessed using Cronbach's alpha. The coefficients ranged from 0.894 to 0.982 for the student questionnaire and from 0.891 to 0.969 for the revised lecturer domains, with the revised recommendations domain reaching 0.949. The EFA and reliability results for both respondent groups are summarized in Table 2.

The semi-structured interview protocol was developed to obtain qualitative data on participants' understanding, experiences, and reflections. The interview protocol was mapped to the survey domains and refined after preliminary analysis of the quantitative findings. Survey results concerning the gap between awareness and understanding informed questions about participants' conceptual interpretations; findings on curriculum implementation and perceived effectiveness informed questions about formal and informal curriculum practices; and findings on barriers and institutional variation informed questions about lecturer capacity, resources, coordination, and external collaboration. This mapping enabled the qualitative phase to explain and expand specific quantitative findings rather than merely provide illustrative quotations. The interviews were conducted in Vietnamese so that participants could express their views fully and accurately. Codes were used instead of participants' real names to protect confidentiality.

3.4. Data collection procedure

Before data collection, participants were informed about the purpose of the study, voluntary participation, confidentiality, anonymity, and their right to withdraw. Informed consent was obtained from all participants. The survey was administered online using Google Forms. Student participants received the survey link through class Zalo groups, email groups, class leaders, or lecturers. Lecturer participants received the survey link through faculty or department communication channels, email groups, Zalo groups, or direct

contact from the research team. All responses were collected anonymously and used only for research purposes. After the survey phase, preliminary quantitative results were reviewed to identify findings requiring further explanation, particularly the gap between awareness and understanding, uneven curriculum integration, and institutional differences. These findings were used to refine the semi-structured interview protocol and determine the issues explored in greater depth. The interviews were carried out from August to November 2025, lasted approximately 30 to 45 minutes, and were recorded with participants' permission.

Table 2. Construct structure and internal consistency reliability of the questionnaire

Scale	Number of items	Students				Lecturers			
		KMO	Factors	Variance explained (%)	Cronbach's α	KMO	Factors	Variance explained (%)	Cronbach's α
Awareness of the importance of interdisciplinary sustainability education	10/10	0.949	1	67.38	0.953	0.872	1	60.70	0.926
Understanding of interdisciplinary education, ESD, and the SDGs	6/10	0.914	1	75.37	0.948	0.889	2	78.73	0.945
Current curriculum implementation	28/28	0.976	2	71.45	0.982	0.908	4	72.12	0.969
Perceived effectiveness of implementation	7/8	0.939	1	73.38	0.951	0.921	1	74.47	0.946
Influencing factors	7/16	0.882	1	54.79	0.894	0.863	3	72.52	0.891
Recommendations for curriculum development	5/7	0.892	1	69.91	0.920	0.865	1	77.11	0.949

Note: the number of items is presented as student questionnaire/lecturer questionnaire where the two versions differed. All Bartlett's tests of sphericity were significant at $p<0.001$. EFA was conducted separately for each theoretically defined domain using principal axis factoring.

3.5. Data analysis

Quantitative data were analyzed using EFA, reliability analysis, descriptive statistics, and inferential statistics. EFA was conducted separately for the theoretically defined questionnaire domains using principal axis factoring and Promax rotation when multiple factors were retained. Sampling adequacy was assessed using the KMO measure and Bartlett's test of sphericity, while factor retention was determined based on eigenvalues greater than 1, factor loadings, and theoretical interpretability. Cronbach's alpha was calculated to assess internal consistency. Frequencies and percentages were used to describe participants' characteristics while means and standard deviations were calculated to identify response patterns. Mean scores from 1.00 to 1.80 were interpreted as very low, 1.81 to 2.60 as low, 2.61 to 3.40 as moderate, 3.41 to 4.20 as high, and 4.21 to 5.00 as very high. One-way analysis of variance (ANOVA) was conducted to examine differences in students' perceptions across the four institutions. Statistical significance was set at $p<0.05$, effect sizes were reported using eta squared, and significant omnibus results were followed by Tukey-Kramer post-hoc comparisons to identify pairwise institutional differences.

Qualitative data from the interviews were analyzed using thematic analysis [30]. The analysis began with repeated reading of the transcripts to become familiar with the data. Initial codes were generated from meaningful segments related to the research questions. Some codes were informed by the conceptual framework, such as awareness, curriculum integration, informal learning, institutional support, lecturer capacity, and external collaboration. Other codes emerged inductively from participants' accounts. Similar codes were then grouped into broader categories and themes. To enhance trustworthiness, the coding results and emerging themes were reviewed and discussed by the research team. Differences in interpretation were resolved through discussion until agreement was reached. Representative quotations were selected not only to illustrate but also to explain and expand the quantitative results. The qualitative analysis focused on three themes aligned with the research questions: i) awareness and understanding of interdisciplinary education and ESD; ii) integration into formal and informal curricula; and iii) facilitating conditions, barriers, and recommendations for curriculum development.

Integration occurred at both the connecting and interpretation stages. Preliminary survey findings were used to refine the interview protocol and identify issues requiring further explanation, while qualitative themes were compared with corresponding quantitative results to examine convergence, divergence, and institutional variation. The two datasets were merged through narrative comparison to generate integrated interpretations of awareness, curriculum implementation, institutional conditions, and recommendations.

4. RESULTS AND DISCUSSION

4.1. Empirical results

4.1.1. Awareness and understanding of interdisciplinary sustainability education

Both lecturers and students attached considerable importance to interdisciplinary sustainability education. As shown in Table 3, the mean score for awareness was very high among lecturers (M=4.46) and students (M=4.25). This indicates broad recognition of its relevance to student development, employability, social responsibility, and readiness for complex professional contexts. However, understanding was noticeably lower. Students reported only a moderate level of understanding of interdisciplinary education, the SDGs, and ESD (M=3.18). Lecturers reported a somewhat higher level of understanding (M=3.55), but their understanding of curriculum design with sustainability integration was still only moderate to high (M=3.50).

Table 3. Awareness and understanding of interdisciplinary sustainability education

Dimension	Lecturers M	Students M
Awareness of the importance of interdisciplinary sustainability education	4.46	4.25
Understanding of interdisciplinary education, SDGs, and ESD	3.55	3.18
Lecturers' understanding of curriculum design with sustainability integration	3.50	—

The interview findings explain why this strong endorsement did not translate into equally strong understanding. Participants commonly associated interdisciplinary sustainability education with broader graduate capabilities. One lecturer stated that:

> "*Interdisciplinary education is not the new trend but compulsory to train our students for employability in complex engineering systems.*" (L4.1)

A student (S1.2) also linked interdisciplinary learning with "*synthesis thinking, interdisciplinary collaboration*, *problem solving, critical thinking, self-study, and social and environmental responsibility*." These accounts help explain the high awareness scores by showing that participants understood the general educational and professional value of interdisciplinarity and sustainability. At the same time, the interviews revealed uncertainty about how these broad purposes could be translated into curriculum practice. Some lecturers observed that, except for colleagues in environmental fields or those with international exposure, many academic staff "*only know the general concept of sustainable development goals and may not clearly see how the SDGs relate to teaching*" (L2.2; L3.2). In addition, a student similarly noted:

> "*Many students have not yet recognized the urgency of interdisciplinary aspects or sustainable development issues.*" (S1.2)

The integrated evidence therefore indicates that the main gap was not resistance to interdisciplinary sustainability education, but limited curriculum-design literacy. Awareness had developed at the level of educational values and graduate aspirations, while practical knowledge of how to embed sustainability competencies into learning outcomes, teaching activities, and assessment remained less developed. This distinction has an important implication for curriculum development in Vietnamese higher education. Awareness-raising alone is unlikely to produce systematic curriculum change unless lecturers are also provided with discipline-sensitive guidance on outcome formulation, pedagogy, assessment, and the alignment of formal and informal learning. The findings therefore suggest that professional development should move beyond introducing ESD concepts and focus more directly on curriculum enactment.

4.1.2. Integration into learning outcomes, course content, and learning activities

The second group of findings concerns the way interdisciplinarity and sustainability were integrated into curricula and learning experiences. Table 4 shows that both lecturers and students perceived this integration at a moderate-to-high level. Students rated the integration slightly higher than lecturers across the main dimensions. The mean score for integration into learning outcomes was 3.63 among lecturers and 3.73 among students. For course content, the mean score was 3.57 among lecturers and 3.69 among students.

The results show that interdisciplinary elements were more visible than sustainability elements. Interdisciplinary general education courses and specialized courses received relatively higher ratings, while courses explicitly integrating the SDGs received the lowest ratings, especially from lecturers. This pattern suggests that interdisciplinarity was already embedded in professional training requirements, general education, problem-based assignments, or the combination of knowledge areas. Sustainability, by contrast, requires more explicit links to social, environmental, economic, and ethical goals, and these links were not

always visible in curriculum documents or classroom activities. The slightly higher student ratings may indicate that students recognized broad sustainability-related themes and activities, whereas lecturers evaluated integration more critically in relation to formal curriculum design.

Table 4. Integration of interdisciplinary and sustainability elements into curricula and courses

Dimension	Lecturers M	Students M	Main pattern
Integration into program and course learning outcomes	3.63	3.73	Moderate to high
Integration into general and specialized courses	3.72	3.78	Interdisciplinarity more visible
SDGs-integrated courses	3.18	3.48	Least visible dimension
Interdisciplinary and sustainability themes in extracurricular activities	3.51	3.63	Present but uneven

The interviews explain why interdisciplinarity appeared more visible than explicit sustainability integration. Some lecturers had already incorporated interdisciplinary and sustainability-related competencies into course learning outcomes. One lecturer described:

> "*Course outcomes in terms of critical thinking, the ability to view technical problems from multiple perspectives, a sense of responsibility towards sustainable environment and society, international communication, and interdisciplinary teamwork skills.*" (L4.2)

Another lecturer reported:

> "*Interdisciplinary elements in learning outcomes helped students develop employability skills, tolerance, and respect for cultural differences.*" (L3.2)

These accounts help explain the relatively positive survey ratings by showing that some courses had moved beyond content coverage and had begun to frame interdisciplinarity and sustainability as competency-oriented learning. They also indicate that interdisciplinary competencies were often easier to connect with existing professional and employability outcomes than explicit sustainability competencies. However, the integration was often implicit. Several interviewees noted that the SDGs were rarely stated directly in program objectives or course learning outcomes. Some lecturers observed:

> "*SDGs are hardly mentioned explicitly in the objectives and learning outcomes*." (L1.1; L4.1)
> "*Sustainability goals related to well-being, social progress, equality, and sustainable governance were rarely emphasized in curriculum outcomes*." (L4.1)

The qualitative evidence therefore clarifies that sustainability was often present through values, themes, examples, and activities but remained insufficiently explicit in stated outcomes, assessment criteria, and learning pathways. The integrated finding is that curriculum presence should not be equated with curriculum alignment: sustainability-related content may exist without being intentionally mapped, assessed, or progressively developed. This limits universities' capacity to monitor whether students actually acquire the intended sustainability competencies.

Informal curricula also played an important role. Students encountered sustainability through volunteering, environmental campaigns, student clubs, workshops, exchange activities, student research, start-up competitions, green business projects, circular economy initiatives, and community-oriented programs. One student (S1.1; S2.2) described volunteering activities such as planting trees and protecting water and soil, which helped students see "*the practical application of interdisciplinary and sustainable knowledge.*" Other participants stated:

> "*Referred to green supply chain projects, green logistics, carbon reduction, green leadership, circular economy, green consumption, nature conservation, and sustainable finance activities*." (L1.1; L2.1; S3.1b; S1.2)

These activities created meaningful opportunities for experiential learning, peer collaboration, and social engagement. Yet they were not always connected to formal learning outcomes. One student (S1.2) commented that the integration of interdisciplinary and sustainability themes in extracurricular activities "*still depends on the individual orientations of the student groups or suggestions from the supervising lecturer*." Another participant (L4.2) noted that extracurricular programs were rarely designed to explicitly connect interdisciplinary fields or promote the SDGs, resulting in "*a lack of connection between knowledge,*

experience, and social impact." These explanations reveal an activity–curriculum gap: universities offered numerous sustainability-related experiences, but these activities did not consistently form an intentional and cumulative curriculum pathway. Informal learning was therefore active and potentially valuable, yet its contribution remained uneven when it was not connected to guided reflection, assessment, recognition, or formal learning outcomes. For Vietnamese higher education, the implication is that extracurricular and community-based activities should be systematically mapped to sustainability competencies and linked to portfolios, reflection tasks, advising, credit, or other recognition mechanisms.

4.1.3. Facilitating conditions and barriers

Participants identified several conditions that could support the development of interdisciplinary sustainability curricula. As seen in Table 5, both lecturers and students rated the broader economic, social, and technological context of globalization as an important facilitating condition. Lecturers also placed strong emphasis on institutional policies encouraging interdisciplinary academic programs and training activities, green initiatives, social volunteering, international engagement, and interdisciplinary research teams.

Table 5. Facilitating conditions for developing interdisciplinary sustainability curricula

Facilitating condition	Lecturers M	Students M
Economic, social, and technological context of globalization	4.21	4.12
Committed management and innovative faculty teams	4.11	4.04
Leaders and lecturers with international experience and global engagement	4.10	—
Policies encouraging interdisciplinary research teams	4.06	—
Green initiatives and social volunteering activities	4.13	—
Policies encouraging interdisciplinary academic programs and training activities	4.22	—

The findings in Table 5 are important because they show that participants did not view curriculum reform as a purely classroom-based matter. The high ratings for globalization, leadership, innovation, green initiatives, and interdisciplinary research indicate that curriculum integration depends on the broader institutional environment in which teaching and learning take place. The interviews explain how these broader conditions could stimulate curriculum renewal. Participants noted that:

> "*Law, economics, engineering, and other fields rarely operate in isolation and increasingly require interaction with other fields.*" (S1.1; S3.1a)
> "*They also identified international collaboration, growing business interest in sustainability, professional training opportunities, and interdisciplinary research groups as conditions that could translate external change into curriculum innovation.*" (L1.2; L2.2)

These accounts help explain the high survey ratings by showing that globalization and institutional engagement were perceived not merely as background conditions, but as drivers of new curriculum expectations, academic cooperation, and external partnership.

At the same time, important barriers remain. Table 6 shows that lecturers gave relatively high ratings to students' limited awareness, uneven capacity among management and academic staff, lecturers' unsynchronized awareness, lack of guiding documents, weak external cooperation, insufficient resources, and limited coordination across faculties or departments. Students also identified limited awareness, weak external cooperation, lack of encouragement or reward policies, and lack of surveys on students' needs and interests.

Table 6. Barriers to the development of interdisciplinary sustainability curricula

Barrier	Lecturers M	Students M
Lack of specific guiding documents	3.96	—
Lack of effective coordination between faculties or departments	3.84	—
Inadequate human and financial resources	3.85	—
Lecturers' unsynchronized awareness	3.99	—
Students' limited awareness	4.07	3.94
Uneven capacity of management and academic staff	4.07	—
Lack of cooperation with external agencies and enterprises	3.96	3.87
Lack of student encouragement or reward policies	—	3.83
Lack of surveys on students' needs and topics of interest	—	3.84

The interviews explain why these barriers persisted and how they reinforced one another. One lecturer stated that:

> "*Interdisciplinary education and SDGs are not specifically defined in any competency framework, while cooperation between faculties and external partners remained fragmented and lacked clear support mechanisms.*" (L2.1)

Other lecturers pointed out:

> "*To limited funding and facilities for project activities and interdepartmental collaboration, adding that lecturers had not received sufficient training in design and pedagogy.*" (L4.1)
> "*Workload was also mentioned. Some lecturers noted that young staff were already under pressure to follow existing course outlines, making large-scale interdisciplinary projects difficult to organize.*" (L1.2; L2.1)

One student (S2.1) also reported "*pressure from major coursework could reduce their interest in additional sustainability-related activities*."

The integrated evidence indicates that the main constraint was not opposition to interdisciplinary sustainability education, but a system of mutually reinforcing implementation barriers. The absence of explicit competency frameworks made curriculum design less consistent; limited professional development reduced lecturers' capacity to design interdisciplinary learning and assessment; workload and resource constraints discouraged project-based and experiential activities; and weak coordination made initiatives dependent on individual relationships rather than institutional processes. Students' participation was similarly affected when sustainability activities competed with major coursework and lacked visible incentives or connections to formal learning. This interpretation suggests that isolated interventions are unlikely to produce sustainable change. Guidance documents without lecturer development may remain procedural, while training without workload recognition, resources, coordination, and external partnerships may be difficult to implement. For Vietnamese higher education, curriculum reform therefore requires an aligned institutional system linking policy, professional development, organizational coordination, incentives, student engagement, and external collaboration.

4.1.4. Recommendations for curriculum development

Lecturers expressed strong agreement with all proposed recommendations. As shown in Table 7, the highest-rated measures were developing specific guidance documents, investing more resources, establishing support and reward policies, promoting cooperation between faculties or departments, developing external partnerships, strengthening training, and increasing guidance for students. The interviews clarify the practical meaning of these recommendations. Participants repeatedly emphasized the need for a clear institutional framework that could guide curriculum design, teaching and learning activities, assessment, and quality assurance while still allowing faculties to adapt implementation to their disciplinary contexts (L1.1; L2.1; L2.2). This recommendation directly responds to the earlier finding that curriculum integration remained implicit, uneven, and dependent on individual lecturers. The qualitative evidence therefore explains why guidance documents received one of the highest survey ratings: participants did not seek general policy statements alone, but practical direction for translating sustainability competencies into learning outcomes, teaching activities, assessment, and quality-assurance processes.

Professional development was another priority. Several lecturers suggested training programs to help academic staff understand the SDGs, design interdisciplinary teaching materials, and assess students' sustainability competencies. One lecturer (L2.2; L3.2; L4.1) proposed a "*train-the-trainer-oriented program to strengthen lecturers' understanding of SDGs and interdisciplinarity and to support teaching material development.*" The interviews further explain why training alone was considered insufficient. Participants also called for incentives, workload recognition, and administrative support to enable lecturers to apply what they had learned. A student (S1.1) suggested "*rewards for interdisciplinary education, research projects, competitions, and workshops to motivate students to engage more deeply with sustainable development issues.*" A lecturer (L3.3) emphasized "*the need for administrative support for practical activities, real-world experiences, and field trips.*"

Taken together, these accounts indicate that professional development should be understood as part of an implementation system rather than as a stand-alone intervention. Training may strengthen knowledge and design capacity, but its effects are likely to remain limited when lecturers lack time, resources, incentives, or institutional permission to redesign courses and organize experiential learning. This integrated interpretation connects the high ratings for training, resources, and support policies and shows why these measures need to be implemented in combination.

Collaboration was a recurring recommendation. Participants suggested that:

"*More experiential activities, community-based research, business cooperation, inter-faculty projects, and interdisciplinary competitions*" (S2.1; L2.1)

One student proposed that:

"*The university could establish a specialized center for sustainable development as a hub for training, research, and community connection*" (S1.2)

Such a structure could connect formal curricula, informal learning opportunities, and external partnerships while reducing dependence on temporary projects or individual relationships. The proposal also expands the survey recommendation on cooperation by identifying a possible coordinating mechanism through which faculties, students, communities, and enterprises could work together. The integrated evidence suggests that the proposed measures should not be treated as a list of separate actions. Rather, they form the components of an institutional implementation strategy linking curriculum guidance, lecturer development, resources, incentives, inter-faculty coordination, student engagement, and external partnership. For Vietnamese higher education, the practical implication is that universities should sequence and align these measures so that policy commitments are translated into sustained curriculum practice rather than isolated initiatives.

Table 7. Lecturers' recommendations for developing interdisciplinary sustainability curricula

Recommendation	Mean	SD
Strengthening training workshops and hands-on seminars	4.29	0.869
Developing specific guidance documents	4.46	0.768
Promoting cooperation between faculties or departments	4.42	0.727
Investing more resources, especially for interdisciplinary projects	4.46	0.730
Increasing seminars and guidance materials for students	4.31	0.829
Developing effective support, guidance, and reward policies	4.45	0.717
Developing mechanisms for cooperation with external agencies, localities, and enterprises	4.37	0.746

4.1.5. Institutional differences in students' perceptions

To examine whether students' perceptions varied across institutional contexts, one-way ANOVA was conducted for the student survey. The results showed significant differences across the four institutions in several selected aspects of awareness, understanding, implementation, perceived effectiveness, influencing factors, and recommendations. Table 8 presents selected significant results, together with eta-squared effect sizes and significant Tukey–Kramer post-hoc comparisons.

The ANOVA results add an institutional dimension to the descriptive findings. Although all selected differences were statistically significant, the eta-squared values ranged from 0.018 to 0.045, indicating small practical effects. The largest effects were observed for courses involving the comparison and analysis of global issues and for perceptions of the economic, social, and technological context of globalization (both η^2=0.045), followed by tolerance and respect for differences (η^2=0.039) and project-based learning (η^2=0.037). Thus, institutional context influenced students' perceptions, but it accounted for only a modest proportion of the overall variation. The post-hoc comparisons show that most significant pairwise differences involved Uni D, whose mean scores were lower than those of one or more other institutions across several items. These differences were particularly evident in curriculum implementation, project-based and experiential learning, extracurricular integration, communication and teamwork assessment, perceived tolerance and respect for differences, leadership support, inter-faculty cooperation, and collaboration with external organizations.

In contrast, the differences in understanding were more specific: Uni C reported higher scores than Uni A for understanding the role of interdisciplinary education in implementing the SDGs and higher scores than Uni D for understanding how to integrate the SDGs into extracurricular activities. The qualitative findings help explain these institutional patterns. Participants linked differences in students' experiences to the visibility of interdisciplinary and sustainability themes in courses, lecturer capacity, leadership support, disciplinary traditions, opportunities for experiential learning, and access to external partners. These explanations suggest that institutional variation should be understood as meaningful but modest, rather than as evidence that the four institutions represented entirely contrasting curriculum systems. The integrated evidence indicates that students across all four institutions generally valued interdisciplinary sustainability education, while the availability and visibility of specific learning opportunities varied. Differences were most apparent in areas requiring deliberate curriculum organization, including project-based learning,

experiential learning, global-issue analysis, extracurricular integration, and competency-based assessment. For Vietnamese higher education, this finding implies that a shared strategic framework may support greater coherence, but implementation should remain responsive to the disciplinary, organizational, and resource conditions of individual institutions.

Table 8. Selected significant ANOVA, effect-size, and post-hoc results for students' perceptions across institutions

Domain	Selected item	F	p	η^2	Significant post-hoc differences
Awareness	Interdisciplinary education develops students' holistic competencies	6.031	<0.001	0.035	Uni A>Uni D (p<0.001); Uni C>Uni D (p=0.028)
	ESD enhances adaptability and intercultural communication/cooperation	6.084	<0.001	0.035	Uni A>Uni D (p<0.001); Uni B>Uni D (p=0.043)
Understanding	Understanding the role of interdisciplinary education in implementing SDGs	3.049	0.028	0.018	Uni C>Uni A (p=0.022)
	Understanding how to integrate SDGs into extracurricular activities	3.580	0.014	0.021	Uni C>Uni D (p=0.044)
Curriculum implementation	Courses include comparison and analysis of global issues	7.789	<0.001	0.045	Uni A>Uni D (p<0.001); Uni C>Uni D (p=0.036); Uni B>Uni D (p=0.016)
	Extracurricular activities integrate interdisciplinary and SDG themes	4.174	0.006	0.025	Uni A>Uni D (p=0.009); Uni C>Uni D (p=0.014)
Pedagogy	Project-based learning	6.362	<0.001	0.037	Uni A>Uni D (p<0.001)
	Experiential learning outside the classroom	4.928	0.002	0.029	Uni A>Uni D (p=0.003); Uni C>Uni D (p=0.007)
Assessment	Rubrics for communication and teamwork	4.006	0.008	0.024	Uni A>Uni D (p=0.041); Uni C>Uni D (p=0.025); Uni B>Uni D (p=0.011)
Perceived effectiveness	Tolerance and respect for differences	6.777	<0.001	0.039	Uni A>Uni D (p<0.001); Uni C>Uni D (p=0.001); Uni B>Uni D (p=0.008)
Influencing factors	Economic, social, and technological context of globalization	7.892	<0.001	0.045	Uni A>Uni D (p<0.001); Uni C>Uni D (p=0.004); Uni B>Uni D (p=0.001)
	Committed and innovative leaders/lecturers	6.018	<0.001	0.035	Uni A>Uni D (p=0.001); Uni B>Uni D (p=0.010)
Recommendations	Inter-faculty/departmental cooperation	3.621	0.013	0.021	Uni A>Uni D (p=0.018); Uni B>Uni D (p=0.020)
	Cooperation with external agencies, localities, and enterprises	3.009	0.030	0.018	Uni A>Uni D (p=0.033)

Note: eta-squared values were interpreted as small when $\eta^2<0.06$. All effect sizes reported in Table 8 were small, ranging from 0.018 to 0.045. Tukey–Kramer post-hoc comparisons were used to identify significant pairwise differences among institutions.

4.2. Discussion

4.2.1. From positive awareness to curriculum design capacity

The findings show a clear distance between valuing interdisciplinary sustainability education and being able to implement it systematically. Both lecturers and students recognized its importance, but understanding of how to embed sustainability and interdisciplinarity into curriculum design was less developed. The qualitative findings explain this discrepancy by showing that participants were familiar with the general purposes of interdisciplinarity and the SDGs but were less confident in translating them into learning outcomes, teaching activities, and assessment. This distinction is important because sustainability competency frameworks emphasize systems thinking, anticipatory thinking, strategic action, collaboration, values-based judgment, and integrated problem solving rather than awareness alone [3], [4], [8], [9]. This pattern is consistent with previous studies showing that academic support for sustainability education does not automatically lead to curriculum change without professional development, institutional support, and usable curriculum tools [23], [24]. However, the present study extends this argument by identifying curriculum-design literacy as a specific mechanism connecting positive awareness with curriculum enactment. The principal challenge was therefore not resistance to sustainability education, but the limited capacity to translate broad educational values into explicit, teachable, and assessable curriculum components. For Vietnamese universities, this means that sustainability curriculum reform should not stop at raising awareness. It should include practical guidance for writing learning outcomes, designing interdisciplinary tasks, assessing sustainability competencies, and connecting classroom learning with real social and professional contexts. This implication is consistent with evidence that ESD implementation in Vietnam is shaped by institutional interpretation, teacher preparation, and local curriculum practices [14]. Professional

development should therefore move beyond introducing ESD concepts and focus on how these concepts can be enacted within particular programs, courses, and disciplinary fields.

4.2.2. Aligning formal and informal curricula

The study also shows that sustainability and interdisciplinarity appear across both formal and informal curricula, but the relationship between the two remains weak. Formal curricula include learning outcomes, course content, teaching activities, and assessment. Informal curricula include student clubs, volunteering, field trips, competitions, workshops, community activities, and student projects. Participants described many meaningful informal activities related to green living, volunteering, circular economy, green business, sustainable finance, and community engagement. These activities can help students encounter sustainability as a lived experience rather than a purely academic topic. This interpretation is consistent with research showing that informal and experiential learning can extend sustainability learning beyond formal coursework and strengthen engagement with real-world issues [12], [13]. The interview evidence further indicates that these activities provide opportunities for experiential learning, collaboration, and engagement with authentic sustainability problems. However, informal activities cannot fully support competency development if they remain disconnected from formal learning outcomes, reflection, feedback, and recognition. This finding resonates with the view that sustainability learning requires active, collaborative, project-based, and community-oriented pedagogies [11], [31]. It also reflects the importance of understanding curricula beyond formal course documents [21], [22]. The present study also extends this literature by identifying an activity–curriculum gap: universities may provide numerous sustainability-related activities without organizing them into an intentional and cumulative curriculum pathway. When informal experiences are not connected to learning outcomes, guided reflection, assessment, feedback, or recognition, their contribution to competency development remains implicit. This distinction is scientifically important because the presence of activities should not be treated as equivalent to curriculum integration. Universities should therefore map extracurricular and community-based experiences to sustainability competencies and connect them with reflection journals, portfolios, advising systems, credit recognition, or other mechanisms that make learning visible, assessable, and progressively developed [17], [18].

4.2.3. Institutional conditions for curriculum reform

The facilitating conditions and barriers identified in the study suggest that interdisciplinary sustainability curriculum development is an institutional task, not only a pedagogical choice made by individual lecturers. Participants valued the role of globalization, committed leadership, innovative faculty teams, international engagement, green initiatives, and interdisciplinary research. At the same time, they pointed to the lack of guiding documents, uneven staff capacity, inadequate resources, weak inter-faculty coordination, limited external cooperation, and insufficient support or reward mechanisms. These findings are consistent with studies showing that sustainability integration in higher education often remains fragmented when institutional commitment is not translated into curriculum structures, teaching practices, staff development, and organizational support [32]. They also support earlier arguments that interdisciplinary work can be limited by faculty boundaries, disciplinary traditions, resource allocation, and academic cultures [25], [26]. The present study strengthens these arguments by showing that the barriers operated as a mutually reinforcing implementation system rather than as isolated constraints. The absence of explicit competency frameworks reduced consistency in curriculum design, while limited training restricted lecturers' ability to implement interdisciplinary pedagogy and assessment. Workload and resource constraints further discouraged project-based and experiential learning, and weak coordination made initiatives dependent on individual relationships rather than institutional processes. This indicates that separate interventions are unlikely to be effective unless guidance, professional development, resources, incentives, coordination, and external partnerships are aligned. In the Vietnamese context, national orientations toward green growth and sustainable development therefore need to be translated into coordinated university-level mechanisms rather than remain at the level of general policy commitment [7], [27].

The ANOVA results provide additional evidence that students' experiences were shaped partly by institutional contexts. Significant differences appeared in awareness, understanding, curriculum implementation, pedagogy, assessment, perceived effectiveness, influencing factors, and recommendations. However, eta-squared values ranged from 0.018 to 0.045, indicating that the practical effects were small. The post-hoc findings showed that most significant differences involved Uni D, whose scores were lower than those of one or more institutions in several areas, particularly project-based learning, experiential learning, assessment, institutional support, and external cooperation. These results should not be interpreted as evidence that Uni D had an entirely different or uniformly weaker curriculum system. The qualitative evidence helps explain these differences by linking students' experiences to lecturer capacity, leadership support, disciplinary traditions, the visibility of sustainability themes, and access to experiential and partnership-based learning opportunities. Institutional variation should therefore be understood as meaningful

but modest rather than as evidence of completely different curriculum systems. This finding extends earlier research suggesting that lecturers' and students' responses to interdisciplinary sustainability education vary according to disciplinary background and curriculum experience [33]. The present study indicates that such variation is also organizational: similar policy aspirations can produce different student experiences depending on how institutions translate them into learning opportunities and support mechanisms. For Vietnamese higher education, these findings support a context-sensitive implementation strategy. Universities may benefit from shared national and institutional expectations for sustainability competencies, while allowing programs to adapt implementation to disciplinary orientation, staff capacity, institutional mission, and available partnerships. Such an approach would balance coherence with local flexibility and reduce dependence on isolated lecturer initiatives [18], [20].

4.2.4. Theoretical and practical contributions

The theoretical contribution of this study lies in connecting three areas that are often examined separately: interdisciplinary education, ESD, and curriculum integration. Existing sustainability competency frameworks identify systems thinking, strategic action, collaboration, values-based judgment, self-awareness, and integrated problem solving as central outcomes of higher education [3], [4], [8]–[10]. The findings suggest that interdisciplinary sustainability curricula should be understood through the alignment of three mutually dependent dimensions: intended student competencies, curriculum enactment across formal and informal settings, and institutional enabling conditions. None of these dimensions is sufficient independently. Competency frameworks without curriculum enactment remain aspirational, while learning activities without explicit competency alignment remain fragmented. Similarly, course-level innovations without institutional support tend to depend on individual lecturers and may be difficult to sustain. The study therefore extends existing sustainability competency frameworks by identifying curriculum enactment and institutional alignment as mechanisms through which sustainability competencies become teachable, learnable, and assessable [17], [18], [23], [32]. The mixed-methods design also provides a methodological contribution. The survey established the prevalence and institutional variation of the main patterns, while the interviews explained why high awareness coexisted with moderate understanding, why sustainability was often implicit, and why numerous informal activities did not necessarily form a coherent curriculum. This integration generated interpretations that neither dataset could provide independently, particularly the concepts of curriculum-design literacy, the activity–curriculum gap, and mutually reinforcing institutional barriers, thereby illustrating the value of connecting quantitative and qualitative evidence in explanatory sequential mixed-methods research [28].

The findings suggest that universities should adopt an institution-wide but context-sensitive strategy for interdisciplinary sustainability curriculum development. At the institutional level, this strategy should include competency frameworks, curriculum guidelines, professional development, inter-faculty coordination, workload recognition, resources, incentives, and mechanisms for external collaboration. At the program level, sustainability competencies should be mapped to learning outcomes, course content, pedagogies, assessment, and both formal and informal learning opportunities. Such an aligned approach is consistent with research emphasizing transformative curriculum design, institutional support, and different levels of sustainability curriculum integration [18], [20], [27]. Faculties should retain flexibility in interpreting sustainability through their disciplinary and professional contexts. Engineering and technology programs may emphasize systems, environmental impacts, and responsible innovation, while social sciences, law, economics, and management may focus more strongly on governance, inequality, ethics, behavior, and organizational responsibility. A common framework should therefore promote coherence without reducing sustainability to a uniform list of topics. This discipline-sensitive approach is consistent with evidence that sustainability integration may take different forms across institutional and disciplinary contexts [15], [20]. External partners can provide authentic problems, professional perspectives, community settings, and opportunities for assessing students' interdisciplinary action. However, such partnerships should be integrated into curriculum design rather than treated as occasional extracurricular activities. This implication is supported by research on interdisciplinary service learning, experiential learning, and community-oriented sustainability pedagogy [11], [12], [16]. Overall, the next stage of reform is to move from partial and implicit integration toward a coherent curriculum system in which sustainability competencies, interdisciplinary learning, formal and informal curricula, and institutional support are deliberately connected [18], [27], [32].

5. CONCLUSION

This study examined how interdisciplinarity and ESD are understood and integrated into undergraduate curricula at four higher education institutions in Ho Chi Minh City, Vietnam. The findings show that lecturers and students highly valued interdisciplinary sustainability education, particularly for

developing holistic competencies, critical thinking, collaboration, social responsibility, adaptability, and the capacity to address complex societal challenges. However, this positive awareness was not matched by equally strong understanding or systematic curriculum integration. Sustainability and interdisciplinarity were present in learning outcomes, course content, teaching activities, extracurricular programs, and student projects, but their integration remained uneven, often implicit, and insufficiently connected to assessment, reflection, and institutional support. The ANOVA results further showed statistically significant but small institutional differences, indicating that disciplinary and organizational contexts influenced students' experiences without accounting for a large proportion of the overall variation. The integrated quantitative and qualitative findings therefore suggest that the central challenge is not a lack of support for interdisciplinary sustainability education, but limited curriculum-design literacy, weak alignment between formal and informal learning, and insufficient institutional coordination.

The study has both theoretical and practical implications. Theoretically, it conceptualizes interdisciplinary sustainability curricula as an alignment among intended student competencies, curriculum enactment across formal and informal settings, and institutional enabling conditions. Practically, universities should establish clearer competency frameworks and curriculum guidelines, develop explicit sustainability-related learning outcomes and assessment criteria, strengthen lecturer professional development, align extracurricular activities with formal learning, and provide resources, incentives, inter-faculty coordination, and external partnerships. These measures should be implemented as a coordinated but context-sensitive institutional strategy rather than as isolated initiatives.

Several limitations should be acknowledged. The study involved four institutions in one city and used convenience and voluntary sampling, limiting generalizability. Its cross-sectional, self-reported data reflect perceptions rather than direct evidence from curriculum documents, classroom practices, or demonstrated competencies. Although EFA supported the questionnaire structure, no separate pilot study or confirmatory factor analysis (CFA) with an independent sample was conducted, and the lecturer sample was relatively small for some domains. Future research should include diverse institutions, validate the instrument through CFA, and use longitudinal designs, curriculum-document analysis, classroom observations, and evaluations of curriculum, lecturer-development, and community-partnership interventions.

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C : **C**onceptualization
M : **M**ethodology
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Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors state there is no conflict of interest.

INFORMED CONSENT

Informed consent was obtained from all participants before data collection.

ETHICAL APPROVAL

The study was approved by the Ethics Review Board of the University of Social Sciences and Humanities, Vietnam National University Ho Chi Minh City, on April 29, 2025 (ERB application no. 09-2025).

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author, [TDTM], upon reasonable request.

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