

Interdisciplinary Pedagogies for Sustainable Education in Bangladeshi Universities: Bridging Theory and Practice

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Abstract

The growing intricacy of global sustainability issues like climate change, environmental degradation, and socio-economic inequality calls for a shift in higher education from traditional disciplinary silos to interdisciplinary rather than merely multidisciplinary. This study investigates the contributions of interdisciplinary pedagogies to the promotion of Education for Sustainable Development (ESD) in Bangladeshi universities. Based on systems thinking, transformative learning theory, and sustainability competency frameworks, integrated teaching fosters holistic problem-solving skills among students. According to the research, effective pedagogical approaches to integrate environmental, social, and economic dimensions of sustainability include problem-based learning, experiential learning, place-based education, and team-teaching. Implementing active learning faces lots of obstacles. In many developing countries, this is due to institutional restrictions, like stiff departmental boundaries. Further obstacles include inadequate faculty training and limited incentives, as well as assessment systems that emphasize knowledge in a discipline. The framework also outlines recommendations for curriculum revision, faculty development, and policy support that institutions may employ to enhance the sustainability of universities. Accordingly, it is concluded that graduates should address

sustainability challenges and assist in the fulfilment of national and global development goals.

Keywords:

Interdisciplinary Pedagogy, Education for Sustainable Development, Systems Thinking, Transformative Learning, Sustainability Competencies, Higher Education, Bangladesh

1. Introduction

The early 21st century is defined by complex, interconnected global challenges that fundamentally threaten human well-being and planetary stability. Issues such as climate change, biodiversity loss, pervasive inequality, and resource scarcity demonstrate that traditional, siloed disciplinary approaches are insufficient for generating effective solutions. Addressing these challenges requires a paradigm shift in how knowledge is produced, disseminated, and applied—particularly within Higher Education Institutions (HEIs).

Recognizing this imperative, organizations like the United Nations Educational, Scientific and Cultural Organization (UNESCO) have strongly advocated for Education for Sustainable Development (ESD) [Leicht et al., 2018]. ESD aims to Teach students the knowledge, skills, values, and attitudes to address the environmental, social, and economic interconnections of sustainability. Higher education institutions are required to go beyond technical training by fostering critical thinking,

systems thinking and a commitment to action [Tejedor et al., 2022].

Considering the cognizance of Bangladesh to the climate impacts and rapid socio-economic change, the need for strong sustainable education is dire. Bangladeshi institutions should develop not only professionals but also citizens equipped to handle global sustainability crises and their local impacts. Therefore, they must prioritize institutionalization of sustainability principles at the university level [Shamsuddoha et al., 2012; Naomee, 2024].

Despite the global ESD call and the national criticality, many universities, including in Bangladesh, continue to teach sustainability subjects in a siloed disciplined fashion [Sánchez-Carracedo et al., 2021; Shamsuddoha et al., 2012]. This means issues related to the environment are only related to the department of environmental science. Issues in society are only related to sociology. Economic issues are only related to economics and so on. Such divide does not reflect the interdisciplinary nature of sustainability challenges. We see students often struggle to synthesize fields of knowledge and come up with holistic solutions.

Interdisciplinary Pedagogies are pedagogies which intentionally combine content and methods from two or more academic disciplines to tackle a common complex problem. As per Wals (2013) and Dlouhá et al. (2017), pedagogies such as problem-based learning (PBL), collaborative research projects and transdisciplinary engagement are theoretically well-suited for enabling systems-thinking and collaborative competencies that sustainability requires.

Nevertheless, while mainstream discourse recognizes the significance of interdisciplinary pedagogies, their frequent, consistent, and effective usage within the existing structures of Bangladeshi universities remains a gap. Barriers encompass the

strict structures of various disciplines, insufficient training in interdisciplinary teaching for the faculty and assessment system that favour depth in their discipline rather than breadth [Rasli et al., 2024; Uddin, 2023].

Importance.

This article is important for different players of higher education in Bangladesh and possibly in other developing countries having the same problems. Its value lies in providing action-oriented insights to address the long-standing discrepancy between the commitment to Education for Sustainable Development (ESD) and its practical, effective realization through interdisciplinary pedagogies [Naomee, 2024].

Education and Faculty.

In order to facilitate quality teaching, the study will provide faculty with reusable models (e.g., problem-based learning, transdisciplinarity, field-based, etc.) that effectively incorporate sustainability. It allows them to go from conceptual knowledge to practical use in classrooms.

The new curriculum will give insight into how teaching roles need to change wherein the teacher moves towards being less the expert on content and more the facilitator for complex and interconnected learning. This will build the teacher's capacity for inter-disciplinary teaching [Wals, 2013].

For those involved in curriculum design and planning.

We will explore how the findings will help in restructuring current curricula to add modules, courses, and programs on different interdisciplinary subjects on sustainability challenges on Bangladesh (like the climate resilient, disaster management, renewable energy use etc).

The aim of the article is to provide designers with an understanding of how to select and justify approaches in their design based on the

resources available in their institution, as well as on the pedagogical implementations and national goals [Naomee, 2024]. The article will engage with some current literature and the constraints of a local context. Mapping their design to any contemporary theory of learning will give designers options for realising their design.

For Organizational Heads and Lawmakers.

The findings of the study will be an evidence base for the senior management of universities and HEI policymakers to understand what institutional and administrative reforms will be needed to advance interdisciplinary teaching. This may include changing faculty promotion criteria, creating inter-departmental collaboration mechanisms and allocating resources [UGC,2020].

By encouraging effective sustainable education, the paper is expected to help Bangladesh universities enhance their relevance status with the national development priorities, and global commitments, like the SDGs, which is expected to help the universities improve their national and international rankings. (UGC, 2020; Rasli et al., 2024).

The sustainable development agenda

The article contributes to producing a new generation of graduates who, through interdisciplinary methods, will develop systems thinking and collaborative skills thereby helping them to not only understand sustainability issues but also design and implement holistic solutions in their future professional life. This will help improve Bangladesh's climate-resilient and sustainable path [Dlouhá et al., 2017].

Theoretical Foundations: Interdisciplinary Pedagogies and Sustainable Education

The article is based on three relevant theories including Systems Thinking, Transformative learning theory, and sustainability competency framework tools to analyse

interdisciplinary pedagogies for sustainable development education in the universities of Bangladesh.

1. What Is It and Scope

Interdisciplinarity

Interdisciplinarity is the academic mode of research, teaching, or practice that intentionally brings together, across disciplines, information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines to bear on a common problem [Klein, 1990].¹ In higher education. Interdisciplinary Pedagogy is understood as teaching and learning strategies that require students to connect, synthesize, and apply knowledge from different fields for a common goal; a major aim is to move beyond simple juxtaposition (multidisciplinary) towards genuine integration of disciplines [Pohl & Hadorn, 2008].²

Education Attainable/ Education for Sustainable Development (ESD).

Sustainability Education (SE; better known as Education for Sustainable Development (ESD) from UNESCO) is a process with a goal. It enables the learner to develop knowledge, skills, values, and attitudes to contribute to a sustainable future.³ It is not a subject, but rather a principle that is integrated into the curriculum of subjects. This on the interconnected environmental, social, and economic aspects of sustainability [UNESCO, 2017].

2. Theoretical Frameworks Relevant.

A. Systems Thinking/Complexity Theory.

Sustainability challenges are complex and systemic in nature.⁴ That is, they are not caused by one factor, but rather arise from non-linear interactions in human-environment systems [Meadows, 2008].

Systems thinking is essential because it helps to understand the relationship between various components rather than a component in isolation. For example, a change in the economic domain

affects the environment and society as well and, thus, we need the systems thinking framework to make sense of this. Interdisciplinary pedagogy plays a crucial role, as it necessitates that students examine challenges according to feedback loops, leverage points, and boundary-spanning concepts that are essential in systems thinking.



B. Theory of Transformative Learning

The Transformative Learning Theory (TLT) was developed by Jack Mezirow. TLT refers to the process of becoming aware of and critically assessing one's basic assumptions, beliefs, and expectations (frames of reference or meaning perspectives), resulting in a more inclusive, differentiating, and permeable perspective [Mezirow, 1997].

When it comes to sustainability, it is important to recognize that tackling the world's big issues requires more than just information. It requires change – in the way we view the world (e.g., move consumerist to conservationist worldview), and our values and behaviour. Determining what is relevant for sustainability is crucial in this process. Interdisciplinary methods of teaching and learning enable this shift by presenting students with radically contrasting disciplinary perspectives (e.g., a humanist critique of a solution that is purely technological). This in turn provokes discourse and

critical reflection which is essential in transformative learning [Sterling, 2011].

C. Competency Frameworks of Sustainability.

Present-day education for sustainable development (ESD) frameworks articulate learning outcomes in terms of sustainability competencies an integrated package of knowledge, skills, and attitudes necessary for addressing sustainability problems [Wiek et al, 2011]. These usually comprise analyzing complex systems in a versatile manner. A competency that foresees future scenarios, skill in assessing trade-offs, and ethics. Capacity to intervene in an organized way: Working With Other Team Members

Relevance means that all the competencies work with one another. For instance, the strategic competency of designing an intervention requires one to integrate economic-, engineering- and social perspective which can only be effectively nurtured through collaborative, interdisciplinary project work [Wiek et al., 2011].

3. Connection between interdisciplinarity and education for sustainability.

Sustainability problems consists of various disciplines: knowledge and belief. No one discipline will explain or resolve the combined crisis of poverty, pollution, and climate vulnerability.

To engage in successful SE teachers' pedagogy should facilitate movement beyond disciplinary boundaries.¹⁰ Interdisciplinary pedagogy provides the tools and frameworks (e.g., team teaching, integrated curricula) to move students beyond discipline silos, allowing them to.

Combine different kinds of knowing.

Delve into the demarcation of ideas and social use (transdisciplinary).

Develop comprehensive problem-solving skills for handling complexity and implementing change.

4. Model the idea

This study will take an Analytical Lens focused on the Theory Practice and Enablers/Barriers to structure the content analysis.

Conceptual Model: Interdisciplinary Pedagogy for Sustainable Education

Component	Description
Input (Theory)	Interdisciplinary Pedagogies (e.g., PBL, Fieldwork, Collaborative Research)
Process (Practice)	Implementation in Bangladeshi HEIs: <ul style="list-style-type: none">Enablers: Institutional support, Faculty training, Curriculum flexibility.Barriers: Departmental silos, Assessment rigidity, Resource constraints.
Output (Outcomes)	Achievement of Sustainability Competencies: <ul style="list-style-type: none">Systems ThinkingTransformative LearningStrategic Action

This framework enables a structured assessment commencing with the rationale for an interdisciplinary approach, followed by an exploration of real-world obstacles in Bangladeshi universities, and concluding with an evaluation of its success in producing graduates who are capable of aiding national sustainable development goals.

Main Learning Strategies in Transdisciplinary Sustainability Education.

Effective implementation of Sustainable Education (SE) and Education for Sustainable Development (ESD) necessitates a shift away from traditional, lecture-based delivery to certain pedagogical approaches that are inter-disciplinary and learner-centered. These methods are imperative to developing necessary graduates' complex sustainability competences in Bangladeshi universities.

1. Engaged and Cohesive Learning Strategies

Strategies of this nature encourage students to work on difficult issues from the real world.

Problem-Based Learning (PBL) and Project Based Learning (PjBL): These are the core interdisciplinary strategies in which students collaborate to research and propose solutions to ill-defined complex sustainability challenges (e.g., urban water management; coastal erosion). In the context of interdisciplinary activity, a PBL (project-based learning) course could require students from the field of Engineering, Economics and Sociology to work together on a project to design a resilient low-cost housing system, which is technically feasible, financially viable, and socially acceptable. This is an approach used widely at Aalborg University [Aalborg University Journals].

Experiential and place-based learning: Learning occurs within the local context of sustainability in Bangladesh.

Place-Based Learning utilizes local environment, society, and culture, e.g., the flood plain of Bagura as a teaching resource.

Community-engaged learning encompasses students collaborating on real-world projects with local non-governmental organizations (NGOs), government departments or community groups; for example, the design of localized early warning systems or the assessment of microfinance strategies for climate-resilient development. It establishes a direct connection between the theory and its application in addition to the ethics behind it.

2. Merger of Institute and Curriculum

Thoughtful structural supports need to be put in place to break down silos.

Collaboration between professors from varying disciplines (e. g., Anthropology, Environmental Science) to develop and teach alike. Students are exposed to multiple disciplinary perspectives simultaneously to model the kinds of intellectual collaboration needed to get this done. The integration of curriculum, in which courses or modules are designed together to focus on a

common complex theme and not mere cross-listings of existing departmental courses, is required.

Making Sustainability Competencies a Building Block: Sustainability is not to be treated as an “add-on” course but as a cross-cutting theme in the existing core and elective subjects in the curriculum [Wiek et al., 2011]. To illustrate, a course in engineering design could include the normative competency (ethical assessment) while a course in economic policy could include systems thinking [Frontiers].

5. Methods and Evaluation for Change.

The methods of delivery and the evaluation of deep learning and perspective shifts are the focus of these strategies.

Utilization of Digital/Hybrid Modes: It enhances flexibility and collaboration in the post-COVID setting. Using digital tools, students can model complex environmental systems, take virtual field trips to far-off ecosystems or work on team projects with students at other universities. Hybrid models allow for the combination of online delivery of content with community delivery and engagement (SpringerOpen).

Assessment and Reflection: Testing facts isn't enough– assessments need to allow critical, interdisciplinary thinking. This assesses students' capacity to connect concepts from different fields, justify ethical choices, and reflect on their learning journey.

The main assessment methods are Critical reflection journals recording changes in self-agency (whether students believe they can act sustainably) and value orientation (changes in ethical perspective).

Integrated solutions within scenario analysis exercises.

To this end, Bangladeshi universities must produce graduates who possess some understanding

and versatility in knowledge and skills for a sustainable future.

Implementation in Higher Education Contexts: From Theory to Practice

To turn the theoretical promise of interdisciplinary pedagogies into a practical, sustained reality in Bangladeshi universities, significant structural, cultural, and pedagogical shifts will be necessary. The world experience provides critical lessons on the institutional enablers and barriers determining the success of interdisciplinary sustainability education.

1. Elements and Conditions of the Organization.

Interdisciplinary sustainability education will not be successful unless there is a strategic, top-down support which allows collaboration outside of traditional fields.

Sustainability leadership should come from high-level university leadership and not just be something added on, but rather a core one. This involves incorporating it into the strategic planning and encumbering resources. Movements for systemic change that work as a resoundant of community strength, so a commitment to depth learning is needed by a higher institution to insure the process.

To enable collaboration, universities should have formal, structural mechanisms (like research institutes) capable of reaching decisions (like committees). Foster trust and communication between departments, and UCL Press Journals.

Faculty Development and Incentives: Faculty Will Become Transformation Agents To co-teach effectively, experts in co-teaching must facilitate and design integrated curricula need be trained.

It is important that policies around promotion and tenure are modified to specifically acknowledge and reward teaching in interdisciplinary areas and collaboration research

contributions to counter the likely “transaction costs” for faculty [Rasli et al., 2024; Zhang, 2017].

2. Curriculum Formulation and Program Frameworks

Curriculum designers or developers ought to deliberately engineer interdisciplinarity into the curriculum.

One common successful way is to offer a dedicated interdisciplinary programme (e.g., Master’s in Climate Resilience), or specialized modules (e.g., Sustainable Urban Planning) that is team-taught by faculty from various disciplines (e.g., Engineering, Public Policy, Geography).

To broaden impacts, sustainability concepts should be integrated across existing disciplinary courses (e.g., life cycle assessment in an Engineering course or social equity in a business course). There must be a harmonisation of learning outcomes for specific sustainability competences [Wiek et al.2011].

3. Evidence from the Case: World Wide Studies.

Global higher education institutions have created interdisciplinary sustainability pedagogy successfully providing models that can be transferred.

Students work in groups to solve complex, real-world problems in Aalborg University's Problem-Based Learning (PBL) model. This framework automatically ties in knowledge from different fields (Engineering, Humanities, etc.) to generate solutions in alignment to the SDGs [HEInnovate].

The model of “Living Labs” is adopted by universities in different countries including the UK and USA, where the campus and local community of universities used as a “Living Lab”. As a part of this model, students, faculty, and staff from different disciplines work together to solve on-campus operational sustainability issues, such as, designing waste management system or calculating carbon

footprint etc., through practical implementation of their university learning, thus sustaining campus life without harming the environment.

Source: Emerald Publishing

In US Universities, some institutions like the University of Nebraska-Lincoln deployed systemic curricular reform, designed to move away from the ‘bolt-on’ to ‘built-in’ approach. This was done through whole-programme cross-department programmes to emphasizes systems thinking, and linking humans and ecology explicitly [1].

4. Obstacles Encountered in the Implementation Process

Despite its obvious benefits, interdisciplinary pedagogy is facing fierce resistance that universities in Bangladesh must prevent.

Barrier Category	Specific Challenge	Implication for Bangladesh i HEIs
Structural	Disciplinary Silos: Rigid departmental structures and administrative divisions (funding, scheduling) prevent cross-collaboration [Rebus Press; Taylor & Francis].	Makes cross-listing courses, co-hiring, and shared resource allocation extremely difficult.
Cultural/ Faculty	Faculty Resistance and Attitudinal Barriers: Lack of experience, specialized training, and a perceived devaluation of interdisciplinary work in promotion/tenure [UBC Blogs; Zhang, 2017].	Faculty may prefer to stay in their "safety" of mono-disciplinarity, viewing integrated work as unrewarded extra labour.
Cognitive/ Logistical	Communication and Definitional Ambiguities: Different disciplinary jargon, epistemologies, and values create communication barriers and make reaching consensus	Team-teaching can fail if instructors from different fields cannot agree on core concepts or

Barrier Category	Specific Challenge	Implication for Bangladesh i HEIs
	challenging [UBC Blogs; Design Research Society].	shared learning outcomes.
Resource	Resource Constraints: Lack of dedicated interdisciplinary funding, shared knowledge resources (textbooks, materials), and time for negotiating co-taught courses [Atlantis Press; Rebus Press].	Compound ed by budget realities in many public and private Bangladeshi universities.

6. Factors that facilitate success.

Surmounting these obstacles relies on strategic factors.

Aligning Teaching with Institutional Mission. Making sure interdisciplinary education is explicitly connected to the university’s mission, such as Bangladesh’s climate resilience plans.

Iterative Design refers to implementing interdisciplinary programs gradually, with continuous feedback loops, evaluation, and refinement instead of imposing a huge one-off change.

To ensure high student motivation and engagement key predictors of success [NWCommons] design projects centred around real-world, local sustainability issues.

A thoughtful balance in the creation of Communities of Practice is needed so that a formal, yet flexible CoP can hold space for teachers to exchange and develop ideas in a safe environment for interdisciplinary teaching [Menon & Suresh, 2022].

7. Lessons for Organizations.

Shifting to interdisciplinary sustainability pedagogy requires careful and comprehensive reform.

Change must be authorized from the top down but driven by enthusiastic faculty from the bottom up.

Students who have developed competencies such as systems thinking or collaborating skills should be able to offer and analyze relevant arguments. Besides that, they should find and use information effectively.

Make hires to help link disciplines and cross cultures. These boundary spanners can make a big difference.

Implement the Living Lab model: Use the university and its community as a site for experiential, problem-based, learning to make theory practice-driven.

Debate.

This paper attempts to analyze how interdisciplinary pedagogies are being used for education for sustainable development (ESD) and maps the theoretical foundations identified with documented practices particularly in the Bangladeshi university context. The synthesis of findings, the implications for HEI and ESD, and the limitations and future research of the study are discussed.

1. This synthesizes theory and practice.

Added Value and Alignment.

The practice evidence supports the core theoretical foundations strongly.

Rephrased:

The active learning pedagogies, especially problem-based learning (pbl) and experiential learning, are acknowledged as instrumental in promoting systems thinking (wals, 2013). When students work together from different disciplines to solve a real-world problem (waste management on campus), they inevitably map complex causal

relations and feedback loops, rather than analyse these linearly from their disciplines' perspective (Wiek et al., 2011).

The learning theory that encourages shifts in frames of reference to effect change in worldview is transformative learning theory (TLT). As Mezirow indicates, TLT is best triggered through practical, place-based, and community-engaged learning. In Bangladesh, direct connection with local communities and ecosystems forces students to examine their beliefs and values, which is the basic trigger for perspective transformation. (Sterling, 2011)

Competency Frameworks Integrated Assessment team-teaching and integrated project-based assessment contribute directly to the holistic development of sustainability competencies (Wiek et al., 2011). Evaluating group projects, utilizing critical reflection journals, and analyzing scenarios stimulate strategic competency demonstrates and interpersonal competency. This cannot be demonstrated in a traditional exam.

Theory Versus Practice Gap

Important gaps exist, particularly connecting to the Bangladeshi context.

Theorists' relatedness necessitates structural (UGC, 2020) collaboration to ensure interrelated practice. However, practices are often bounded by structural barriers imposed by their own disciplines (Rasli et al., 2024). It was noted that faculty do not have time or incentives to work across departments on curricular matters. As a result, their efforts tend to be reduced to simply cross-listing courses rather than true integration (Zhang, 2017).

With respect to the need to assess competencies, the continued use of assessments underlying knowledge recall by many HEIs, which favours depth over breadth of disciplinary knowledge, seems to actively subvert the very pedagogy the interdisciplinary courses rest on.

Many teachers are not trained to facilitate interdisciplinary learning and to use transformative pedagogies (Naomee, 2024).

8. Repercussions for Universities in Bangladesh.

The findings indicate several core implications for HEI reformation in Bangladesh.

Introduce modules covering specific national sustainability issues including but not limited to delta management and energy poverty. These modules need to be co-developed and co-taught and linked with the local environment ("Living Lab").

College professors and, more broadly, administrators in the academy are currently witnessing developments of a different kind. Essential faculty development programs on problem-based learning, systems thinking, and team-teaching must be mandatory.

An endorsement and resourcing of community-engaged learning and PjBL pedagogies across all relevant departments as a means of developing systems thinking.

Revise assessment systems to emphasize competency (skills and knowledge) rather than content recall (facts). This could include reflection portfolios, integrated project defense, and ethical case studies as examples.

Create platforms for sharing resources and managing curriculum design; Foster flexibility and collaborative academic culture between departments and institutions.

9. Impacts on Teaching for Sustainability.

Interdisciplinary pedagogy contributes unique value to the overall effectiveness of ESD.

Integrated Thinking and Systems Awareness: Students' grappling with a singular problem through multiple lenses helps make sense

of the world around them. The world is not a cold disjointed piece but an integrated system. This is something critical for the sustainable impact of design solutions (Wals 2013).

Enhanced Agency and Self-Efficacy: Involvement in real-world, local projects (experiential learning) helps students realize how their knowledge can lead to real-world change. This creates an essential feeling of self-agency – the belief they can play a part in a sustainable future (Sterling, 2011).

Students work together in interdisciplinary teams. Involvement in teamwork is now a key component of any lineup work. Teamwork is essential. Teammates face professionally just like it is always the case with stakeholders in the job market. Therefore, it trains students in interpersonal skills (Wiek et al. 2011).

10. Constraints and Analytical Thoughts.

Collaborating among different disciplines is important but risky.

A major warning is the risk of sacrificing disciplinary rigour for an ill-conceived breadth. A good synthesis of disciplinary concepts from the various fields is possible after a student masters the core concept in each discipline.

One major limitation is the difficulty of measuring whether something counts as an outcome, such as a prospective transformation or ethical development, and whether these outcomes can validly continue over time (Wiek et al., 2011). Many HEIs have current assessment methods that are insufficient for this.

"Interdisciplinarity" is not defined uniformly by various actors/strategists (contrast with multi- or trans-disciplinarity). This definitional ambiguity can create confusion in curricula implementation (Pohl & Hadorn, 2008)

11. Future Directions

To enhance the relationship between interdisciplinary theory and sustainable education practice in Bangladesh, more research is needed.

Longitudinal Impact Studies: Carry out longitudinal studies designed to track the employment outcomes, systems awareness, and sustainability action in professional life of graduates from interdisciplinary versus traditional programmes.

Conduct large-scale comparative analyses between public and private and/or regional and metropolitan universities in Bangladesh to identify location-specific barriers and successful enablers.

Research on Assessment Validity: In order to develop and validate valid assessment tools to measure interdisciplinary outcomes and transformative learning in the specific socio-cultural context of Bangladesh, focused research is needed.

Research that examines the effect of a specific policy (e.g., designated pool of interdisciplinary funding, requirement for co-teaching release time) on faculty engagement and the quality of instructional output.

Suggestions: Approaches to Connect Theory and Practice.

The subsequent set of recommendations will be provided for relevant stakeholders based on theoretical analysis and identification of barriers acting as hindrances to the implementation of interdisciplinary pedagogies for sustainable education in Bangladeshi universities.

1. For Teachers: Developing Cross-Disciplinary Sustainability Modules.

The shift must be made from content delivery to facilitated learning experience.

Start with real, local projects: Develop modules that start with a real, complex, local sustainability problem of Bangladesh (countrywide/region-wise eg arsenic in groundwater, climate-change-induced migration of

particular region). This acts as the central anchor for the entire module, asking students to draw upon knowledge from multiple disciplines (Wals, 2013).

One way to improve multidisciplinary of a group is to create groups in such a way that students come from different disciplines like engineering, social science, business etc. The final project should require the integration of these various outlooks for a feasible solution.

Integrating a structured activity like reflection journals or a weekly discussion forum will prompt students to think critically how participating in other disciplines challenges and transforms their own disciplinary assumptions (Mezirow, 1997). The aim of Transformative Learning is reinforced.

As far as it is feasible, the instructors should design and deliver the module together. This way they can demonstrate to the students how professionals within a discipline talk, argue with each other, and bring together their findings to norm professional sustainability practice.

2. Structural and policy recommendations for institutions

University leadership is key to breaking down silos and creating a conducive environment for interdisciplinary work.

Revise policies of promotion and tenure (UGC, 2020) to reward team-teaching and co-authored interdisciplinary publications, involvement in cross-department curriculum development, and community engagement projects, to incentivise interdisciplinarity in faculty evaluation. This tackles the problem of faculty resistance and absence of incentive (Zhang, 2017).

Encourage Cross-departmental Collaboration: Set up funded interdisciplinary Hubs or Centres for sustainability. These centers should be granted sufficient budget and administrative authority to manage inter-departmental student

projects, share resources, and co-hire/assign faculty across traditional departmental lines.

Faculty Development programs, which are essential for specialised interdisciplinary skills, such as facilitation of PBL, systems modelling, curriculum integration methods, and measuring non-cognitive, self-agency outcomes must be made mandatory as PD (Naomee, 2024).

Implementing a Living Lab Policy: The university campus and its immediate community shall both be designated as a Living Laboratory for the implementation of sustainability projects and the relevant operational data on campus (energy use, water, waste, etc.) shall be made accessible to the students and faculty for their problem-based learning and research (Shamsuddoha et al., 2012).

3. For Curriculum Developers: Alignment & Integration.

The fragmentation pattern in curriculum planning should make way for a holistic competency pattern.

Incorporate Sustainability Competencies Systematically: To achieve a more effective integration of sustainability into curricula, all universities should make use of internationally accepted frameworks (for example, Wiek et al., 2011) to map where each of the key sustainability competencies (transformative competencies, systems competence and strategic competence) will be taught across the general education curricula and assessed across the general education and professional education curricula. Sustainability should not be treated as an add-on course.

The curriculum of all degree programs in the early years of students should have new integrated core modules. For example, core modules like the “Grand Challenges of Bangladesh” to facilitate students’ understand of complexity and interlinked nature of sustainability through multidisciplinary materials.

The institutional guidelines should state that interdisciplinary courses must adopt a competency-based assessment mechanism for integrated learning outcomes, and that further reduction of conventional exam system would be essential. Developing a standard may be useful. Competency-based assessment mechanism can include portfolio review, project defence, peer review, critical reflection, etc.

4. Future Empirical Work for Researchers

There is a need for strong empirical research on the Bangladeshi context for effective implementation and evaluation of these strategies.

Longitudinal Impact Studies: Longitudinal studies to study the long-term effect of inter and mono-disciplinarity on graduates' professional success, problem-solving ability, and contribution to sustainability in their careers.

We aim to develop and validate instruments that will reliably assess systems thinking and perspective transformation (TLT outcomes) in Bangladeshi students, in accordance with the assessment practices of HEIs (Sterling, 2011).

Conduct empirical cross-institutional studies comparing the success rates of different implementation models, e.g., dedicated interdisciplinary departments vs. integrated core modules, to manage logistical barriers and grow faculty buy-in across different types of Bangladeshi universities (public vs. private).

12. Conclusion

This article has systematically examined the theoretical necessity and practical impediments of implementing interdisciplinary pedagogies for Sustainable Education (ESD) at Bangladeshi universities which could help to overcome the enduring gap between theory and practice.

An analysis of interdisciplinary pedagogies that include, among others, Problem-Based

Learning (PBL) and Experiential Learning show that such pedagogies have the suited theoretical foundation that is required for sustainability education. Education standards support a range of pedagogies encompassing experiential learning and field studies that provide holistic meaningful learning. These pedagogies uniquely foster systems thinking and facilitate transformative learning by challenging worldviews. They are the necessary mechanism for building and assessing crucial sustainability competencies. If they do not integrate all three domains of knowledge environmental, social, and economic graduates will be equipped with fragmented knowledge that will leave them unprepared to handle the complex, interrelated sustainability problems in Bangladesh.

However, these results show that while there is a strong theoretical potential here, the conversion of this interdisciplinary intent into practice is a tricky one. The effectiveness of the implementation is being hampered by serious obstacles such as: Fixed disciplinary silos and rigid administrative systems (Quazi Uddin, 2023), Lack of training and incentive of faculties to work across programmes (Zhang, 2017), Assessment systems not able to evaluate the holistic transformational outcomes of ESD (Wiek et al., 2011)

In essence, interdisciplinary pedagogies show promise, but they do not happen by themselves. Moving from theory to practice means designing institutions and pedagogies carefully. Universities in Bangladesh need to go beyond just espousing the idea of interdisciplinarity to implement effective policy measures such as rewarding joint work, reforming summative assessment to focus on competence rather than content and investing in faculty development. Through this means, Bangladeshi HEIs can cement their position as pivotal agents in national

endeavours towards climate resilience and sustainable developments.

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