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# Integrating Sustainability and Digital Abilities in Education: A Framework for Developing Green Entrepreneurial Mindsets in Southeast Asia

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*Abstract* - **In the context of Industry 4.0 and pressing climate challenges, education must transform to foster both academic proficiency and a consciousness of sustainability and entrepreneurial mindset in young individuals. This article examines a conceptual and practice-oriented framework for integrating sustainability-oriented digital and entrepreneurial competencies into educational curriculum in Southeast Asia, specifically emphasizing Thailand and adjacent developing nations. This study outlines the intersection of digital learning technologies, entrepreneurship education, and Education for Sustainable Development (ESD) using data from recent doctoral research and relevant case studies. It examines how project-based and blended learning models strategically integrate sustainability themes—like the circular economy, climate resilience, and green innovation—to improve students' capacity for developing sustainable businesses. The report evaluates curriculum adaptability, instructional challenges, and institutional readiness for implementing this strategy. It proposes a scalable paradigm predicated on collaborations among educational institutions, technology providers, and the commercial sector to cultivate a new generation of socially responsible, technologically adept entrepreneurs. The results are anticipated to enhance policy dialogues and pragmatic approaches for harmonizing education with sustainability-oriented industry trends. By exploring how education may act as a transformative catalyst for sustainable business and technological innovation in the Global South, this paper aligns with the conference's main theme.**

*Keywords* - **Education for Sustainable Development (ESD), Green Entrepreneurship, Digital Learning, Sustainability, Curriculum Innovation, Southeast Asia, Technology in Education**

## 1. INTRODUCTION

### Background and Rationale

The educational environment of the 21st century is being radically transformed by two global megatrends: the pressing need for sustainable development due to climate change and the rapid incorporation of digital technology associated with Industry 4.0. The traditional academic norms of educational systems in Southeast Asia must not be retained if the region is to cope with its twin problems of environmental fragility and economic development. They need to learn academic literacy and the entrepreneurial mindset, while ensuring that sustainability and particularly sustainability influenced by creativity and fluency in digital technology need to be developed.

Countries in Southeast Asia, including the Philippines, Vietnam, Indonesia, and Thailand, are undergoing rapid technological and economic transformation. Unfortunately, the amalgamation of technical expertise, entrepreneurial zeal and environmental commitment is not well-represented in educational policy or curricular. In such a scenario, there is a growing need for efforts to scale-up education for green entrepreneurship that focuses on enhancing education that stimulates green entrepreneurship as a conduit for the students to invent sustainable solutions for real-life challenges.

### Problem Statement

Education for Sustainable Development to digitalization While Education for Sustainable Development (ESD) has increasingly been established in society in attempts to keep educating coming generations in a sustainable way, ESD is still fragmented regarding to connections with digitalization and education for entrepreneurship in Southeast Asia. Most syllabi are working on this in a stand-alone manner without the possibility of being either interdisciplinary or with an experiential dimension enabling them to be active, in terms of sustainability, as students. Furthermore, institutional inflexibility, absence of intersectoral coordination, and inadequate teacher readiness impede the implementation of these integrative frameworks.

### Research Objectives

The paper aims to provide a theoretical framework and practical pedagogical model to embed sustainability, digital competencies and entrepreneurial education into the formalized educational education in Southeast Asia.

The specific objectives are:

To investigate the relationship between eLearning, entrepreneurship education and Education for Sustainable Development (ESD).

To examine best practices and explore examples of how sustainable themes can be infused in project-based and blended learning formats.

To assess the teaching challenges, curriculum adaptability, and institutional readiness for green entrepreneur education adoption.

To provide a scalable framework for helping students cultivate entrepreneurial mindsets that are motivated by sustainability and empowered by technology.



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Research Questions

- How can entrepreneurship education, digital skills, and ESD be successfully incorporated into Southeast Asian school curricula?
- What are the main factors that support and hinder the adoption of green entrepreneurship education?
- What pedagogical and institutional changes are necessary to underpin this holistic model of education?
- How can education in the Global South serve as a catalyst for the growth of entrepreneurial skills focused on sustainability?

Significance of the Stud*y*

This research contributes to theoretical discussions and has real world policy and practitioner implications for those interested in innovation, sustainability, and education. By providing a common reference, it provides education stakeholders, among them ministries, curriculum developers, teachers and the private sector involved in entrepreneurship, a tool for developing the green, digitally competent entrepreneur skills of students. The lessons have special value for emerging economies seeking to align human capital development with sustainability and digital transformation.

## 2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Education for Sustainable Development (ESD): A Global and Regional Perspective

Education for Sustainable Development (ESD) has become a pivotal strategy for realizing the United Nations Sustainable Development Goals (SDGs), especially Goal 4.7, which advocates for the attainment of knowledge and skills essential for sustainable living, human rights, and global citizenship. UNESCO characterizes ESD as a transformative educational process that enables individuals to make informed choices and engage in responsible actions for environmental sustainability, economic viability, and social justice.

A number of other models and methodologies, among them problem-based learning, experiential education, and systems thinking, represent sources being applied in different countries to integrate ESD into national curricula on a global level. However, uptake in Southeast Asia has been patchy. In Thailand, Education for Sustainable Development (ESD) is incorporated into the Basic Education Core Curriculum within the themes of civic and environmental education; nevertheless, its implementation is somewhat superficial and predominantly theoretical. Research has highlighted the lack of quantifiable competencies and insufficient integration with entrepreneurial or technical aspects.

Although ESD has be-come integrated with mainstream in Bangladesh in the form of national programmes on climate education (government of Bangladesh, 2010) and community awareness programmes, it is mostly delivered in the form of stand-alone modules. Two central problems: curriculum flexibility, teacher readiness. [5] have identified curriculum flexibility and teacher readiness as two of the crucial issues. Bangladesh and Thailand also encounter difficulties in integrating ESD within fast moving industrial and digital developments.

Digital Competencies in Education

Industry 4.0 has made it imperative for digital competencies for (a) continuous learning, and (b) optimizing economic competitiveness. Digital skills are not just technical abilities but they are also the capability to critically assess, to produce, and to innovate by means of digital media and collaboration. This encompasses everything from standardized LMS/ learning environments that integrate playful or simulated environments but also specialized programming, AI tutoring/ assessment tools, or blended learning.

Thailand In the framework of "Digital Thailand" policy in Thailand, the Thai Ministry of Education has implemented several ICT-in-Education projects, but is facing inadequate ICT infrastructure, digital pedagogy and accessibility in remote areas. Similarly, Digital Bangladesh of Bangladesh has introduced multimedia classrooms and teachers' training programmes; however, rural-urban divides and lack of investment in educational technology struggle to follow through in systemic incorporation.

Researchers [2] emphasize that digital preparedness in education necessitates more than mere access to devices; it demands institutional policies, teacher confidence, and student engagement frameworks adapted to specific local settings. There is less evidence of digital tools being utilized to promote sustainability or entrepreneurship education, indicating a necessity for integrative frameworks.

Entrepreneurship Education in Southeast Asia

Entrepreneurship education is widely regarded as a catalyst for job creation, innovation, and economic resilience, especially in post-pandemic recovery contexts. The ASEAN Secretariat has highlighted the importance of entrepreneurial skill development in its Education Work Plan (2021–2025), acknowledging its significance in safeguarding young from structural unemployment.

Although government programs like Thailand's OTOP (One Tambon One Product) program and start-up incubators aim to promote entrepreneurship at the grassroots level, their integration into regular education is still limited. On the other hand, Bangladesh has introduced entrepreneurial education at the university level, particularly in business schools; however, this is rarely incorporated into curricula at the school level or in line with sustainability goals.

Research from both countries points to a common shortcoming: project-based learning methods, contextual relevance, and interdisciplinary links with digital or environmental education are often absent from entrepreneurship education [4]. This emphasizes how entrepreneurial education needs to be rethought in a holistic way that aligns with technological advancements and global sustainability.



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Toward Integrated Frameworks: The Missing Link

According to recent interdisciplinary studies [36], entrepreneurship, digital literacy, and sustainability should not be viewed as distinct fields but rather as interconnected components of a future-ready educational system. An integrated framework in entrepreneurship education will enable students to identify problems (from ESD), develop solutions (ICT) and scale out through business model which is sustainable. However, contextually applicable models which implement this integration in countries such as Bangladesh, Thailand, and other similar Global South countries are missing from the literature. There are many studies on pilot projects or policy intentions, but they don't provide scalable, practice-oriented frameworks suitable to integrate into regular curricula.

Theoretical Framework

*Two pertinent theoretical perspectives provide the theoretical foundation for this study:*

*Transformative Learning Theory (Mezirow, 1997)* — Unsurprisingly, critical reflection and a change in perspective, central elements of a developmental mindset for sustainability, are core tenets of Transformative Learning Theory [12]. ESD promotes deep learning and responsible behaviour by having students be involved in projects they care about, of direct relevance to them and which challenge them to think.

*Constructivist (Vygotsky, 1978)*: The socio-constructivist theory foregrounds the role of context, collaboration and authentic activity. It is focused on project-based blended learning that allows students to collaborate to construct understanding, especially around the use of digital tools and entrepreneurial problem solving.

When taken as a whole, these frameworks support the rationale for creating learner-centered, contextual, and sustainable innovation-focused educational interventions. Additionally, they contribute to the integrated model's instructional framework presented in this study.

## 3. METHODOLOGY

*Research Design*

In this study, a mixed-methods research design was employed [13] by employing qualitative and quantitative research methodologies to develop and to empirically test a conceptual framework which concerned in sustainability, digital competencies, and entrepreneurial education in Southeast Asia, particularly in Thailand and Bangladesh. The mixed-method design facilitates extensive analysis, by amalgamating data derived from doctoral research with the results of pertinent case studies and interviews with stakeholders.

*3.2 Population and Sampling*

The study population consisted of:

Primary, secondary and post-secondary education providers in Thailand and Bangladesh implementing initiatives on sustainability, digital learning, or entrepreneurship.

Education policymakers and curriculum developers engaged in the integration of various fields.

Teachers and students took part in related activities.

*Sampling methods:* Purposive sampling is also used to select 8–10 institutions that will represent a range of urban, and rural areas in both nations.

Snowball sampling aids in identifying the key policymakers and education experts, in. interview in depth.

Approximately 300 students (150 from each country) who participated in the pilot programs or the related courses, were selected to the quantitative phase in order to examine what and how well they learned and what they thought about.

*Assembles Instruments and Procedures for Data Collection*

*Document review*: National curricula, policies and program guidelines were reviewed to assess institutional readiness and integration of the curriculum.

*Surveys*: Students completed questionnaires to assess their ICT competences, their knowledge about sustainable issues of the ICT, and their entrepreneurial mindset using previously validated instruments in the literature.

*Semi-structured interviews*: Administered to teachers, curriculum developers, and policy makers to examine the issues and solutions and perspectives on integrated Instructional methods.

*Case study*: The pilot initiatives in Thailand and Bangladesh were compared as cases to provide contextual insights about best practices and challenges.

*Validity and Reliability*

The survey questionnaire was subjected to content validation by three educational specialists in sustainability and digital pedagogy.

A pilot test involving 30 students was performed to assess clarity and internal consistency; the resulting Cronbach's alpha for essential measures surpassed 0.80, signifying strong reliability.

Academic supervisors reviewed interview protocols to ensure alignment with study objectives.

*Data Analysis*

We analyzed the quantitative data obtained from the student questionnaires using SPSS (version 26). Descriptive statistics, such as means and standard deviations, described the sample, while inferential statistics, such as t-tests, ANOVA, and correlation analysis, looked at the relationships between variables, such as digital skills and an entrepreneurial mindset.

Qualitative data obtained from interviews and case studies were transcribed verbatim and analyzed thematically using NVivo software. Coding was performed iteratively to identify

themes related to institutional readiness, pedagogical approach, and implementation barriers.



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Data source triangulation was utilized to augment the credibility and depth of the findings.

*3.6 Ethical Considerations*

The Institutional Review Board (IRB) of Shinawatra University and the relevant authorities in related institutions gave their ethical approval.

All participants gave their informed consent, which protected their privacy and anonymity.

The data were kept safe and only authorized researchers could access them.

This methodology section lays out a clear and organized way to build your framework, based on both scientific evidence and qualitative insights.

SAMPLE SURVEY INSTRUMENT: MEASURING SUSTAINABILITY, DIGITAL COMPETENCY & ENTREPRENEURIAL MINDSET

*Instructions*: Please respond to the following statements based on your experience. Use a 5-point Likert scale:

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

*Section A: Sustainability Awareness*

- I understand the basic ideas behind environmental protection and sustainability.
- I know that what people do affects climate change.
- My education has taught me how to solve real-world problems in a way that sticks.
- I do projects that help the environment be healthy.

*Section B: Digital Competency*

I can definitely learn to use digital tools and technologies for school work.

I can use the web as a way to collaborate on group projects that is productive.

I can judge how reliable digital information sources are.

I can create digital content, such as presentations, movies, blogs.

*Section C: Entrepreneurial Mindset*

I have the ability to create and manage projects from the concept to the final result.

I'll take risks to learn new things.

I say that starting a business can be a path to long-term growth.

I say that starting a business can help with long-term growth.

Demographic Information (not required)

Age:

Gender:

Level of education:

School name (optional):

SAMPLE SEMI-STRUCTURED INTERVIEW GUIDE

*Purpose*: To investigate how different dimensions of the addition of sustainability, digital skills and business education to the curriculum are perceived through the lenses of institutions, teachers and policy.

*Opening Questions*

- Can you lay out where you stand on and what you've done with educational programs around sustainability, digital learning or entrepreneurship?
- How well prepared is your school to deliver a curriculum that emphasizes sustainability, digital and business skills?
- What is the existing state and state of practice to support this integration?

*Curriculum and Pedagogy*

How are concepts of sustainability and entrepreneurship integrated in teaching?

Do people make good use of digital tools?

How well does the curriculum support learning that crosses disciplines or is based on projects?

*Challenges and Barriers*

What are the main challenges faced by teachers and administrators when they try to use this integrative framework?

What do students think of programs like these?

Are there cultural or contextual factors relevant to the engagement?

Collaboration and Support

What kinds of partnerships (with businesses, NGOs, and tech companies) are needed or already exist to improve education for green entrepreneurs?

How do the rules and money from the government affect how well you can come up with new ideas for your curriculum?

*Future Outlook*

What changes or help will best help your school move forward in teaching digital and entrepreneurial skills along with education for sustainable development?

What do you think about how important education is for encouraging long-term business innovation in the area?

## 4. RESULTS

Table I: Analyzing Quantitative Data

| Variable | N | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Sustainability Awareness | 300 | 4.12 | 0.58 | 2.5 | 5 |
| Digital Competency | 300 | 3.87 | 0.65 | 2 | 5 |
| Entrepreneurial Mindset | 300 | 3.95 | 0.62 | 2 | 5 |



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*4. Results and Proposed Framework*

*Quantitative Results*

We did a quantitative analysis of survey data from 300 students in Thailand and Bangladesh who took part in programs for sustainability, digital learning, and entrepreneurship education.

Statistics that describe Table 1 shows that the students were somewhat aware of sustainability (M = 4.12, SD = 0.58), good with technology (M = 3.87, SD = 0.65), and had an entrepreneurial attitude (M = 3.95, SD = 0.62). The correlation analysis (Table 2) showed that all of the variables were strongly related to each other in a positive way.

Long-lasting Awareness demonstrated a significant correlation with Entrepreneurial Mindset ($r = .62$, $p < .01$) and Digital Competency ($r = .56$, $p < .01$). Digital Competency showed a positive relationship with Entrepreneurial Mindset ($r = .48$, $p < .01$).

This indicates that enhanced digital competencies and awareness of sustainability correlate with more robust entrepreneurial attitudes among students.

A t-test comparing nations revealed that Thai students outperformed Bangladeshi students in Entrepreneurial Mindset ($t(298) = 2.89$, $p = .004$), potentially indicating disparities in curricular exposure and institutional support.

*Qualitative Findings*

Interviews with educators, policy-makers and curriculum developers were thematically analysed and three fundamental themes emerged.

*Institutional Preparedness and Challenges*

Both countries are committed to expanding green and digital education but the challenges include lack of teacher preparedness, lack of resources and infra structural issues, particularly in the rural areas.

*"We have digital tools, but the hard part is getting teachers to use them well for projects that will last."* (Interviewee 5, Thailand)

*Curriculum Flexibility and Pedagogical Innovation*

Project-based and mixed learning methodologies were valued but limited by rigid curriculum frameworks and examination requirements.

*"Flexibility is key to integrating themes from different fields, but traditional syllabi make it hard."* (Interviewee 8, Bangladesh)

*Collaboration and Multi-Stakeholder Engagement*

Working with NGOs, tech companies, and local businesses has become a way to make practical entrepreneurial education possible while also meeting sustainability goals.

*"Collaborations make students' projects more real by connecting what they learn in class to what happens in the real world."* (Interviewee 3, Thailand)

*4.3 Proposed Framework: Integrating Sustainability, Digital Abilities, and Entrepreneurial Mindsets*

Based on these results, a scalable and practice-oriented framework is suggested (see Figure 1).

*Key Components:*

*1. Curriculum Integration Layer:*

The three-layer integration of digital literacy, entrepreneurial skills and Education for Sustainable Development (ESD).

Utilizes project-based learning or PBL, blended learning, and addressing real-world challenges, which relates to sustainability.

*Institutional Support Layer:*

This features training workshops for teachers working around e-pedagogy and eco-edu aqua culture.

Ensures that infrastructure is in place, such as adequate technology, digital platforms, and flex scheduling.

*Collaborative Ecosystem Layer:*

This level of autonomy allows schools, companies, NGOs or government bodies to collaborate with one another more easily.

Assists in securing internships, mentorship, and access to networks of green innovation.

Student Empowerment Layer o Promotes entrepreneurial mindset such as innovative or risk-taker or socially responsible.

Promotes digital innovation to support businesses going green.

*Framework Application and Benefits*

This approach enables schools in Thailand, Bangladesh, and similar countries to:

Make it easier for students to work on climate, sustainability and other issues by bringing back entrepreneurial journeys.

Level up your digital skills to help you arrive at innovative, long-lasting solutions.

Supporting systemic change by integrating curriculum, teaching practice, institutional preparedness and partnerships with outside organizations.

Ensure that education objectives are consistent with local economic and environmental imperatives in the area and produce a new generation of green entrepreneurs.

Table II: Integrating Sustainability, Digital Skills, and Entrepreneurial Education

| Layer | Focus Areas | Expected Results |
|---|---|---|
| 1.Student Empowerment | Novelty and creativity - Risk-taking and proactiveness - The environment and society. | A business case for going green - student driven initiatives for sustainability |



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| | | |
|---|---|---|
| 2. Curriculum Integration | Digital literacy and entrepreneurialism - Project-Based and Blended Learning - Real-worldproblems - Education for Sustainable Development (ESD) | Interdisciplinary skills - hands-on-learning, sustainability focus |
| 3. Institutional Support | Training of teachers in ESD and digital teaching - Learning platforms and infrastructure - Flexible curriculum representation | Creating learning spaces – teachers empowered and schools prepared for technology |
| 4. Collaborative Ecosystem | Corporate partners, tech companies and NGOs - Mentoring, internships and centers for new ideas - Government help and policy | — Exposure to the world beyond school, adaptable pathways from school to work |

## 5. DISCUSSION

*Fusing digital skills, sustainability and entrepreneurialism*

This study supports the general linkage between awareness of environment, digital literacy and the development of entrepreneurial mind-set in the students of Southeast Asia. The strong positive associations revealed in the quantitative analysis lend support to the theoretical assertion that these dimensions are mutually reinforcing foundations of future-ready schooling. This finding supports the findings of [22.12] promoting comprehensive learning promotion and transversality in ESD.

*Challenges in Institutions and Teaching*

The qualitative results emphasized long-standing constraints in institutional readiness, particularly with respect to training of teachers and infrastructure—problems that previous research in Thailand [29] and Bangladesh [26] have also found. These results call for substantial teacher training and flexible curriculum models to facilitate the effective integration of green entrepreneurial education. The tension between a highly prescriptive curriculum and innovative educational methods like project-based learning is a few of the complex issues that emerge in education reform in emerging democracies.

*5.3 What Collaborative Ecosystems Do*

The emerging problem of multi-stakeholder collaboration illustrates how connections between schools, business and civil society can make a difference. Such networks comprised reality based learning environments and resources which facilitate students F entrepreneurial experiences, corroborating the literature on EECs [12]. If anything, laws should facilitate and promote the growth of green entrepreneurships education.

*Implications for policy and practice*

Our proposed integrated approach provides a scalable approach for education systems in Thailand, Bangladesh, and over other (6) South-Asian countries to address the current inequality. Sustainability and digital literacy need to be baked into programs that train people to start their own businesses. That way the lessons would be current with the latest technology and environmental and technology issues.

And investing in developing teachers' skills and digital infrastructure is just as critical to getting this policy to work on the ground. By connecting learning objectives with local efforts at sustainability, we can more effectively educate students who are prepared to lead innovation toward a green economy.

*Constraints and Prospective Investigations*

This research presents broad conceptual and empirical groundwork, but is limited in its focus to select institutions in Thailand and Bangladesh. It requires verification in other contexts in Southeast Asia and for different levels of schooling. Longitudinal studies focusing on the effects of continued integrated sustainability and business education in student outcomes and the local economy would be useful. Moreover, there could be some empirical studies on focused instructional interventions in this framework to enhance best practices.

## 6. CONCLUSION AND RECOMMENDATIONS

*Conclusion*

The paper provides a full framework to implement Sustainability - Digital Skills - Entrepreneurial mindset system integration into educational systems in Southeast Asia (with focus on Thailand and Bangladesh). Quantitative and qualitative findings echo a pervasive interdisciplinarity among a wide array of fields, and illuminate opportunities and challenges that accompany efforts to enact integrated education. The proposed framework articulates curriculum innovation, institutional preparedness, multi-stakeholder participation, and enhanced student participation as key components for nurturing environmentally friendly entrepreneurial mindsets to address urgent environmental and socio-economic challenges. Education can be a major force in sustainable development and economic recovery in the Global South by preparing a generation of technologically savvy and community-responsible entrepreneurs.

*Suggestions*

*The findings led to the following recommendations:*

*1. Policy Change*: The education ministries need to legislate policies: where ESD, digital literacy, entrepreneurship education are explicitly included in the national curriculum.

*2. Teacher Professional Development*: Help teachers gain more expertise in digital pedagogy and sustainability-focused entrepreneurship, so they feel more prepared to be successful.

*3. Curriculum flexibility*: Promote the use of blended learning and project-based learning that allow cross-disciplinary methods to be effectively used and real-world problems to be solved more easily.

*4. Infrastructure and Resources*: Ensure it's easier for green innovation to access digital tools, platforms and networks — particularly in rural schools and undersourced communities.



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*5. Collaborative Partnerships*: Join forces with schools, businesses, government and community groups to make it more cost-effective for people to learn from one another, find mentors and secure funding.

6. More Research: Do a better job of allowing long-term and experimental studies to determine how well integrative educational frameworks work and how best to implement them.

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