FULL REPORT

**TEACHING SUSTAINABLE DEVELOPMENT GOALS (SDGS)
IN THE 21ST CENTURY: CASE STUDY OF COURSE 2302308
"INTRODUCTION TO SUSTAINABLE DEVELOPMENT"
AT MAE FAH LUANG UNIVERSITY**

By

Asst. Prof. Maya Dania

Reni Juwitasari

ACKNOWLEDGMENT

Thank you.

Chiang Rai, 1 February 2025
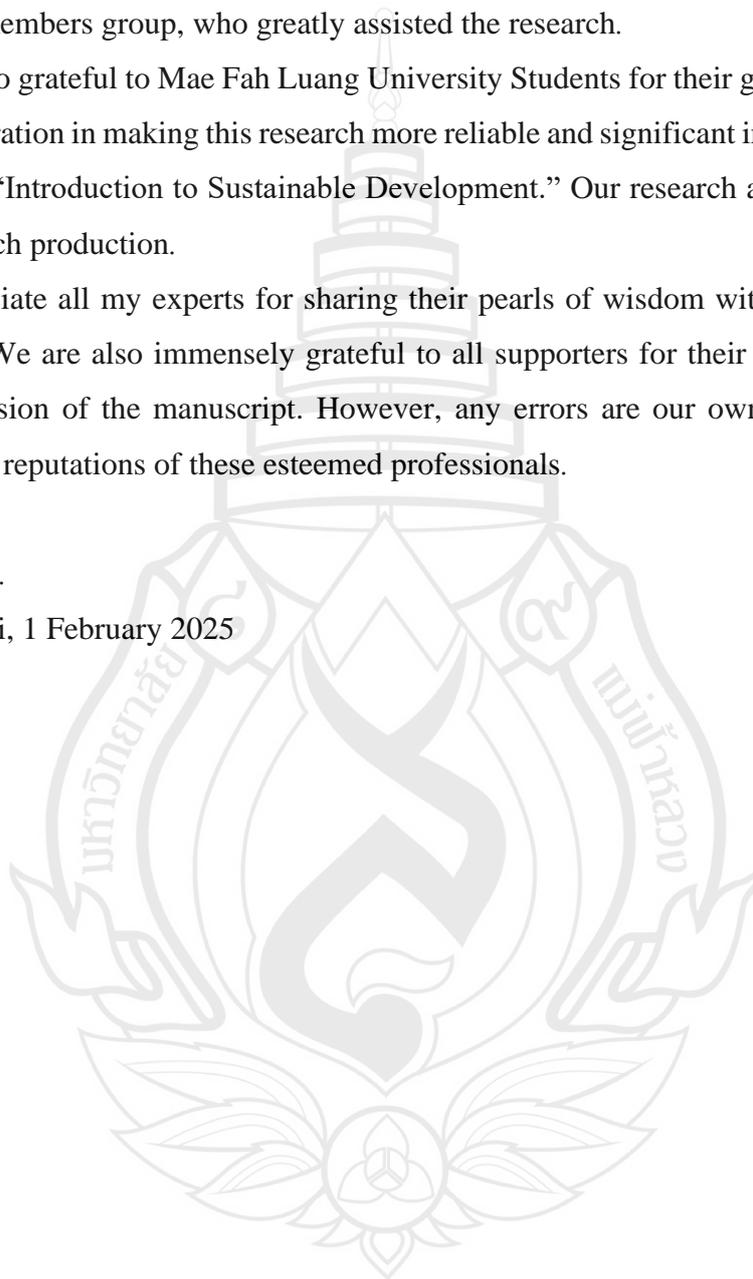
EXECUTIVE SUMMARY

Significance of the Research

This research integrates Sustainable Development Goals (SDGs) into Thai higher education by employing innovative pedagogical models to address the critical need for sustainability education. By utilizing frameworks such as Bloom's Taxonomy, the Felder-Silverman Learning Model, and the KAP Design Model, the study fills a significant gap in localized research and offers practical, context-specific solutions for curriculum reform. Using Course 2302308 as a case study, it develops a replicable approach that enhances student engagement, caters to diverse learning styles, and promotes inclusive education in line with SDG4. Additionally, the research advances academic discourse by addressing key questions on improving cognitive engagement, learning outcomes, and course design, thereby providing valuable insights and tools for educators aiming to build a more sustainable future.

Objectives of the Research

This research has its primary objective: to answer the research questions provided for the study academically. Based on these questions, the objectives of this research are mainly as follows. First, the study aims to enhance the teaching of Sustainable Development Goals (SDGs) in higher education, specifically within the context of Mae Fah Luang University (MFU) in Thailand. This goal is pursued through a multi-faceted approach that focuses on improving cognitive engagement, accommodating diverse learning styles, and making course content more relevant and engaging for students.

One of the core objectives is to examine students' cognitive engagement in learning about SDGs using Bloom's Taxonomy. This involves a thorough assessment of both Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS), with the intent to understand how effectively the course promotes cognitive development—from basic knowledge recall to complex problem-solving and critical analysis. In tandem with this, the research seeks to investigate students' preferred teaching and learning styles for SDGs by applying the Felder-Silverman model. This objective aims to ensure that the course caters to a wide array of learning preferences, including active versus reflective, sensing versus intuitive, visual versus verbal, and

sequential versus global styles, thereby tailoring teaching methods to enhance overall learning outcomes and inclusivity.

A further objective is to redesign the syllabus for Course 2302308, leveraging insights derived from the Knowledge-Attitude-Practice (KAP) Design Model. This redesign is intended to make the course content more relevant and engaging by aligning it with students' existing knowledge, attitudes, and practices related to SDGs. The insights gained from this model are used to inform the development of teaching modules that are better suited to students' needs and perspectives, ultimately aiming to improve their engagement and understanding of sustainability concepts.

Beyond these specific instructional goals, the research also aspires to contribute to broader educational reforms within higher education institutions (HEIs). By focusing on curriculum reform, the study offers practical solutions for integrating SDGs into HEI curricula, using Course 2302308 as a case study for developing innovative and replicable methodologies. The research further emphasizes promoting inclusive education in alignment with SDG 4 (Quality Education), addressing gaps in student engagement and learning outcomes for diverse populations.

In addition, the study aims to advance academic discourse on sustainability education by publishing its findings in international journals and presenting at conferences, thereby positioning MFU as a leader in this field. Finally, the research seeks to transform teaching practices and empower stakeholders (including educators, policymakers, and students) by providing evidence-based pedagogical strategies that foster collaborative efforts toward a more equitable and sustainable future. Through these comprehensive objectives, the study is designed to equip students with the essential skills, knowledge, and values required to address complex sustainability challenges effectively.

Scope of the Research

The scope of this research is centered on Course 2302308, "Introduction to Sustainable Development," at Mae Fah Luang University (MFU) in Thailand. The study uses a mixed-methods approach that combines qualitative data, such as classroom observations and interviews, with quantitative surveys and performance assessments.

This course serves as a case study to explore innovative, interdisciplinary teaching methods aimed at enhancing student awareness of global sustainability challenges.

The research involves two primary participant groups: a core sample of 50 students enrolled in the target course over two semesters and a secondary sample of 150 students from across MFU's 15 schools. The secondary group provides broader insights into institutional attitudes and practices toward sustainability education. Data collection is further enriched through the application of established pedagogical models. Bloom's Taxonomy is employed to assess cognitive engagement, the Felder-Silverman Learning Model identifies preferred learning styles, and the Knowledge-Attitude-Practice (KAP) Design Model informs the syllabus redesign to make content more relevant and engaging.

Geographically, the study is focused on MFU in Thailand, emphasizing context-specific approaches to localizing SDG principles within Thai higher education institutions. An emphasis on inclusivity ensures that the teaching methods bridge gaps in student engagement and learning outcomes, particularly for those from underrepresented disciplines or backgrounds, in line with SDG4 (Quality Education).

Finally, the expected outcomes include the development of practical sustainability assessment indicators, contributions to curriculum reform, and enhanced academic discourse on sustainability education. The findings aim to offer replicable, context-specific solutions that will position MFU as a leader in advancing SDG-related education and contribute to the global dialogue on sustainability in higher education.

Research Methodology

This study employs a mixed-method approach to evaluate the effectiveness of pedagogical frameworks in Sustainable Development Goals (SDG) education at Mae Fah Luang University (MFU). The research integrates qualitative and quantitative data collection tools to provide both nuanced insights into student learning experiences and measurable evidence of learning outcomes. It focuses on implementing and assessing Bloom's Taxonomy, the Felder-Silverman Learning Styles Model, and the Knowledge-Attitude-Practice (KAP) Design Model within the context of Course 2302308, "Introduction to Sustainable Development."

The methodology involves two sample groups: a primary group of 50 students enrolled in the target course over two semesters and a secondary group of 150 students from MFU's 15 schools. Qualitative data is gathered through semi-structured classroom interviews and structured classroom observations, which explore students' perceptions, the clarity of course content, and the overall effectiveness of the teaching methods. Quantitative data is collected via a KAP questionnaire, administered before and after the implementation of the pedagogical frameworks, as well as through class assessments, including assignments, exams, and projects that align with Bloom's Taxonomy levels.

Data collection occurs in three phases: a pre-implementation phase establishing baseline measures, an implementation phase during which the new teaching strategies are integrated and observed, and a post-implementation phase that assesses changes in students' knowledge, attitudes, and practices. Analysis involves thematic examination of qualitative data, descriptive and inferential statistical methods for quantitative data, and triangulation to ensure the validity and reliability of the results. Throughout the study, strict ethical guidelines are followed, including obtaining informed consent and anonymizing data in accordance with MFU's Institutional Review Board (IRB) requirements.

In summary, the research methodology is both thorough and comprehensive, combining qualitative and quantitative methods to provide a robust evaluation of innovative teaching strategies in SDG education, all while maintaining high ethical standards.

Findings

The research demonstrated that integrating innovative pedagogical frameworks into the "Introduction to Sustainable Development" course at MFU significantly enhanced student engagement and learning outcomes. By applying Bloom's Taxonomy, the course was deliberately structured to cultivate cognitive skills progressively. In the initial weeks, interactive memory games were employed to foster lower-order thinking skills (LOTS), enabling students to effectively recall key SDG icons and descriptions, an approach that achieved a 90% active participation rate. As the course advanced, activities such as case study discussions, debates, and collaborative group work were

introduced to develop higher-order thinking skills (HOTS), encouraging students to critically analyze, evaluate, and creatively apply theoretical concepts to tangible sustainability challenges.

The implementation of the Felder-Silverman Learning Styles Model further enriched the learning environment by addressing diverse student needs. The course design intentionally integrated activities tailored to a range of learning preferences: active, reflective, visual, and verbal. For example, interactive lectures combined visual aids with verbal engagement, while case discussions and debates effectively stimulated active learners. Complementary exercises, such as the SDG Photo Hunt and storybook reflections, not only connected abstract theoretical concepts to real-world examples but also enabled students to synthesize their learning by linking personal experiences to specific SDGs.

Utilizing the Knowledge-Attitude-Practice (KAP) model provided further insight into the course's impact. The model revealed significant gains in students' understanding of sustainable development, as evidenced by post-test knowledge scores increasing from 2.9 to 4.4. Moreover, improvements in attitudes were notable, with scores rising from 3.2 to 4.6, indicating a heightened commitment to sustainability initiatives. Behavioral changes were equally compelling, as practice scores increased from 2.8 to 4.2. An interdisciplinary survey of 150 students across 15 schools further highlighted variations in KAP performance: while Science and Technology fields exhibited a vigorous theoretical knowledge base, Social and Humanities fields demonstrated pronounced emotional engagement, and Health and Medicine maintained a balanced proficiency across all dimensions.

The study also incorporated the SOC-IN model (Styles, Objectives, and Contents in Integration) to create a holistic learning environment that effectively aligns diverse learning styles with clearly defined educational objectives and targeted content. This integrated framework not only informed curriculum revisions, emphasizing a coherent progression from LOTS to HOTS but also underpinned recommendations for enhanced SDG education, such as increasing community engagement and fostering interdisciplinary collaborations.

In summary, this research confirms that an integrated approach, combining Bloom's Taxonomy, the Felder-Silverman Learning Styles Model, and the KAP model

within the SOC-IN framework, substantially improves student engagement and learning in sustainability education. These findings provide evidence for the efficacy of innovative, inclusive pedagogical strategies, offering a replicable model for curriculum reform in higher education institutions dedicated to advancing Sustainable Development Goals.

Benefits of the Research

This research significantly enhances SDG education at higher education institutions, particularly at Mae Fah Luang University, by integrating innovative pedagogical frameworks. Using Bloom's Taxonomy, the study demonstrates how structuring course activities from foundational knowledge to higher-order thinking skills can deepen understanding and improve critical problem-solving. Additionally, the application of the Felder-Silverman Learning Styles Model ensures that teaching methods accommodate diverse learning preferences, creating an inclusive environment that engages active, reflective, visual, and verbal learners.

The study also employs the Knowledge-Attitude-Practice (KAP) Design Model to measure and improve students' sustainability-related knowledge, attitudes, and behaviors, while the SOC-IN Model offers a comprehensive framework for aligning learning styles, objectives, and content. This context-specific approach not only provides evidence-based recommendations for curriculum reform but also bridges the gap between theory and practical application through experiential learning activities. Ultimately, the research empowers educators, policymakers, and students to collaboratively advance sustainability collaboratively, contributing to both local and global efforts in sustainable development.

This research brings benefit in which the results from this research have been presented and published in an academic journal, and IOP proceeding, as follows:

1. Presentation at an academic conference of the 2024 Association of Southeast Asian Institutions of Higher Learning (ASAIHL) Conference held by Universitas Airlangga, Surabaya, Indonesia.

2. Presentation at an academic conference of the 3rd NIC-NIDA Conference, 2024, held by the National Institute of Development Administration (NIDA), Bangkok, Thailand

3. Publication in academic Journal of International Journal of Horizon. The title of the research paper in the Journal is "Curriculum Integration of Climate Crisis Topics at Mae Fah Luang University: Findings from Classroom Research."

4. Publication in an academic journal of ASEAN Journal of Education. The title of the research paper in the Journal is "Addressing Eco-Anxiety Among Students of Mae Fah Luang University (Thailand) Through HOTS-Oriented Classroom Towards Sustainable Development Goal 4 (Quality Education)".

ABSTRACT

The project acknowledges that Higher Education Institutions (HEIs) are crucial for achieving the Sustainable Development Goals (SDGs), yet there is a pressing need for context-specific approaches to SDG education, particularly in Thai HEIs. This study was conducted in the context of Thailand 4.0, an initiative that aligns with the SDGs by emphasizing human capital and innovation as drivers of sustainable development. The research aimed to examine students' cognitive engagement with SDGs using Bloom's Taxonomy, investigate students' preferred learning styles through the Felder-Silverman model, and redesign the course syllabus using insights from the Knowledge-Attitude-Practice (KAP) Design Model. These objectives were designed to create a robust framework for enhancing the teaching and learning of sustainability within higher education.

The study employed a dual-sampling strategy, selecting a primary sample of 50 students enrolled in the "Introduction to Sustainable Development" course and a secondary sample of 150 students across MFU. Qualitative data was gathered through classroom observations and interviews, while quantitative data was collected using the KAP questionnaire and class assessments, ensuring a comprehensive evaluation of the implemented pedagogical approaches. Key findings indicated that Bloom's Taxonomy was effective in enhancing students' cognitive engagement by fostering a progression from lower-order to higher-order thinking skills. The Felder-Silverman Learning Model contributed to creating an inclusive learning environment by addressing diverse learning preferences, while the KAP survey demonstrated statistically significant improvements in students' knowledge, attitudes, and practices related to sustainability. Additionally, the study developed the SOC-IN Model, which integrates learning styles, objectives, and contents; findings revealed that active and visual learning styles were most effective for student engagement, whereas reflective and verbal learning styles were most effective for knowledge production. The KAP survey also revealed field-specific strengths and weaknesses across MFU schools.

The research suggests that a holistic approach to SDG education is necessary, one that utilizes various pedagogical frameworks to meet diverse student needs. The SOC-

IN Model offers a practical framework for integrating different learning styles, clearly defined learning objectives (as outlined by Bloom's Taxonomy), and targeted content (informed by the KAP model). The study also emphasized the importance of experiential learning activities, such as case study discussions, photo hunts, and storytelling, to bridge the gap between theory and practice.

In conclusion, the study finds that integrating Bloom's Taxonomy, the Felder-Silverman Learning Model, and the KAP Design Model through the SOC-IN framework can significantly enhance SDG education. It underscores the need to tailor teaching methods to accommodate varied learning preferences and to incorporate experiential learning activities that connect theoretical knowledge with real-world applications. The study recommends ensuring a progression from lower-order to higher-order thinking skills, incorporating a variety of learning activities, aligning course content with students' knowledge, attitudes, and practices, and including community engagement components. It further advocates for facilitating interdisciplinary collaboration, using a mix of pedagogical tools, employing diverse assessment methods, incorporating reflective practices, and revising the syllabus of the "Introduction to Sustainable Development" course.

Keywords: Sustainable Development Goals (SDGs), Quality Education, Higher Education, Innovative Curriculum, Mae Fah Luang University

นามธรรม

โครงการนี้ยอมรับว่าสถาบันการศึกษาในระดับอุดมศึกษามีความสำคัญต่อการบรรลุเป้าหมายการ
พัฒนาที่ยั่งยืน (SDGs) อย่างไรก็ตาม ยังมีความจำเป็นเร่งด่วนที่จะต้องใช้แนวทางเฉพาะบริบทใน
การศึกษา SDGs โดยเฉพาะในสถาบันการศึกษาไทย งานวิจัยนี้ดำเนินการภายใต้บริบทของ
Thailand 4.0 ซึ่งเป็นโครงการที่สอดคล้องกับ SDGs โดยเน้นย้ำถึงทุนมนุษย์และนวัตกรรมในฐานะ
ปัจจัยขับเคลื่อนการพัฒนาที่ยั่งยืน การวิจัยมีเป้าหมายเพื่อศึกษาการมีส่วนร่วมด้านการรับรู้ของ
นักศึกษาต่อ SDGs โดยใช้ Bloom's Taxonomy, สำรวจสไตล์การเรียนรู้ที่นักศึกษาชื่นชอบผ่าน
แบบจำลอง Felder-Silverman และออกแบบหลักสูตรใหม่โดยใช้ข้อมูลเชิงลึกจากแบบจำลองการ
ออกแบบรู้–ทัศนคติ–ปฏิบัติ (KAP) วัตถุประสงค์เหล่านี้ถูกกำหนดขึ้นเพื่อสร้างกรอบงานที่แข็งแกร่ง
ในการยกระดับการสอนและการเรียนรู้ด้านความยั่งยืนในสถาบันการศึกษาในระดับอุดมศึกษา

งานวิจัยใช้กลยุทธ์การสุ่มตัวอย่างแบบคู่ โดยคัดเลือกกลุ่มตัวอย่างหลักจำนวน 50 คนจากนักศึกษาที่
ลงทะเบียนในรายวิชา "บทนำสู่การพัฒนาที่ยั่งยืน" และกลุ่มตัวอย่างรองจำนวน 150 คนจากทั่ว
มหาวิทยาลัยแม่ฟ้าหลวง ข้อมูลเชิงคุณภาพถูกเก็บรวบรวมผ่านการสังเกตการณ์ในห้องเรียนและการ
สัมภาษณ์ ขณะที่ข้อมูลเชิงปริมาณถูกเก็บรวบรวมผ่านแบบสอบถาม KAP และการประเมินผลในชั้น
เรียน เพื่อให้การประเมินแนวทางการสอนที่นำไปใช้มีความครอบคลุม ผลการวิจัยหลักชี้ให้เห็นว่า
Bloom's Taxonomy มีประสิทธิภาพในการเสริมสร้างการมีส่วนร่วมด้านการรับรู้ของนักศึกษา โดย
ส่งเสริมความก้าวหน้าจากทักษะการคิดระดับล่างไปสู่ระดับสูง แบบจำลองสไตล์การเรียนรู้ Felder-
Silverman มีส่วนช่วยในการสร้างสภาพแวดล้อมการเรียนรู้ที่ครอบคลุมโดยตอบสนองต่อความ
ต้องการที่หลากหลายของนักศึกษา ในขณะที่แบบสอบถาม KAP แสดงให้เห็นถึงการปรับปรุงในด้าน
ความรู้, ทัศนคติ และการปฏิบัติที่เกี่ยวข้องกับความยั่งยืนอย่างมีนัยสำคัญ นอกจากนี้ งานวิจัยยังได้

พัฒนาแบบจำลอง SOC-IN ซึ่งรวมเอาสไตล์การเรียนรู้, วัตถุประสงค์ และเนื้อหาเข้าด้วยกัน ผลการ
วิเคราะห์เผยว่าสไตล์การเรียนรู้แบบกระตือรือร้นและแบบเห็นภาพ (visual) มีประสิทธิภาพมากที่สุด
สำหรับการมีส่วนร่วมของนักศึกษา ในขณะที่สไตล์การเรียนรู้แบบสะท้อนคิดและแบบใช้วาจามี
ประสิทธิภาพสูงสุดในการผลิตความรู้ แบบสอบถาม KAP ยังเผยให้เห็นถึงจุดแข็งและจุดอ่อนเฉพาะ
สาขาวิชาต่าง ๆ ภายในมหาวิทยาลัยแม่ฟ้าหลวง

งานวิจัยชี้ให้เห็นถึงความจำเป็นของแนวทางการศึกษา SDGs ที่ครอบคลุม โดยใช้กรอบการสอนที่
หลากหลายเพื่อรองรับความต้องการที่แตกต่างกันของนักศึกษา แบบจำลอง SOC-IN นำเสนอกรอบ
การปฏิบัติที่เป็นรูปธรรมสำหรับการบูรณาการสไตล์การเรียนรู้ที่หลากหลาย, วัตถุประสงค์การเรียนรู้
ที่ชัดเจน (ตามที่ระบุใน Bloom's Taxonomy) และเนื้อหาที่มุ่งเน้น (โดยได้รับข้อมูลจากแบบจำลอง
KAP) งานวิจัยยังเน้นย้ำถึงความสำคัญของกิจกรรมการเรียนรู้เชิงประสบการณ์ เช่น การอภิปราย
กรณีศึกษา, การล่าภาพ (photo hunts) และการเล่าเรื่อง (storytelling) เพื่อเป็นสะพานเชื่อม
ระหว่างทฤษฎีกับการปฏิบัติ

โดยสรุป งานวิจัยพบว่าการบูรณาการ Bloom's Taxonomy, แบบจำลองการเรียนรู้ Felder-
Silverman และแบบจำลองการออกแบบ KAP ผ่านกรอบงาน SOC-IN สามารถยกระดับการศึกษา
SDGs ได้อย่างมีนัยสำคัญ โดยเน้นย้ำถึงความจำเป็นในการปรับวิธีการสอนให้เหมาะสมกับความ
ต้องการที่หลากหลายของนักศึกษาและการนำกิจกรรมการเรียนรู้เชิงประสบการณ์เข้ามาเพื่อเชื่อมโยง
ความรู้ทางทฤษฎีกับการประยุกต์ใช้ในโลกแห่งความเป็นจริง งานวิจัยนี้แนะนำให้มีการส่งเสริม
ความก้าวหน้าจากทักษะการคิดระดับล่างไปสู่ระดับสูง, การนำกิจกรรมการเรียนรู้ที่หลากหลายมาใช้,
การปรับเนื้อหาหลักสูตรให้สอดคล้องกับความรู้, ทัศนคติ และการปฏิบัติของนักศึกษา รวมถึงการนำ
องค์ประกอบของการมีส่วนร่วมของชุมชนเข้ามาใช้ นอกจากนี้ ยังสนับสนุนการทำงานร่วมกันระหว่าง

สาขาวิชา, การใช้เครื่องมือการสอนที่หลากหลาย, การประเมินผลที่หลากหลาย, การส่งเสริมการสะท้อนคิด และการปรับปรุงหลักสูตรของรายวิชา "บทนำสู่การพัฒนาที่ยั่งยืน"

คำสำคัญ: เป้าหมายการพัฒนาที่ยั่งยืน (**SDGs**)**,** การศึกษาเพื่อคุณภาพ**,** การศึกษาในระดับอุดมศึกษา**,** หลักสูตรนวัตกรรม**,** มหาวิทยาลัยแม่ฟ้าหลวง
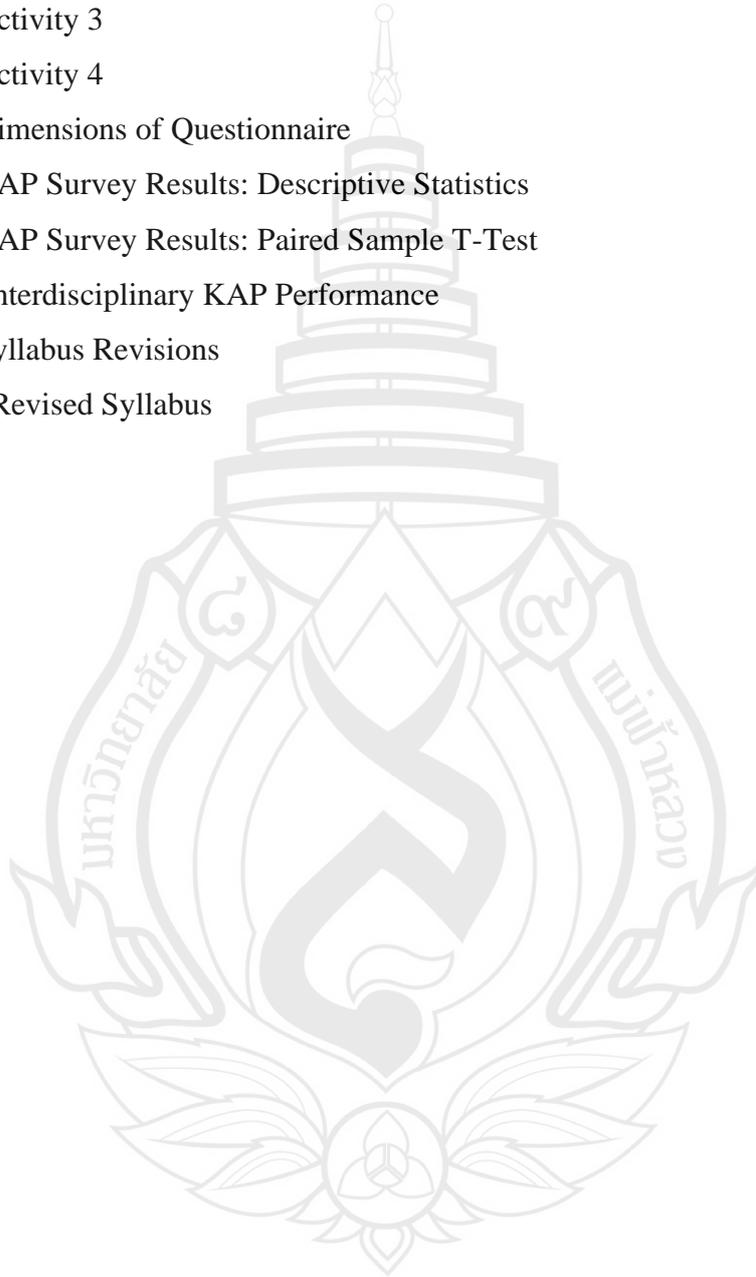
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CHAPTER 1

INTRODUCTION

This chapter will explain the background of the research, the objectives, the importance, the hypothesis, the scope of the study, and definitions of terms.

1.1 Background

The Sustainable Development Goals (SDGs), established by the United Nations in 2015, constitute a comprehensive global framework addressing interconnected social, economic, and environmental challenges. These 17 goals and 169 specific targets provide a "blueprint for global development," seeking to eradicate poverty, reduce inequalities, protect the planet, and ensure prosperity for all by 2030 (United Nations, 2015). The SDGs are underpinned by the principle of leaving no one behind, emphasizing inclusivity and equity in the quest for sustainable development. Higher Education Institutions (HEIs) are identified as pivotal in achieving these ambitious objectives, as they serve as incubators for knowledge generation, skill development, and value transmission that are vital for fostering sustainable futures (Shulla et al., 2020; Fischer & Riechers 2019).

HEIs hold the unique potential to integrate sustainability principles across curricula, equipping students with the critical thinking skills, interdisciplinary knowledge, and ethical values necessary to address complex global issues. The urgency of incorporating sustainability in education stems from escalating environmental degradation, socio-economic disparities, and the need for innovative solutions to global crises such as climate change and resource depletion (Leal Filho et al., 2020). The integration of sustainability into academic frameworks is not merely aspirational but an essential adaptation to the realities of the 21st century. The challenge, however, lies in operationalizing this integration in a manner that transcends traditional education paradigms, enabling learners to act as proactive agents of change in their communities and professional fields (Woiwode et al., 2021).

Incorporating sustainability into business education is especially critical, given the sector's profound influence on global development. The concept of the triple bottom line, which emphasizes social, economic, and environmental well-being, underscores

the necessity of moving beyond profit-driven mindsets to cultivate responsible and ethical management practices (Elkington, 1999). Business education that prioritizes sustainability empowers students to understand the systemic nature of global challenges and promotes practices that align with the principles of responsible corporate citizenship (Sterling, 2011). Failure to incorporate these principles risks perpetuating amoral business behaviors, which could exacerbate environmental and social crises, undermining progress toward the SDGs (Fischer & Riechers, 2019).

Thailand has positioned itself as a regional leader in sustainability through its national strategy, Thailand 4.0, which emphasizes security, prosperity, and sustainability without compromising environmental integrity (Phanthuwongpakdee et al., 2022). This strategic framework aligns with the SDGs by fostering innovation, human capital development, and environmental stewardship. Thai HEIs play a significant role in advancing Education for Sustainable Development (ESD), with efforts to integrate sustainability concepts into curricula gaining traction across various institutions (Murugiah, 2020). However, despite progress, challenges remain in embedding sustainability holistically within higher education systems. Gaps in curriculum design, limited interdisciplinary collaboration, and the need for pedagogical innovation highlight the urgency of reforming Thai HEIs to meet 21st-century sustainability objectives (Shulla et al., 2020).

Curriculum reforms that incorporate sustainability education are critical for achieving long-term societal and environmental goals. This is particularly pertinent in business and social sciences education, where fostering a sustainability mindset among graduates is essential for promoting ethical leadership and sustainable innovation (Sterling, 2011). While Thailand's national strategies emphasize sustainability, effectively translating these priorities into classroom practices requires systematic efforts to redesign university curricula to reflect the complexities of the SDGs (Phanthuwongpakdee et al., 2022).

At Mae Fah Luang University (MFU), sustainability education has gained prominence through initiatives such as the inclusion of "Sustainable Development" in five courses across various disciplines. Among these, Course 2302308, "Introduction to Sustainable Development," stands out as a foundational offering designed for undergraduate students as a General Education (GE) or Free Elective (FE) subject. First

introduced in the 2022/1 academic year, the course has attracted 71 students over three semesters, serving as an entry point for young learners to engage with sustainability concepts. The course's open accessibility to students from all disciplines highlights MFU's commitment to fostering interdisciplinary learning and raising awareness of global challenges among its student body (Registrar Office, MFU, 2023).

Despite these efforts, the integration of SDGs into teaching practices at MFU still faces hurdles, including limited alignment with modern pedagogical frameworks and the evolving needs of students in a rapidly changing world. This research addresses these gaps by focusing on Course 2302308 as a case study to explore innovative approaches for teaching SDGs. By incorporating models such as Bloom's Taxonomy, the Felder-Silverman Learning Model, and the Knowledge-Attitude-Practice (KAP) Design, this research seeks to enhance the cognitive engagement, learning styles, and practical understanding of students enrolled in the course (Abosalem, 2016; Felder & Silverman, 1988).

The critical need for research and innovation in sustainability education is underscored by the global call to action for HEIs to accelerate progress toward the SDGs. This project recognizes the absence of standardized prototypes for creating learning objectives and teaching methodologies centered on sustainability, particularly in Thai HEIs. By leveraging the SOC-IN Model, which integrates learning Styles, Objectives, and Contents, this research aims to promote inclusive education (SDG4) while equipping students with 21st-century skills such as critical thinking, collaboration, and problem-solving (González-Pérez & Ramírez-Montoya, 2022). The KAP Design Model further supports this objective by providing insights into students' knowledge, attitudes, and practices related to SDGs, informing the redesign of teaching modules to meet diverse learning needs (Salas-Zapata et al., 2018).

The findings of this research are expected to contribute to the academic discourse on sustainability education, offering practical solutions for curriculum reform in HEIs. Furthermore, the project aims to publish its results in international journals, establishing MFU as a leader in advancing SDG-related education in Thailand and beyond.

1.2 Objectives

The primary objectives of this research are:

1) To examine students' cognitive engagement in learning about SDGs using Bloom's Taxonomy, focusing on both Lower Order Thinking Skills (LOTS) and Higher Order Thinking Skills (HOTS).
2) To investigate students' preferred teaching and learning styles for SDGs using the Felder-Silverman model, ensuring that diverse learning preferences are accommodated.
3) To redesign the syllabus for Course 2302308 based on the insights gained from the Knowledge-Attitude-Practice (KAP) Design Model, making the course content more relevant and engaging for students.

1.3 Importance of the Research

The role of higher education in achieving the Sustainable Development Goals (SDGs) by 2030 has become increasingly vital as global sustainability challenges intensify. Universities, as centers of learning and innovation, are uniquely positioned to develop future leaders equipped with the skills, knowledge, and values needed to address complex environmental, social, and economic issues. Higher education institutions (HEIs) are not merely passive participants but active drivers of change, shaping the discourse and practices around sustainability (Leal Filho et al., 2020). The transformation required to align educational systems with the SDGs demands a significant shift in teaching approaches, prioritizing interdisciplinary learning, global competence, and inclusive education to prepare students for leadership roles in a rapidly changing world (Shulla et al., 2020).

At Mae Fah Luang University (MFU), Course 2302308, "Introduction to Sustainable Development," exemplifies the institution's commitment to sustainability education. Offered as a General Education (GE) or Free Elective (FE) course, it has become a critical entry point for undergraduate students to engage with sustainability concepts. Over three semesters, the course has provided foundational knowledge to 71 students from diverse disciplines, demonstrating its potential to foster interdisciplinary collaboration and broaden students' understanding of global challenges (MFU Registrar

Office, 2023). This research focuses on enhancing the teaching of SDGs in this course, leveraging the lecturer's practical teaching experiences to develop innovative methodologies that align with both institutional goals and global educational standards.

The transition from theoretical discussions of sustainability to actionable teaching practices is a pressing need in higher education. The research underscores the effectiveness of frameworks such as Principles for Responsible Management Education (PRME) in fostering students' understanding of sustainability through interdisciplinary and experiential learning (Lozano et al., 2021). By emphasizing responsible management practices, PRME provides a robust foundation for curriculum reform, encouraging students to develop critical thinking, ethical leadership, and problem-solving skills. This research adopts a similar approach, integrating pedagogical models such as Bloom's Taxonomy and the Knowledge-Attitude-Practice (KAP) Design Model to evaluate and enhance sustainability learning outcomes. These tools facilitate a structured assessment of cognitive skills and provide insights into students' beliefs and behaviors, creating opportunities for transformative learning (Abosalem, 2016; Salas-Zapata et al., 2018).

Despite the growing emphasis on sustainability in education, significant gaps remain in the integration of SDGs into university curricula, particularly in the Thai context. Most studies on SDG education focus on Western institutions, leaving a critical knowledge gap in understanding how these principles can be effectively localized within Thai HEIs (Phanthuwongpakdee et al., 2022). This research addresses this gap by providing empirical evidence on the effectiveness of teaching methods, learning objectives, and content design tailored to Thai universities. By focusing on context-specific approaches, the study aims to develop sustainability assessment indicators that align with the diverse needs and conditions of Thai HEIs, including variations in institutional size, geographic location, and student demographics (Shulla et al., 2020).

The SDGs call for a paradigm shift in education, moving beyond rote memorization to develop skills essential for the 21st century, such as critical thinking, collaboration, innovation, and adaptability (Sterling, 2011). This research explores the application of Bloom's Taxonomy to cultivate both lower-order and higher-order cognitive skills, ensuring that students can engage deeply with sustainability concepts and apply their knowledge in real-world contexts. Additionally, the Felder-Silverman

Learning Model is incorporated to accommodate diverse learning styles, fostering an inclusive educational environment that values equity and accessibility (Felder & Silverman, 1988). By integrating these frameworks, the research seeks to create a holistic teaching approach that aligns with the needs of a diverse student body and the demands of a rapidly evolving global landscape.

Inclusive education, a core principle of SDG4 (Quality Education), is central to this research. Ensuring that sustainability education is accessible and relevant to all learners requires a commitment to diversity, equity, and the principle of "leaving no one behind" (United Nations, 2015). This research prioritizes inclusive pedagogies that bridge gaps in student engagement and learning outcomes, particularly for those from underrepresented disciplines or backgrounds. By fostering an environment where all students can participate meaningfully, the study aligns with global efforts to promote equity in education while advancing sustainability (Leal Filho et al., 2020).

The findings of this research are expected to make a significant contribution to the global academic discourse on sustainability education. By publishing in international journals and presenting at conferences, the study aims to share practical insights and evidence-based recommendations for integrating SDGs into higher education curricula. This dissemination will not only enhance the teaching of SDGs at MFU but also provide a replicable model for other HEIs seeking to reform their educational practices to align with the 2030 Agenda for Sustainable Development (Lozano et al., 2021).

By addressing these critical areas, this research endeavors to transform the teaching of SDGs at MFU and beyond. Its focus on innovative pedagogies, context-specific approaches, and inclusive education ensures that it responds to the needs of a rapidly changing world. Ultimately, the study seeks to empower educators, policymakers, and students to collaboratively advance sustainability education collaboratively, contributing to a more equitable and sustainable global future.

1.4 Hypothesis

1) Implementing Bloom's Taxonomy in teaching SDGs will significantly enhance students' cognitive engagement and critical thinking skills.

2) Understanding students' preferred learning styles through the Felder-Silverman model will improve their learning experiences and outcomes in SDG education.

3) The application of the KAP Design Model will provide valuable insights that can be used to effectively redesign the course syllabus, improving student engagement and understanding of SDGs.

1.5 Scope of the Study

This study primarily focuses on students enrolled in Course 2302308, "Introduction to Sustainable Development," at Mae Fah Luang University (MFU). The research employs a mixed-methods approach, incorporating both qualitative and quantitative data collection techniques. Qualitative methods include classroom observations and interviews with students currently enrolled in the course, aimed at understanding their learning experiences, preferences, and challenges. Quantitative methods involve surveys administered to both current students and potential students from various schools within MFU. This broader participant pool allows the study to gather comprehensive insights into the effectiveness of the course's teaching methods, learning objectives, and content design. By integrating these diverse perspectives, the research aims to evaluate and enhance the course's alignment with the principles of sustainability education and the broader objectives of the Sustainable Development Goals (SDGs).

1.6 Definitions of Terms

These definitions provide clarity on the key terms and concepts used in this research, ensuring a comprehensive understanding of the study's framework and objectives.

1.6.1 Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are a set of 17 global objectives adopted by the United Nations in 2015, designed to address the world's most pressing challenges across social, economic, and environmental dimensions. These goals aim to eradicate poverty, reduce inequalities, ensure environmental protection, and foster peace and prosperity for all by 2030 (United Nations, 2015). Each goal is supported by specific targets and indicators to monitor progress, making them a comprehensive blueprint for sustainable global development. The SDGs emphasize the interconnectedness of issues and advocate for inclusive, participatory approaches to achieve long-term solutions.

1.6.2 Education for Sustainable Development (ESD)

Education for Sustainable Development (ESD) refers to an educational paradigm that equips learners with the competencies needed to contribute to sustainable development actively. It emphasizes transformative learning that encourages critical thinking, problem-solving, and the ability to envision alternative futures (UNESCO, 2017). ESD integrates sustainability principles into curricula across all educational levels, fostering values and attitudes that support equitable and sustainable practices. By aligning with SDG 4 (Quality Education), ESD promotes inclusive, equitable, and quality education as a foundation for sustainable development.

1.6.3 Higher Education Institutions (HEIs)

Higher Education Institutions (HEIs) are academic entities such as universities, colleges, and technical institutes that deliver tertiary education and conduct research. These institutions play a pivotal role in advancing the SDGs through curriculum innovation, sustainability research, and community engagement (Leal Filho et al., 2020). HEIs also act as hubs for preparing students to navigate complex global challenges by fostering interdisciplinary collaboration and cultivating skills essential for sustainability.

1.6.4 Bloom's Taxonomy

Bloom's Taxonomy is a hierarchical framework for categorizing educational objectives, developed by Benjamin Bloom in 1956 and later revised by Anderson and Krathwohl in 2001. It divides cognitive skills into six levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. This taxonomy provides educators with a structured approach to designing curricula and assessing learning outcomes (Anderson & Krathwohl, 2001). In sustainability education, Bloom's Taxonomy supports the development of both lower-order thinking skills (LOTS) and higher-order thinking skills (HOTS), enabling students to engage deeply with complex global issues.

1.6.5 Felder-Silverman Learning Model

The Felder-Silverman Learning Model identifies four dimensions of learning styles: Active-Reflective, Sensing-Intuitive, Visual-Verbal, and Sequential-Global. Developed by Felder and Silverman (1988), the model highlights the diversity in how students process information and engage with educational content. By understanding these preferences, educators can design inclusive teaching strategies that enhance engagement and learning outcomes. This model is particularly useful in sustainability education, where diverse learning styles can influence how students internalize complex concepts such as the SDGs.

1.6.6 Knowledge-Attitude-Practice (KAP) Model

The Knowledge-Attitude-Practice (KAP) Model is a survey-based framework that evaluates individuals' knowledge, attitudes, and behaviors related to a specific topic. It provides insights into how knowledge and beliefs influence actions, offering a basis for designing targeted educational interventions (Salas-Zapata et al., 2018). In the context of SDG education, the KAP Model is used to assess students' awareness, attitudes, and practices regarding sustainability, helping educators refine teaching strategies to foster meaningful behavioral change.

1.6.7 Inclusive Education

Inclusive education ensures that all learners, regardless of background, ability, or circumstance, have equal opportunities to access and succeed in education. It prioritizes diversity and equity, creating learning environments where differences are celebrated and barriers to participation are removed (UNESCO, 2017). In sustainability education, inclusive practices are critical for achieving SDG 4, as they foster broader engagement and understanding of global challenges across diverse student populations.

1.6.8 Principles for Responsible Management Education (PRME)

The Principles for Responsible Management Education (PRME) initiative provides a framework for embedding sustainability and ethics into business and management education. It aligns with the SDGs by promoting responsible leadership and sustainable business practices (Lozano et al., 2021). PRME emphasizes experiential learning and real-world application, making it a valuable tool for equipping students with the skills and values necessary for sustainable development.

1.6.9 Thailand 4.0

Thailand 4.0 is a national economic model focused on fostering innovation-driven development to achieve sustainability, prosperity, and inclusivity. It emphasizes the role of human capital and technological advancement in driving sustainable growth while minimizing environmental impacts (Phanthuwongpakdee et al., 2022). This model aligns with the SDGs and has become a guiding principle for sustainability-focused education and development initiatives in Thailand.

1.6.10 21st-Century Skills

21st-century skills encompass a broad range of competencies required to thrive in a rapidly evolving and interconnected world. These include critical thinking, creativity, collaboration, communication, digital literacy, and adaptability (González-Pérez & Ramírez-Montoya, 2022). In the context of sustainability education, these skills are essential for empowering students to address complex global issues and implement innovative solutions that contribute to sustainable development.

CHAPTER 2

THEORETICAL FRAMEWORK AND RELATED LITERATURE

The integration of Sustainable Development Goals (SDGs) into higher education curricula is essential for cultivating the next generation of leaders and professionals who are equipped to address global sustainability challenges. This section reviews the existing literature and theoretical frameworks that inform the current research project. It highlights the critical role of Higher Education Institutions (HEIs) in advancing SDGs, explores effective pedagogical frameworks and learning styles, and discusses empirical evidence from case studies. The aim is to provide a comprehensive understanding of the state of SDG education and identify gaps that the current research seeks to address. Through this review, the project aims to situate its contributions within the broader academic and practical discourse on sustainable development education.

2.1 Theoretical Framework

The theoretical framework of this research integrates multiple models to construct a robust approach for evaluating and enhancing sustainability education within higher education institutions (HEIs). By combining Bloom's Taxonomy, the Felder-Silverman Learning Model, and the Knowledge-Attitude-Practice (KAP) Design Model, the framework provides a multidimensional lens to analyze learning objectives, teaching methods, and student outcomes. These models align with global educational standards and are particularly relevant for achieving the Sustainable Development Goals (SDGs), specifically SDG 4, which emphasizes quality education and inclusive learning.

2.1.1 Bloom's Taxonomy

Bloom's Taxonomy, originally developed by Benjamin Bloom in 1956 and revised by Anderson and Krathwohl in 2001, provides a hierarchical classification of cognitive processes that form the foundation of learning objectives. The taxonomy identifies six levels of cognitive complexity: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. These levels are grouped into Lower-Order Thinking Skills (LOTS) and Higher-Order Thinking Skills (HOTS) (Anderson & Krathwohl, 2001). LOTS focuses on foundational knowledge and comprehension, while HOTS emphasizes critical analysis, synthesis, and innovation.

In the context of sustainability education, Bloom's Taxonomy is instrumental in structuring learning objectives that move students beyond memorization to application and problem-solving. For instance, teaching the SDGs requires students not only to understand global challenges but also to evaluate potential solutions and create innovative responses. The taxonomy ensures that students engage in meaningful cognitive processes, fostering skills necessary for sustainable development leadership (Abosalem, 2016).

2.1.2 Felder-Silverman Learning Model

The Felder-Silverman Learning Model (Felder & Silverman, 1988) categorizes learning preferences into four dimensions:

1. Active-Reflective: Preferences for group work versus independent learning.
2. Sensing-Intuitive: Preferences for practical, concrete information versus theoretical, abstract concepts.
3. Visual-Verbal: Preferences for visual aids versus textual or oral explanations.
4. Sequential-Global: Preferences for step-by-step learning versus holistic understanding.

In the 21st-century classroom, students exhibit diverse learning styles, and addressing these preferences is critical for effective teaching. For sustainability education, the Felder-Silverman Model allows educators to design teaching strategies that resonate with varied student profiles. For example, visual learners may benefit from infographics and diagrams about the SDGs, while reflective learners might prefer independent projects that analyze sustainability case studies. By accommodating these preferences, educators can increase student engagement and learning outcomes, supporting inclusivity as emphasized by SDG 4 (Felder & Brent, 2005).

2.1.3 Knowledge-Attitude-Practice (KAP) Design Model

The Knowledge-Attitude-Practice (KAP) Model provides a framework for evaluating the extent to which individuals' knowledge, attitudes, and behaviors align with specific objectives, such as sustainability principles. The model posits that knowledge acquisition influences attitudes, which in turn shape practices or behaviors (Salas-Zapata et al., 2018). This sequential relationship underscores the importance of

comprehensive education strategies that not only impart knowledge but also inspire positive attitudes and actionable practices.

In this research, the KAP Model is employed to assess students' understanding and perceptions of sustainability, as well as their ability to integrate these principles into daily life and future careers. For example, a student knowledgeable about renewable energy technologies may develop a positive attitude toward their adoption and actively promote sustainable energy solutions. By analyzing these dimensions, the study aims to identify gaps in the current teaching of SDGs and propose targeted improvements to foster a sustainability mindset.

2.1.4 Inclusive Education and SDG 4

Inclusive education, a cornerstone of SDG 4 (Quality Education), emphasizes providing equitable learning opportunities for all students, regardless of background or ability. The principle of "leaving no one behind" necessitates teaching methods that accommodate diverse learning needs and promote participation from marginalized groups (UNESCO, 2017). In sustainability education, inclusivity ensures that students from varied disciplines and socio-economic contexts engage meaningfully with the SDGs, fostering a collective commitment to sustainable development.

The integration of inclusive education into this theoretical framework highlights the need for adaptive teaching models like the Felder-Silverman Learning Model and participatory approaches such as the KAP Design Model. These strategies not only enhance accessibility but also ensure that the curriculum resonates with diverse learner profiles, promoting a deeper understanding and broader application of sustainability concepts.

2.1.5 Principles for Responsible Management Education (PRME)

The Principles for Responsible Management Education (PRME) initiative aligns closely with the objectives of sustainability education by integrating ethics, corporate responsibility, and sustainability into business and management curricula. PRME emphasizes experiential learning and interdisciplinary approaches, equipping students to navigate the complexities of global challenges while fostering ethical leadership (Lozano et al., 2021). This framework is particularly relevant for teaching the SDGs,

as it encourages students to approach global issues with a systems-thinking perspective, linking theoretical knowledge with practical applications.

In this research, PRME principles inform the development of teaching strategies for Course 2302308, ensuring that the curriculum not only addresses sustainability knowledge but also cultivates skills such as critical thinking, collaboration, and decision-making. By embedding these principles, the course aligns with global standards for sustainability education and contributes to the professional readiness of graduates.

2.2 Related Literature

Research on sustainability education in HEIs highlights the growing need for innovative teaching approaches that integrate cognitive, affective, and behavioral learning outcomes. Studies have demonstrated that frameworks like Bloom's Taxonomy and the KAP Model significantly enhance students' ability to engage with sustainability concepts (Abosalem, 2016; Salas-Zapata et al., 2018). Additionally, the application of learning style models such as Felder-Silverman underscores the importance of tailoring educational strategies to diverse student preferences (Felder & Brent, 2005).

In the Thai context, studies reveal gaps in the integration of SDGs into university curricula, with limited research on context-specific approaches (Phanthuwongpakdee et al., 2022). This underscores the importance of this research, which addresses these gaps by proposing evidence-based recommendations for curriculum reform at Mae Fah Luang University. The findings are expected to contribute to the global discourse on sustainability education, providing valuable insights for HEIs worldwide.

2.2.1 The Role of Higher Education Institutions in Advancing SDGs

Higher Education Institutions (HEIs) are increasingly recognized as pivotal actors in the global effort to achieve the Sustainable Development Goals (SDGs). As hubs of knowledge creation, innovation, and social transformation, HEIs are uniquely positioned to integrate sustainability into their core functions of teaching, research, and community engagement (Shulla et al., 2020). The transformative potential of HEIs lies not only in educating future leaders but also in fostering societal change through

collaborative efforts with government, industry, and civil society. This role is underscored by the United Nations' 2030 Agenda for Sustainable Development, which calls on educational institutions to equip individuals with the knowledge, skills, and attitudes necessary to address complex global challenges (United Nations, 2015).

The integration of sustainability into higher education represents a paradigm shift, requiring institutions to embed sustainable development principles into their academic and operational strategies. Leal Filho et al. (2020) emphasize that HEIs must transcend traditional disciplinary boundaries, adopting interdisciplinary and transdisciplinary approaches to address interconnected global issues such as climate change, inequality, and resource depletion. By fostering cross-disciplinary collaboration, HEIs can provide students with a holistic understanding of sustainability, enabling them to develop systems-thinking capabilities and innovative problem-solving skills (Lozano et al., 2021).

Moreover, HEIs serve as living laboratories for sustainability, where theoretical concepts can be tested and refined through experiential learning. For example, integrating sustainability into campus operations—such as energy management, waste reduction, and biodiversity conservation—provides real-world contexts for students to apply and deepen their understanding of sustainable practices (Leal Filho et al., 2020). This dual approach, combining theory with practice, enhances students' ability to tackle real-world sustainability challenges.

The interconnected nature of the SDGs demands educational approaches that go beyond traditional disciplinary silos. Interdisciplinary education encourages collaboration between related fields, such as environmental science and public policy, to address complex issues more comprehensively (Sterling, 2011). Transdisciplinary education, on the other hand, involves integrating knowledge from both academic and non-academic sources, fostering collaboration between HEIs and external stakeholders such as local communities and industry (Lang et al., 2012). These approaches not only enrich the learning experience but also ensure that research and teaching are aligned with societal needs and priorities.

For example, addressing SDG 13 (Climate Action) requires an understanding of climate science, economic implications, sociopolitical dynamics, and behavioral change strategies. Through interdisciplinary courses and collaborative projects, students can develop a nuanced understanding of these interrelated dimensions, empowering them to design and implement effective solutions. This holistic approach aligns with the Principles for Responsible Management Education (PRME), which advocates for the integration of sustainability and ethics into higher education curricula to prepare students for responsible leadership (Lozano et al., 2021).

Sustainable Development Education (SDE) in HEIs plays a critical role in equipping students with the competencies needed to navigate the complexities of the 21st century. Shulla et al. (2020) argue that SDE should focus on developing cognitive, social, and emotional skills, enabling students to think critically, act ethically, and collaborate effectively. This aligns with the Knowledge-Attitude-Practice (KAP) Model, which emphasizes the sequential relationship between knowledge acquisition, attitude formation, and behavioral change (Salas-Zapata et al., 2018). By incorporating the KAP Model into sustainability curricula, HEIs can ensure that students not only understand sustainability concepts but are also motivated to apply them in their personal and professional lives.

In addition, Bloom's Taxonomy, a widely recognized framework for categorizing educational objectives, provides a structured approach to designing sustainability curricula that address both lower-order and higher-order cognitive skills (Anderson & Krathwohl, 2001). Through activities such as case studies, simulations, and community-based projects, students can progress from foundational knowledge to advanced skills in analysis, evaluation, and innovation. This progression is essential for fostering critical thinking and problem-solving abilities, which are central to achieving the SDGs.

The integration of SDGs into the operational strategies of HEIs is equally important. This involves embedding sustainability into institutional policies, campus operations, and governance structures. For example, HEIs can align their procurement policies with fair trade principles, implement renewable energy systems, and adopt sustainable building practices (Leal Filho et al., 2020). These initiatives not only reduce

the environmental footprint of HEIs but also serve as tangible demonstrations of sustainability in action, reinforcing the principles taught in the classroom.

Moreover, HEIs can leverage their research capacity to drive innovation in sustainable development. By prioritizing research that addresses the SDGs, institutions can contribute to the development of new technologies, policies, and practices that advance global sustainability efforts. Collaborative research projects involving multiple stakeholders can further enhance the impact and relevance of HEI contributions to the SDGs (Lang et al., 2012).

The contributions of HEIs to the SDGs extend beyond their immediate campuses and communities. Through international collaborations, student and faculty exchange programs, and participation in global networks such as the Sustainable Development Solutions Network (SDSN), HEIs can amplify their impact on sustainable development (SDSN, 2021). These global partnerships facilitate the sharing of best practices, resources, and innovations, fostering a collective effort toward achieving the SDGs. Furthermore, by publishing research, hosting conferences, and engaging with policymakers, HEIs play a crucial role in shaping the global discourse on sustainability. Their thought leadership helps to influence policy decisions, drive public awareness, and inspire action across sectors and societies.

In conclusion, HEIs are indispensable in the global pursuit of the SDGs, serving as catalysts for knowledge, innovation, and societal transformation. By embedding sustainability into their teaching, research, and operations, these institutions can prepare students to navigate the complexities of the modern world while contributing to the broader goals of sustainable development. The integration of interdisciplinary and transdisciplinary approaches, coupled with experiential learning and global collaborations, ensures that HEIs remain at the forefront of efforts to achieve a sustainable future for all.

2.2.2 Pedagogical Frameworks for SDG Education

Effective Sustainable Development Goal (SDG) education requires innovative pedagogical frameworks designed to cultivate critical thinking, problem-solving, and actionable knowledge among students. As the SDGs address interconnected global

challenges, educational methodologies must prioritize the development of systems-thinking capabilities and interdisciplinary competencies. Several pedagogical frameworks have proven instrumental in advancing these objectives, with Bloom's Taxonomy serving as a foundational model for structuring learning objectives and assessing cognitive development.

Bloom's Taxonomy, initially conceptualized by Bloom et al. (1956) and later revised by Anderson and Krathwohl (2001), offers a hierarchical framework for categorizing cognitive skills into six levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. These levels are divided into Lower Order Thinking Skills (LOTS), which focus on foundational knowledge, and Higher Order Thinking Skills (HOTS), which emphasize critical analysis, synthesis, and innovation. The taxonomy is widely regarded as a versatile tool for designing curricula that progressively enhance students' cognitive abilities (Anderson & Krathwohl, 2001).

In the context of SDG education, Bloom's Taxonomy provides a structured approach to developing learning activities that move students from passive knowledge acquisition to active problem-solving and creativity. For example, teaching SDG 13 (Climate Action) might begin with LOTS by introducing students to basic concepts of climate change (Remembering) and its implications (Understanding). As students progress, they could engage in activities requiring HOTS, such as evaluating policy responses to climate change (Evaluating) or designing community-based adaptation strategies (Creating). This progression ensures that students develop both the theoretical understanding and practical skills necessary to address sustainability challenges (Abosalem, 2016).

The dynamic nature of global challenges necessitates the adaptation of Bloom's Taxonomy to contemporary educational contexts. Murugiah (2020) underscores the importance of aligning the taxonomy with the cognitive dimensions of 21st-century skills, including critical thinking, creativity, and collaborative problem-solving. These skills are integral to preparing students for the complexities of the SDGs, as they enable learners to analyze interconnected issues, develop innovative solutions, and work effectively in diverse teams.

For instance, the revised taxonomy's emphasis on creating the highest cognitive level aligns closely with the goals of SDG education, which prioritize innovation and sustainable development. Activities that encourage students to design new solutions, such as community projects or simulations, not only foster HOTS but also equip students with practical experience in addressing real-world sustainability issues (Anderson & Krathwohl, 2001; Sterling, 2011). This approach bridges the gap between theoretical knowledge and actionable outcomes, ensuring that students are well-prepared for leadership roles in sustainability.

While Bloom's Taxonomy provides a cognitive framework, its integration with experiential learning models further enhances its applicability to SDG education. Experiential learning emphasizes active engagement, reflection, and application of knowledge in real-world contexts, aligning well with the action-oriented nature of the SDGs (Kolb, 1984). For example, students might apply the taxonomy by first learning theoretical concepts (Understanding), analyzing case studies (Analyzing), and then engaging in fieldwork or simulations to create sustainable solutions (Creating).

Such integrative approaches have been shown to deepen students' understanding and retention of sustainability concepts. Research by Lozano et al. (2021) highlights the effectiveness of combining cognitive frameworks like Bloom's Taxonomy with experiential learning to foster both intellectual and practical competencies. This combination is particularly effective in preparing students to address multifaceted issues such as inequality (SDG 10) or climate change (SDG 13).

The emphasis on Higher Order Thinking Skills (HOTS) in Bloom's Taxonomy aligns with the critical need for students to develop analytical and evaluative abilities. HOTS are essential for understanding the systemic nature of sustainability challenges, enabling students to dissect complex issues and evaluate potential solutions. Anderson and Krathwohl (2001) argue that fostering HOTS requires educational activities that challenge students to think critically and creatively.

In SDG education, this could involve tasks such as evaluating the effectiveness of renewable energy policies, comparing sustainability practices across industries, or designing innovative approaches to poverty alleviation. By engaging students in these

activities, educators not only enhance their cognitive abilities but also inspire them to become active participants in sustainable development efforts (Murugiah, 2020).

Collaborative learning further enhances the applicability of Bloom's Taxonomy in SDG education. Collaboration enables students to share diverse perspectives, refine their understanding through peer interaction, and develop solutions collectively. This approach aligns with SDG 17 (Partnerships for the Goals), which emphasizes the importance of cooperation in achieving sustainability objectives.

For instance, group projects that require students to design a sustainability initiative for a local community can incorporate multiple levels of the taxonomy. Students begin by researching the community's needs (Remembering, Understanding), analyzing potential solutions (Analyzing), and collaboratively designing and presenting their initiative (Creating). Such activities foster not only cognitive growth but also social and emotional skills, preparing students for the collaborative nature of sustainability work (Lozano et al., 2021).

Innovative pedagogical strategies that integrate Bloom's Taxonomy with other frameworks, such as the Knowledge-Attitude-Practice (KAP) Model, can further enhance SDG education. The KAP Model complements the taxonomy by evaluating students' knowledge acquisition, attitude development, and behavioral change, providing a holistic assessment of learning outcomes (Salas-Zapata et al., 2018). For example, after engaging in activities designed around the taxonomy, students' attitudes toward sustainability and their readiness to adopt sustainable practices can be assessed, ensuring that education translates into meaningful action.

Additionally, integrating Bloom's Taxonomy with digital learning tools can enhance its relevance in modern educational contexts. Interactive simulations, online collaborative platforms, and virtual reality experiences can provide dynamic opportunities for students to engage with sustainability challenges at various cognitive levels. These tools not only enhance student engagement but also make SDG education more accessible to diverse populations (Sterling, 2011).

In conclusion, Bloom's Taxonomy remains a foundational framework for structuring SDG education, offering a clear progression from foundational knowledge

to advanced problem-solving and innovation. Its adaptability to contemporary educational needs, integration with experiential and collaborative learning, and alignment with 21st-century skills make it an invaluable tool for preparing students to tackle sustainability challenges. By combining Bloom's Taxonomy with other pedagogical models and innovative tools, educators can create transformative learning experiences that empower students to contribute meaningfully to the achievement of the SDGs.

2.2.3 Learning Styles and Educational Effectiveness

Understanding and accommodating diverse learning styles is essential for optimizing student engagement, comprehension, and retention in Sustainable Development Goal (SDG) education. The Felder-Silverman Learning Styles Model (FSLSM), developed by Felder and Silverman (1988), provides a robust framework for analyzing how students perceive, process, and assimilate information. This model categorizes learning preferences into four dimensions: Active-Reflective, Sensing-Intuitive, Visual-Verbal, and Sequential-Global, offering educators actionable insights to tailor their teaching strategies to meet diverse student needs.

The Active-Reflective dimension categorizes students based on their preference for learning through action or introspection. Active learners excel in collaborative environments and prefer hands-on activities such as group projects and simulations, while reflective learners thrive in individual tasks that allow time for contemplation and analysis (Felder & Silverman, 1988). In the context of SDG education, this suggests that a mix of group-based sustainability projects and independent research assignments can cater to both learner types.

The Sensing-Intuitive dimension addresses students' preferences for concrete, practical information versus abstract, theoretical concepts. Sensing learners favor factual, real-world applications and structured content, making case studies and practical exercises effective. Intuitive learners, on the other hand, are drawn to theories, innovation, and the exploration of abstract ideas. For example, in teaching SDG 9 (Industry, Innovation, and Infrastructure), sensing learners may benefit from studying

real-world examples of sustainable manufacturing, while intuitive learners might explore futuristic models of green innovation (Bajraktarevic et al., 2003).

The Visual-Verbal dimension highlights the preference for visual aids such as diagrams, graphs, and videos versus textual or spoken information. Visual learners are better engaged through infographics illustrating SDG interlinkages or climate action data visualizations, while verbal learners prefer discussions, lectures, and detailed textual explanations (Felder & Silverman, 1988). Designing SDG content that incorporates both visual and verbal elements ensures inclusivity and enhances comprehension across learner types.

The Sequential-Global dimension reflects students' preference for linear, step-by-step learning versus holistic, big-picture understanding. Sequential learners benefit from structured modules that break down sustainability challenges into manageable steps, while global learners excel when provided with overarching frameworks and integrative approaches. For example, sequential learners might approach SDG 13 (Climate Action) by analyzing individual climate policies, whereas global learners would benefit from understanding how these policies fit into a comprehensive climate strategy (Felder & Brent, 2005).

The research underscores the significant impact of aligning instructional methods with students' learning preferences. Bajraktarevic et al. (2003) found that tailoring educational approaches to individual learning styles improves academic performance and fosters deeper engagement. Similarly, Felder and Silverman (1988) demonstrated that mismatched teaching methods often result in disengagement and reduced learning outcomes. In SDG education, where the content is inherently interdisciplinary and complex, accommodating diverse learning styles is particularly critical for ensuring inclusivity and effectiveness.

For instance, SDG 10 (Reduced Inequalities) might be taught using a combination of approaches: group debates for active learners, reflective essays for reflective learners, statistical data for sensing learners, theoretical discussions for intuitive learners, visual charts for visual learners, detailed readings for verbal learners, step-by-step policy analysis for sequential learners, and comprehensive systemic overviews for

global learners. This multi-dimensional strategy ensures that all students are equally engaged and able to grasp the subject matter effectively (Bajraktarevic et al., 2003).

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) emphasizes the importance of inclusive education in achieving SDG 4 (Quality Education), ensuring that all students, regardless of background or learning preference, have equal access to effective learning environments (UNESCO, 2017). The Felder-Silverman model aligns closely with this principle, as it advocates for the diversification of teaching strategies to cater to varied learner needs. By incorporating learning style dimensions into SDG education, educators can create an inclusive classroom environment that supports diverse learners, including those from underrepresented or marginalized groups.

For example, in teaching SDG 11 (Sustainable Cities and Communities), an inclusive approach might involve field trips to sustainable urban projects for active learners, reflective discussions on urban development policies for reflective learners, visual presentations of city plans for visual learners, and textual policy briefs for verbal learners. This ensures that all students, regardless of their preferred learning style, can meaningfully engage with the content.

Incorporating the Felder-Silverman Learning Styles Model into SDG education not only enhances individual engagement but also promotes collaboration among students with differing learning preferences. Group projects designed to leverage diverse strengths can foster creativity and innovative thinking. For instance, a project on SDG 12 (Responsible Consumption and Production) might assign tasks based on learning styles: visual learners could design infographics, verbal learners could write reports, active learners could lead stakeholder interviews, and sequential learners could develop implementation plans. Such collaborations reflect the interdisciplinary and cooperative ethos of the SDGs themselves (Felder & Brent, 2005).

While aligning teaching methods with learning styles offers numerous benefits, it also poses challenges, including the need for educators to balance diverse preferences within limited instructional time. However, advances in educational technology provide opportunities to address these challenges. Digital learning tools, such as adaptive

learning platforms, can personalize content delivery to match individual learning styles, making SDG education more efficient and accessible (Sterling, 2011). For example, interactive dashboards can present sustainability data visually for visual learners, while verbal learners can access detailed text-based analyses.

In conclusion, the Felder-Silverman Learning Styles Model provides a comprehensive framework for understanding and addressing the diverse learning needs of students in SDG education. By aligning teaching methods with these preferences, educators can enhance engagement, foster inclusivity, and improve learning outcomes. This approach not only aligns with the principles of SDG 4 (Quality Education) but also equips students with the cognitive and collaborative skills necessary to tackle complex sustainability challenges. The integration of learning style models into SDG education represents a critical step toward creating transformative educational experiences that prepare students to become active contributors to a sustainable future.

2.2.4 The Knowledge-Attitude-Practice (KAP) Model in Educational Research

The Knowledge-Attitude-Practice (KAP) Model is a widely used framework in educational research and intervention design. It provides a systematic approach to understanding the relationship between what learners know, how they feel, and how they act in relation to a specific subject or behavior. Halladay and Moses (2013) define the KAP Model as a dynamic triad, emphasizing that effective learning and behavioral change occur when knowledge acquisition influences attitudes, which in turn drive actionable practices. This interconnectedness makes the KAP Model particularly relevant for Sustainable Development Goal (SDG) education, where the ultimate goal is not just awareness but also active engagement with sustainable practices.

The KAP has three main components, they are: Knowledge, Attitude, and Practice. Knowledge represents the foundational understanding that students have about a particular topic. In the context of SDG education, knowledge includes awareness of global challenges, understanding the principles of sustainability, and familiarity with specific SDG goals and targets (Salas-Zapata et al., 2018). For example, students learning about SDG 13 (Climate Action) would gain knowledge about the causes and impacts of climate change, as well as potential mitigation and adaptation

strategies. Meanwhile, attitudes reflect students' perceptions, beliefs, and feelings toward a topic. Positive attitudes toward sustainability can motivate learners to prioritize sustainable practices in their personal and professional lives. Patel (2022) highlights that fostering positive attitudes is essential for bridging the gap between knowledge and practice. For instance, students who perceive sustainability as a critical global priority are more likely to advocate for and adopt sustainable behaviors. Finally, practices encompass the actions students take based on their knowledge and attitudes. This includes both individual behaviors, such as reducing waste or conserving energy, and collective actions, such as participating in community sustainability initiatives. The practice component of the KAP Model assesses whether students apply their learning to real-world contexts, making it a critical indicator of educational effectiveness (Patel, 2022).

The application of the KAP Model in SDG education provides a comprehensive method for evaluating and improving learning outcomes. By conducting KAP surveys, educators can identify gaps in students' understanding, uncover misconceptions, and gauge their readiness to engage with sustainability practices (Salas-Zapata et al., 2018). For example, a survey might reveal that while students are aware of the importance of renewable energy (knowledge) and express support for its adoption (attitude), they lack the resources or opportunities to implement these practices (practice). This insight enables educators to design interventions that address these specific barriers.

In teaching SDG 12 (Responsible Consumption and Production), for instance, the KAP Model could be used to assess students' baseline knowledge about waste management, their attitudes toward reducing consumption, and their actual recycling behaviors. Based on these findings, the curriculum could be adapted to include hands-on activities, such as waste audits or DIY workshops on sustainable living, to enhance both attitudes and practices.

The KAP Model is instrumental in designing targeted and effective educational interventions. Patel (2022) emphasizes that KAP surveys provide actionable data for educators to tailor curricula to specific learning needs and behavioral goals. For example, if students demonstrate high knowledge but low practice in energy

conservation, the curriculum could incorporate experiential learning activities, such as energy-saving challenges or field trips to renewable energy facilities, to bridge the gap.

Moreover, integrating the KAP Model into curriculum design aligns with the principles of Education for Sustainable Development (ESD), which aim to foster transformative learning experiences. Transformative learning goes beyond information transfer, focusing on changing attitudes and behaviors to promote active engagement with sustainability. By addressing all three components of the KAP Model, educators can create a holistic learning environment that empowers students to become sustainability advocates (Salas-Zapata et al., 2018; UNESCO, 2017).

The KAP Model also serves as a robust tool for assessing the effectiveness of educational programs. Halladay and Moses (2013) argue that evaluating all three components (knowledge, attitude, and practice) provides a multidimensional perspective on student learning outcomes. For instance, a high score in knowledge but low scores in attitude and practice might indicate the need for more engaging or motivational content. Conversely, high scores in attitude and practice with limited knowledge might suggest the importance of strengthening theoretical foundations.

In the context of SDG 4 (Quality Education), the KAP Model aligns with the global goal of providing inclusive and equitable education that not only imparts knowledge but also fosters values and skills for sustainable development. For example, an SDG-themed course that incorporates KAP assessments could measure changes in students' sustainability knowledge, shifts in their attitudes toward global issues, and increases in their participation in community service projects.

One example of the KAP Model in action is its application in a course on SDG 6 (Clean Water and Sanitation). Students might initially be surveyed to assess their knowledge about global water scarcity, their attitudes toward water conservation, and their current water use practices. Based on the results, the course could include interactive lessons on water-saving technologies, debates about water policies, and practical assignments, such as tracking household water usage. Post-course surveys would then evaluate changes across the KAP components, providing evidence of the course's impact on student learning and behavior.

While the KAP Model offers a comprehensive framework, its implementation in educational research comes with challenges. Collecting accurate self-reported data on attitudes and practices can be difficult due to social desirability bias or students' limited self-awareness (Patel, 2022). However, triangulating survey data with other methods, such as observations or peer reviews, can enhance validity and reliability. Additionally, digital tools and platforms now offer opportunities for more interactive and accurate KAP assessments, enabling educators to track progress over time and adapt teaching strategies accordingly (Sterling, 2011).

In conclusion, the Knowledge-Attitude-Practice (KAP) Model provides an invaluable framework for understanding and enhancing educational interventions, particularly in the context of SDG education. By systematically assessing students' knowledge, attitudes, and practices, the KAP Model enables educators to design curricula that foster not only awareness but also actionable change. This approach aligns with the principles of Education for Sustainable Development, ensuring that students are equipped to address complex global challenges with informed, positive, and impactful actions. The KAP Model's holistic perspective makes it an essential tool for advancing the goals of sustainable development through education.

2.2.5 Integrative Approaches to SDG Education

The integration of Sustainable Development Goals (SDGs) into higher education curricula necessitates a holistic and interdisciplinary approach that moves beyond traditional education paradigms. As global challenges become increasingly interconnected, educational institutions must foster critical consciousness, systems thinking, and active citizenship among students. Odell et al. (2020) argue that transformative education is essential for achieving these outcomes, emphasizing the need to combine knowledge acquisition with the development of ethical, social, and practical competencies. This aligns with the broader goals of Education for Sustainable Development (ESD), which seeks to prepare students to address the complexities of sustainable development.

Transformative education, as proposed by Odell et al. (2020), is an educational approach that focuses on cultivating students' ability to analyze global issues critically,

reflect on their ethical implications, and take meaningful action. This type of education aligns with SDG 4 (Quality Education) by promoting inclusivity, equity, and lifelong learning. Transformative education encourages students to question existing paradigms, explore alternative solutions, and develop the leadership skills necessary to drive change.

For example, teaching SDG 10 (Reduced Inequalities) through transformative education might involve analyzing the root causes of social and economic disparities, engaging in community-based projects that address these inequalities, and reflecting on the systemic changes required to create more equitable societies. This approach ensures that students are not only aware of the issues but are also equipped to act as change agents within their communities (Chiba et al., 2021).

Education 4.0, a term popularized in response to the Fourth Industrial Revolution, incorporates digital literacy, innovative pedagogies, and collaborative learning environments into higher education. González-Pérez and Ramírez-Montoya (2022) highlight that these components are critical for preparing students to navigate the complexities of sustainable development. Digital tools, for example, enable students to access and analyze vast amounts of data related to the SDGs, fostering data-driven decision-making. Additionally, collaborative learning platforms encourage peer-to-peer interaction, enabling students to co-create solutions to sustainability challenges.

One application of Education 4.0 in SDG education is the use of simulation-based learning, where students can model and predict the outcomes of different policy interventions on issues such as climate change or poverty. This type of experiential learning not only enhances students' understanding of theoretical concepts but also provides practical insights into the challenges of implementing sustainable development initiatives (Odell et al., 2020).

Experiential learning, as described by Kolb (1984), involves active participation in real-world scenarios to facilitate deeper learning and retention. In the context of SDG education, experiential learning enables students to apply theoretical knowledge to tangible challenges, such as designing sustainable urban development projects (SDG 11) or implementing clean water initiatives (SDG 6). Chiba et al. (2021) emphasize that

this approach not only enhances students' cognitive understanding but also fosters emotional and social competencies, such as empathy and teamwork.

Similarly, problem-based learning (PBL) is an effective strategy for integrating SDGs into curricula. PBL encourages students to work collaboratively to address complex, open-ended problems, mirroring the interdisciplinary and interconnected nature of the SDGs. For example, a PBL project focused on SDG 7 (Affordable and Clean Energy) might involve analyzing energy policies, assessing the feasibility of renewable energy sources, and proposing actionable recommendations for communities. This hands-on approach develops critical thinking, innovation, and practical problem-solving skills, which are essential for advancing sustainable development (Chiba et al., 2021).

Community engagement is another critical component of integrative SDG education. Engaging with local communities allows students to understand sustainability challenges from a grassroots perspective, bridging the gap between academic theory and practical application. Chiba et al. (2021) identify community-based projects as a key strategy for fostering global citizenship, a concept that aligns with the values of the SDGs. By collaborating with communities on initiatives such as waste management or disaster resilience, students not only contribute to local sustainability efforts but also develop a sense of social responsibility and cultural sensitivity.

For example, integrating community engagement into SDG 13 (Climate Action) education could involve organizing climate adaptation workshops in vulnerable regions. These workshops would provide students with the opportunity to learn directly from affected populations, gain insights into local knowledge systems, and co-develop solutions that are culturally and contextually appropriate (Odell et al., 2020).

The SDGs are inherently interdisciplinary, addressing interconnected issues that require systems thinking to solve. Systems thinking involves understanding the relationships between various components of a system and identifying leverage points for sustainable change (Sterling, 2011). Odell et al. (2020) argue that SDG education must integrate interdisciplinary approaches to help students navigate these

complexities. For example, addressing SDG 3 (Good Health and Well-Being) might require combining insights from public health, economics, and environmental science to design comprehensive healthcare solutions.

Additionally, interdisciplinary education encourages collaboration across academic disciplines, fostering diverse perspectives and innovative solutions. A course focused on SDG 2 (Zero Hunger) might involve students from agriculture, economics, and social sciences working together to develop strategies for reducing food insecurity. This approach not only enriches the learning experience but also mirrors the collaborative efforts required to achieve the SDGs (Chiba et al., 2021).

While integrative approaches to SDG education offer significant benefits, they also present challenges, including the need for institutional support, faculty training, and curriculum redesign. For instance, implementing experiential learning or community engagement initiatives often requires additional resources and logistical planning. However, advancements in educational technology and increased global collaboration among higher education institutions provide opportunities to overcome these challenges. Platforms such as the Sustainable Development Solutions Network (SDSN) offer resources and best practices for integrating SDGs into academic programs (SDSN, 2021).

In conclusion, integrative approaches to SDG education are essential for equipping students with the knowledge, skills, and values required to address the complex realities of sustainable development. Transformative education, Education 4.0 components, experiential learning, and community engagement all play critical roles in fostering competencies such as critical thinking, collaboration, and systems thinking. By embracing these strategies, higher education institutions can create inclusive and dynamic learning environments that empower students to contribute meaningfully to the achievement of the SDGs.

2.2.6 Case Studies and Empirical Evidence

Empirical studies and case analyses are essential for understanding the practical implementation of Sustainable Development Goal (SDG) education within Higher Education Institutions (HEIs). By analyzing real-world examples, these studies provide

evidence-based insights into effective strategies, challenges, and opportunities for integrating SDGs into academic programs and institutional practices. Alm et al. (2022) emphasize the importance of adopting both implicit and explicit approaches to teaching sustainability, arguing that these methods can complement each other to foster a holistic and integrative learning experience. This dual approach aligns with the SDGs' interconnected nature, ensuring that students not only acquire theoretical knowledge but also develop actionable skills for addressing complex sustainability challenges.

The implicit approach to SDG education involves embedding sustainability principles into the broader ethos and practices of HEIs. This might include adopting sustainable campus operations, fostering an institutional culture of environmental stewardship, or encouraging faculty to integrate sustainability concepts into diverse disciplines (Alm et al., 2022). For example, a university might implement a zero-waste policy or prioritize renewable energy use, demonstrating sustainability practices that students observe and internalize without formal instruction.

In contrast, the explicit approach involves structured and intentional teaching of SDGs through dedicated courses, workshops, and extracurricular activities. Courses like "Introduction to Sustainable Development" explicitly address SDG principles, equipping students with the knowledge and competencies to tackle global issues. Alm et al. (2022) argue that a balanced integration of both implicit and explicit strategies is crucial for creating a comprehensive educational experience that promotes sustainability at both the individual and institutional levels.

Shulla et al. (2020) present a series of case studies showcasing successful strategies for embedding SDGs into HEI curricula and policies. One notable example is the integration of interdisciplinary SDG-focused courses that bring together students from various academic backgrounds. These courses encourage cross-disciplinary collaboration, mirroring the interconnected nature of the SDGs. For instance, a course addressing SDG 11 (Sustainable Cities and Communities) might involve students from urban planning, environmental science, and sociology working together to design sustainable urban development projects.

In addition to curricular integration, institutional policies play a vital role in supporting SDG education. Shulla et al. (2020) highlight examples of universities adopting sustainability frameworks, such as the Green University Initiative, which aligns operational practices with SDG targets. These policies not only reinforce the institutional commitment to sustainability but also provide students with living examples of SDG implementation, bridging the gap between theory and practice.

Case studies also highlight the effectiveness of experiential learning and community engagement in advancing SDG education. Kolb's (1984) experiential learning model, which emphasizes active participation and reflection, is frequently applied in sustainability education to deepen students' understanding of real-world challenges. For instance, Shulla et al. (2020) describe a university-led initiative where students collaborated with local communities to develop waste management solutions. This hands-on experience not only enhanced their understanding of SDG 12 (Responsible Consumption and Production) but also cultivated practical skills and a sense of social responsibility.

Community engagement projects, such as urban greening initiatives or water conservation programs, provide opportunities for students to work alongside local stakeholders, fostering a collaborative approach to sustainable development. These initiatives exemplify how HEIs can act as catalysts for societal change, leveraging their resources and expertise to address sustainability challenges at the community level (Alm et al., 2022).

Empirical evidence underscores the importance of flexibility and adaptability in teaching SDGs, particularly given the diversity of student needs and learning styles. Alm et al. (2022) highlight how flexible course designs, such as modular programs and hybrid learning formats, can accommodate diverse student preferences and enable more inclusive education. For example, hybrid learning platforms allow students to access SDG content asynchronously, ensuring that education remains accessible to those with varying schedules or learning constraints.

Additionally, adaptive teaching methods, such as personalized feedback and collaborative projects, foster deeper engagement with SDG content. A case study by

Shulla et al. (2020) illustrates how a university used project-based learning to teach SDG 7 (Affordable and Clean Energy), enabling students to design renewable energy solutions tailored to specific geographic contexts. This adaptability not only enhanced student engagement but also ensured that the learning outcomes were contextually relevant and impactful.

Empirical studies also highlight the role of global collaboration and knowledge sharing in advancing SDG education. International partnerships, such as the Sustainable Development Solutions Network (SDSN), facilitate the exchange of best practices, research findings, and educational resources among HEIs (SDSN, 2021). For example, Shulla et al. (2020) describe a collaborative project between universities in Europe and Africa, where students and faculty co-developed sustainability solutions for food security challenges (SDG 2). These partnerships not only enrich the educational experience but also demonstrate the global nature of SDG challenges and the need for collective action.

While the benefits of SDG education are clear, case studies also reveal challenges, including resource constraints, resistance to curricular changes, and the need for faculty training. Alm et al. (2022) emphasize the importance of institutional support in overcoming these barriers. For example, securing funding for experiential learning projects or providing professional development opportunities for faculty can significantly enhance the effectiveness of SDG education. Additionally, fostering a culture of collaboration and innovation within HEIs can help address resistance and encourage the adoption of transformative teaching practices.

In conclusion, case studies and empirical evidence provide critical insights into the practical implementation of SDG education, highlighting both successes and challenges. The integration of implicit and explicit teaching approaches, coupled with experiential learning and institutional policies, ensures that HEIs can effectively promote sustainability at both individual and societal levels. By leveraging global collaborations and adopting flexible teaching methods, HEIs can continue to act as catalysts for sustainable development, preparing students to address the complex challenges of the 21st century.

2.2.7 Gaps and Future Directions

While significant strides have been made in integrating the Sustainable Development Goals (SDGs) into higher education curricula, critical gaps persist in both research and practice. These gaps highlight the need for deeper exploration of effective teaching models, long-term outcomes, and contextualized strategies to ensure that SDG education achieves its intended transformative impact.

One of the most pressing gaps in SDG education is the limited empirical research on the effectiveness of different teaching models and strategies across diverse educational contexts. While frameworks like Bloom's Taxonomy, the Felder-Silverman Learning Styles Model, and the Knowledge-Attitude-Practice (KAP) Model have shown promise, there is a lack of comprehensive studies evaluating their application and outcomes in real-world classroom settings (Alm et al., 2022; Salas-Zapata et al., 2018). Additionally, most existing research focuses on HEIs in developed countries, leaving significant gaps in understanding how SDG education can be effectively implemented in resource-constrained settings or culturally diverse environments (Shulla et al., 2020).

For instance, while experiential learning and problem-based approaches are often cited as effective, their adaptability to specific contexts, such as online learning environments or interdisciplinary programs, remains underexplored. Furthermore, there is limited empirical data on how well these strategies address the unique needs of students from marginalized or underrepresented groups, raising concerns about inclusivity in SDG education (UNESCO, 2017).

Another critical gap lies in the paucity of studies examining the long-term impacts of SDG education on students' career trajectories and their contributions to sustainable development. Most research evaluates immediate learning outcomes, such as changes in knowledge or attitudes, without tracking how these translate into real-world actions or professional practices (Patel, 2022). For example, while a student may demonstrate an understanding of SDG 13 (Climate Action) in the classroom, there is little evidence on whether this knowledge influences their decision-making or leadership in the workplace.

Addressing this gap requires longitudinal studies that follow graduates as they transition into their careers, assessing how SDG education shapes their ability to integrate sustainability principles into diverse sectors such as business, government, or community development. Such research could provide valuable insights into the long-term effectiveness of various pedagogical frameworks and their potential to drive systemic change.

The SDGs emphasize the importance of local solutions to global challenges, yet many existing SDG education initiatives fail to contextualize their teaching strategies adequately. Chiba et al. (2021) argue that a one-size-fits-all approach to SDG education often overlooks the cultural, social, and economic nuances that influence how students engage with sustainability. For example, teaching SDG 6 (Clean Water and Sanitation) in a region with abundant water resources may require a different focus than in areas experiencing water scarcity. This lack of contextualization can limit the relevance and impact of SDG education, particularly in multicultural or international learning environments.

Future research should prioritize the development of localized teaching models that address regional sustainability challenges while maintaining alignment with global SDG objectives. This includes integrating indigenous knowledge systems, community-specific case studies, and culturally appropriate learning activities to ensure that SDG education resonates with diverse student populations (Shulla et al., 2020).

The integration of innovative pedagogical frameworks offers significant potential to bridge these gaps. The current research project at Mae Fah Luang University (MFU) aims to address this need by systematically implementing and evaluating the integration of Bloom's Taxonomy, Felder-Silverman Learning Styles, and the KAP Design Model in Course 2302308, "Introduction to Sustainable Development." These models provide complementary perspectives on cognitive, behavioral, and learning style dimensions, creating a comprehensive approach to SDG education.

By applying Bloom's Taxonomy, the study seeks to enhance students' cognitive engagement, progressing from foundational knowledge acquisition (e.g., understanding the principles of SDG 7, Affordable and Clean Energy) to higher-order thinking skills

such as critical evaluation and innovation. The integration of the Felder-Silverman Model allows for the customization of teaching strategies to accommodate diverse learning preferences, ensuring that visual, verbal, active, and reflective learners can engage meaningfully with the material (Felder & Brent, 2005). Finally, the KAP Model provides a framework for assessing how well the course fosters knowledge, positive attitudes, and actionable practices related to sustainability (Salas-Zapata et al., 2018).

In conclusion, despite significant progress, gaps in empirical research, long-term impact assessment, and contextualization continue to challenge the effectiveness of SDG education. The current research project at Mae Fah Luang University represents a critical step toward addressing these gaps by integrating proven pedagogical frameworks into the teaching of sustainability. By generating actionable insights and fostering innovation, this study aims to contribute to the global advancement of SDG education, ensuring that it remains relevant, inclusive, and impactful in preparing students for the complexities of sustainable development.
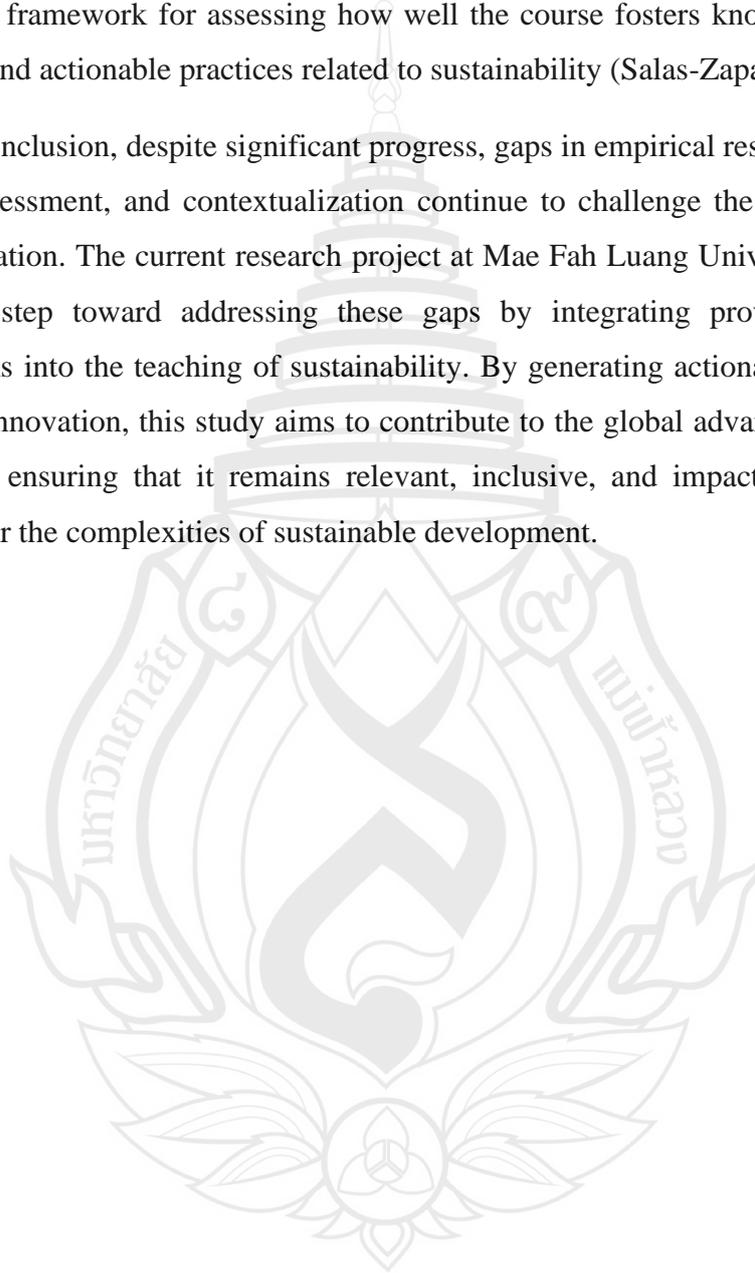
CHAPTER 3

RESEARCH METHODOLOGY

This section outlines the research methodology employed in the study, detailing the processes and approaches used to achieve the research objectives. The methodology is designed to provide a comprehensive and rigorous examination of the educational frameworks applied in Course 2302308, "Introduction to Sustainable Development," at Mae Fah Luang University. By combining qualitative and quantitative methods, this research aims to gather in-depth insights into students' cognitive engagement, learning styles, and the effectiveness of the course content. The following subsections describe the population and sampling groups, research tools, data collection, and data analysis techniques used in the study.

3.1 Population and Sampling Group

The population for this research comprises students currently enrolled at Mae Fah Luang University (MFU). To ensure comprehensive and robust data collection, a dual-sampling strategy has been designed to balance depth and breadth in exploring the integration of Sustainable Development Goal (SDG) education. The population is divided into two sampling groups: the Primary Sample Group, which focuses on students directly participating in the target course in two semesters (n=50 students), and the Secondary Sample Group, which provides a broader perspective on institutional attitudes and practices toward sustainability education. This approach aligns with best practices in educational research, ensuring that findings are both context-specific and generalizable across diverse academic settings (Patton, 2015).

The Primary Sample Group includes a total of 50 students enrolled in Course 2302308, "Introduction to Sustainable Development," during the 2024 semester (Semester 1 for a total of 14 meetings and Semester 2 for a total of 14 meetings). This course serves as the focal point for implementing and evaluating Bloom's Taxonomy, the Felder-Silverman Learning Styles Model, and the Knowledge-Attitude-Practice (KAP) Design Model. This sample group provides the central dataset for examining how these frameworks influence cognitive engagement, foster positive attitudes toward sustainability, and promote actionable practices aligned with SDG principles. Data collection from this group will involve classroom observations, which will document

real-time interactions and the application of pedagogical strategies; performance assessments, including evaluations of assignments, exams, and projects to measure cognitive and practical learning outcomes; and qualitative feedback gathered through surveys and focus group discussions to capture students' perceptions of the teaching methodologies employed (Anderson & Krathwohl, 2001; Felder & Brent, 2005).

The Secondary Sample Group comprises 150 students selected purposively from MFU's 15 schools, with 10 students from each school. To maintain the study's integrity, students already enrolled in Course 2302308 are excluded from this group. The secondary sample is designed to provide a broader exploration of institutional perceptions and attitudes toward SDG education, offering insights into the effectiveness of SDG integration across different disciplines. This group allows for comparative analysis to identify differences in knowledge, attitudes, and practices between those exposed to targeted SDG education and those experiencing general sustainability content indirectly. For example, the study will explore how students from science-oriented disciplines perceive and apply SDG principles compared to those from arts or business schools, shedding light on the interdisciplinary challenges and opportunities in sustainability education (Shulla et al., 2020).

Conducting the Knowledge, Attitude, and Practice (KAP) survey with 150 students from all 15 schools at Mae Fah Luang University (MFU) was a pivotal aspect of this research. The survey's broad scope ensured a comprehensive understanding of how students across diverse academic disciplines engage with the Sustainable Development Goals (SDGs). By including a representative sample from each school, the study highlighted critical variations in students' knowledge, attitudes, and practices, ultimately strengthening the research findings.

The dual-sampling strategy offers several advantages. First, the Primary Sample Group enables in-depth exploration of the frameworks applied in Course 2302308, generating actionable insights into the pedagogical effectiveness of Bloom's Taxonomy, the Felder-Silverman Model, and the KAP Design Model. This group acts as a microcosm for evaluating specific teaching strategies tailored to sustainability education. Second, the Secondary Sample Group captures a university-wide perspective, enhancing the study's generalizability by exploring the broader

perceptions, attitudes, and practices toward SDG education across MFU's diverse academic landscape. This approach aligns with the principles of Education for Sustainable Development (ESD), emphasizing inclusivity and interdisciplinarity in addressing global challenges (UNESCO, 2017).

Ethical considerations are central to this research, ensuring that all participants are treated with respect and their rights are protected throughout the study. Informed consent will be obtained from both primary and secondary sample participants, with clear explanations provided regarding the study's purpose, procedures, and voluntary nature. The research will adhere to MFU's Institutional Review Board (IRB) guidelines to safeguard participants' confidentiality and ensure ethical compliance at every stage of data collection and analysis. Furthermore, all data will be anonymized to prevent the identification of individual participants, reinforcing the study's commitment to ethical integrity (Patton, 2015).

By combining these datasets, this research aims to address critical gaps in SDG education, generating evidence-based recommendations for integrating effective pedagogical strategies into higher education curricula. The findings will not only inform best practices at MFU but also contribute to the global academic discourse on SDG education, providing valuable insights for HEIs worldwide. Through this dual-sampling strategy, the study seeks to advance the understanding of how interdisciplinary and targeted approaches to sustainability education can empower students to become proactive agents of change in achieving the SDGs (Alm et al., 2022; Salas-Zapata et al., 2018).

3.2 Research Tools

This study employs a mixed-methods approach, integrating qualitative and quantitative data collection tools to provide a comprehensive understanding of the effectiveness of pedagogical frameworks in SDG education. By combining these methods, the research captures nuanced insights into students' learning experiences while ensuring the reliability and generalizability of findings. The selected tools are designed to align with the study's objectives, focusing on the implementation and evaluation of Bloom's Taxonomy, the Felder-Silverman Learning Styles Model, and

the Knowledge-Attitude-Practice (KAP) Design Model within the context of sustainable development education.

The integration of qualitative and quantitative tools is critical for achieving the study's objectives, as it combines the depth of qualitative insights with the breadth and reliability of quantitative data. Creswell and Plano Clark (2018) argue that mixed-methods research is particularly effective in educational studies, where understanding both the processes and outcomes of learning is essential. In this study, qualitative tools provide rich, contextualized data on students' experiences and perceptions, while quantitative tools offer measurable evidence of learning outcomes and behavioral changes.

The use of these tools is expected to generate comprehensive data on the effectiveness of SDG education frameworks in fostering knowledge acquisition, attitudinal shifts, and sustainable practices among students. The qualitative tools will provide detailed insights into students' lived experiences and perceptions, while the quantitative tools will quantify learning outcomes and identify trends across the sample groups. By integrating these findings, the study aims to offer evidence-based recommendations for enhancing SDG education at Mae Fah Luang University and beyond, contributing to the global discourse on Education for Sustainable Development (UNESCO, 2017).

For example, while class observations may reveal patterns in student engagement, the KAP Questionnaire quantifies these patterns across a larger sample, ensuring that the findings are generalizable. Similarly, classroom-based interviews can explain the reasons behind certain performance trends observed in-class assessments, creating a comprehensive picture of the frameworks' impact.

3.2.1 Qualitative Tools

1) Classroom-Based Interviews

Classroom-based interviews serve as a key qualitative tool for understanding students' perceptions of their learning experiences in Course 2302308, "Introduction to Sustainable Development." These interviews are conducted with students from the primary sample group, allowing the researcher to explore how the educational

frameworks influence their cognitive engagement, attitudes, and practices related to the SDGs.

The interviews follow a semi-structured format, which provides the flexibility to probe deeper into specific responses while maintaining consistency across participants. Topics covered include students' views on the relevance of SDG education, the clarity of course content, and the effectiveness of teaching methods. This approach ensures that the data captures both individual experiences and shared patterns among participants (Patton, 2015). By analyzing interview transcripts, the study can identify strengths and areas for improvement in the course design, contributing to actionable recommendations for enhancing SDG education.

2) Class Observations

Class observations provide a systematic method for examining the implementation of the educational frameworks and their impact on classroom dynamics. Observations are conducted using a structured protocol that focuses on specific elements, such as student-teacher interactions, group activities, and the application of Bloom's Taxonomy in lesson delivery.

Observations are particularly valuable for capturing real-time behaviors and interactions that may not be fully articulated in interviews or surveys (Creswell & Creswell, 2017). For example, observing how students respond to active versus reflective learning activities can provide insights into the alignment of teaching strategies with the Felder-Silverman Learning Styles Model. Additionally, the data gathered through observations can validate or challenge findings from other tools, enhancing the study's methodological rigor.

3.2.2 Quantitative Tools

1) Quantitative Tools

<u>KAP Questionnaire</u>

The Knowledge-Attitude-Practice (KAP) Questionnaire is a structured survey designed to measure students' knowledge, attitudes, and practices regarding sustainable development. This tool is administered to both the primary and secondary sample

groups, enabling a comparative analysis of students directly and indirectly exposed to the frameworks under study.

The questionnaire includes both closed-ended and open-ended questions. Closed-ended questions use Likert scales and multiple-choice formats to quantify students' knowledge levels, assess their attitudes toward sustainability, and evaluate their engagement in sustainable practices. For example, questions might measure awareness of SDG principles, attitudes toward renewable energy adoption, or frequency of recycling behaviors. Open-ended questions provide respondents with the opportunity to elaborate on their perspectives, capturing qualitative nuances that enrich the data set (Salas-Zapata et al., 2018).

By combining quantitative and qualitative elements, the KAP Questionnaire provides a holistic understanding of students' learning outcomes and their readiness to apply sustainability principles in real-world contexts.

Class Assessments

Class assessments are used to evaluate students' academic performance and cognitive engagement, with a focus on measuring outcomes using Bloom's Taxonomy criteria. These assessments include written assignments, group projects, and exams designed to address various cognitive levels, from foundational knowledge acquisition to higher-order thinking skills such as analysis, evaluation, and creation (Anderson & Krathwohl, 2001).

For instance, an assessment task might require students to analyze the effectiveness of a local sustainability initiative (Analyzing), propose improvements based on evidence (Evaluating), or design a new project aligned with SDG goals (Creating). By systematically coding and analyzing assessment results, the research can quantify the extent to which the course fosters cognitive development across Bloom's Taxonomy levels. This data will be triangulated with qualitative findings to ensure a comprehensive evaluation of the course's effectiveness.

3.3 Data Collection

Ethical protocols are integral to the use of these research tools. Prior to data collection, all participants will receive detailed information about the study's purpose, methods, and voluntary nature. Informed consent will be obtained, ensuring that participants understand their rights, including the option to withdraw at any stage without penalty. Data will be anonymized and securely stored to protect participants' privacy, adhering to the ethical guidelines of Mae Fah Luang University's Institutional Review Board (IRB). Additionally, classroom observations will be conducted with minimal disruption to the learning environment, respecting both students and instructors (Patton, 2015).

The data collection process for this research employs a mixed-methods approach, integrating qualitative and quantitative strategies to ensure comprehensive and nuanced insights into the effectiveness of pedagogical frameworks in Sustainable Development Goal (SDG) education. This approach aligns with best practices in educational research, enabling a multidimensional analysis of both processes and outcomes (Creswell & Plano Clark, 2018). The tools and procedures are designed to systematically gather data from the Primary Sample Group and the Secondary Sample Group, capturing both in-depth experiences and broader trends across diverse academic disciplines.

The data collection process was conducted in three phases:

1) Pre-Implementation Phase: This phase involves administering the KAP Questionnaire to the secondary sample group to establish a baseline understanding of institutional attitudes and practices related to SDG education. Initial classroom observations will also be conducted to document existing teaching practices.

2) Implementation Phase: During this phase, the educational frameworks (Bloom's Taxonomy, Felder-Silverman Model, KAP Design Model) will be actively integrated into Course 2302308. Data will be collected from the primary sample group through classroom-based interviews, real-time observations, and class assessments.

3) Post-Implementation Phase: Following the course's completion, a second round of the KAP Questionnaire will be administered to the primary sample group to

evaluate changes in knowledge, attitudes, and practices. Thematic analysis of interview data and comparative analysis of assessment results will provide a comprehensive evaluation of the framework's impact.

3.3.1 Qualitative Data Collection

1) Classroom-Based Interviews

Classroom-based interviews were conducted with students from the Primary Sample Group, comprising approximately 25–35 students enrolled in Course 2302308, "Introduction to Sustainable Development." These interviews aim to explore students' learning experiences, perceptions of teaching methodologies, and their engagement with Bloom's Taxonomy, Felder-Silverman Learning Styles Model, and Knowledge-Attitude-Practice (KAP) Design Model.

The interviews adopted a semi-structured format, allowing for consistency across participants while providing the flexibility to probe into specific responses (Patton, 2015). Questions will focus on students' perceptions of the course content, their cognitive and emotional engagement, and the relevance of the SDGs to their personal and professional aspirations. For example, students might be asked, "How has this course influenced your understanding of sustainable development?" or "Can you describe a moment when the teaching methods helped you apply what you learned to a real-world context?" Data from these interviews will be transcribed and thematically analyzed to identify recurring patterns and unique insights.

2) Classroom Observations

Systematic classroom observations were conducted to document teaching practices, student engagement, and the practical application of the selected pedagogical frameworks. Observations will follow a structured protocol that examines key aspects such as student-teacher interactions, group dynamics, and the alignment of teaching activities with Bloom's Taxonomy levels (Anderson & Krathwohl, 2001).

For example, an observation may focus on how students engage with active versus reflective learning activities, shedding light on their alignment with the Felder-Silverman Learning Styles Model. Observations will also capture how well the course

integrates sustainability concepts into discussions, projects, and assessments. Observational data will be used to triangulate findings from interviews and surveys, enhancing the validity and reliability of the research (Creswell & Creswell, 2017).

3.3.2 Quantitative Data Collection

1) KAP Questionnaire

The Knowledge-Attitude-Practice (KAP) Questionnaire is a core quantitative tool designed to measure students' understanding, attitudes, and behaviors related to sustainable development. Administered to both the Primary and Secondary Sample Groups, the questionnaire combines closed-ended and open-ended questions to capture a comprehensive range of data. The questionnaire includes sections tailored to assess the following:

- Knowledge: Students' familiarity with SDG principles, global challenges, and sustainability concepts.
- Attitudes: Their perceptions of sustainability's importance and relevance to their academic and personal lives.
- Practices: Their engagement in sustainability-related behaviors, such as energy conservation, waste management, and advocacy for sustainable practices (Salas-Zapata et al., 2018).

For instance, a Likert-scale item may ask students to rate their agreement with statements such as, "I believe sustainability should be a core focus in higher education." Open-ended questions will provide opportunities for students to elaborate on their responses, adding qualitative depth to the quantitative findings. The data from the KAP Questionnaire will be statistically analyzed to identify patterns, trends, and differences between the primary and secondary sample groups.

2) Class Assessments

Class assessments were used to evaluate student performance and cognitive engagement, focusing on their alignment with Bloom's Taxonomy levels. These assessments include written assignments, exams, and group projects designed to

measure students' ability to remember, understand, apply, analyze, evaluate, and create within the context of sustainable development (Anderson & Krathwohl, 2001).

For example, an assessment task may require students to critically evaluate a local sustainability initiative (Evaluating) and propose improvements based on their understanding of SDG principles (Creating). Assessment results will be coded and analyzed to quantify the extent to which the course fosters higher-order thinking skills, providing actionable insights into the effectiveness of the pedagogical frameworks.

3.4 Data Analysis

The data analysis process for this research employs a systematic and rigorous approach to derive actionable insights into the effectiveness of pedagogical frameworks in Sustainable Development Goal (SDG) education. By integrating qualitative and quantitative methods, the analysis ensures a comprehensive evaluation of the data collected from both the Primary Sample Group and the Secondary Sample Group. This mixed-methods approach aligns with best practices in educational research, facilitating a nuanced understanding of the learning processes and outcomes (Creswell & Plano Clark, 2018).

3.4.1 Qualitative Data Analysis

Thematic analysis was the primary method for analyzing qualitative data collected from classroom-based interviews and class observations. This method involves identifying, organizing, and interpreting patterns or themes within the data, providing a detailed account of students' perceptions and experiences (Braun & Clarke, 2006).

For interview data, transcripts were reviewed multiple times to ensure familiarity, followed by systematic coding to identify recurring concepts and themes. Codes will be grouped into categories such as engagement with SDG concepts, perceived relevance of teaching methods, and barriers to learning. For instance, a recurring theme might involve students expressing the importance of collaborative projects in fostering an understanding of SDG 17 (Partnerships for the Goals). Observational data will also be coded to capture interactions, teaching practices, and student responses, triangulating findings from interviews to enhance reliability.

Thematic analysis is particularly suited for capturing the depth and complexity of qualitative data, allowing the researcher to uncover insights that may not be immediately apparent in quantitative results (Creswell & Creswell, 2017). For example, the analysis may reveal how specific teaching strategies resonate differently with active versus reflective learners, providing valuable feedback for refining pedagogical approaches.

3.4.2 Quantitative Data Analysis

1) Descriptive Statistics

Descriptive statistics was used to summarize data from the Knowledge-Attitude-Practice (KAP) Questionnaire and class assessments. Measures such as mean, median, standard deviation, and frequency distributions will provide an overview of students' knowledge levels, attitudes toward sustainability, and engagement in sustainable practices.

For instance, the analysis might reveal that students from the Primary Sample Group have higher mean scores in knowledge and attitudes compared to the Secondary Sample Group, indicating the potential impact of targeted SDG education. Descriptive statistics will also highlight variations across demographic factors, such as academic discipline or year of study, offering insights into how these variables influence students' engagement with sustainability (Salas-Zapata et al., 2018).

2) Inferential Statistics

Inferential statistical methods will be employed to test hypotheses and examine relationships between variables. T-tests will be used to compare differences in knowledge, attitudes, and practices between the primary and secondary sample groups, as well as across subgroups within each sample (e.g., disciplines learning styles) (Field, 2018).

3) Content Analysis for Open-Ended Responses

The open-ended responses from the KAP Questionnaire will undergo content analysis to identify recurring themes and patterns. Content analysis involves

systematically coding text data to quantify the presence of specific ideas or concepts while retaining the richness of qualitative insights (Krippendorff, 2018).

For instance, responses to a question such as "How has this course influenced your understanding of SDGs?" may reveal themes related to increased awareness, perceived relevance, or practical application. These themes will complement the quantitative findings, providing a fuller picture of students' learning experiences and outcomes.

4) Data Integration and Triangulation

A key strength of this study lies in its data integration and triangulation approach, which combines qualitative and quantitative findings to ensure a comprehensive analysis. Triangulation involves cross-verifying data from multiple sources and methods to enhance the validity and reliability of the results (Patton, 2015). For example, quantitative findings from the KAP Questionnaire can be compared with qualitative themes from interviews and observations to identify congruences and discrepancies.

By integrating these datasets, the study can address research questions with greater depth and precision. For instance, if quantitative data indicate significant knowledge gains among students, qualitative data can explain the teaching practices or course activities that contributed to these outcomes. This integrated approach ensures that the study not only measures the effectiveness of the frameworks but also provides actionable insights into how they can be improved.

The data analysis process is expected to yield comprehensive insights into the effectiveness of Bloom's Taxonomy, the Felder-Silverman Learning Styles Model, and the KAP Design Model in SDG education. Qualitative analysis will uncover detailed narratives about students' experiences and perceptions, while quantitative analysis will provide measurable evidence of learning outcomes and behavioral changes. Together, these findings will inform evidence-based recommendations for enhancing SDG education at Mae Fah Luang University (MFU) and contribute to the broader academic discourse on sustainability education (UNESCO, 2017).

CHAPTER 4

RESULTS AND DISCUSSION

This section presents a comprehensive analysis of the findings derived from the implementation of Bloom's Taxonomy, the Felder-Silverman Learning Styles Model, and the Knowledge-Attitude-Practice (KAP) Design Model in Course 2302308, "Introduction to Sustainable Development" at Mae Fah Luang University (MFU). The results are organized to align with the research objectives, addressing key questions about the effectiveness of these pedagogical frameworks in fostering cognitive engagement, promoting inclusivity, and enhancing students' knowledge, attitudes, and sustainable practices. Through a mixed-methods approach, integrating both qualitative and quantitative data, this study provides robust insights into how targeted SDG education impacts student learning outcomes and engagement across diverse academic contexts. The discussion synthesizes these findings with theoretical frameworks and existing literature, offering evidence-based interpretations and actionable recommendations for advancing SDG education in higher education institutions globally.

4.1 Evaluate the Effectiveness of Pedagogical Frameworks in Enhancing Cognitive Engagement

The course activities conducted during Weeks 1-7 demonstrated a clear alignment with the hierarchical structure of Bloom's Taxonomy, which progressively builds cognitive skills from foundational knowledge to advanced problem-solving and creativity. By structuring the course around this framework, students' learning experiences were scaffolded to ensure a gradual yet effective progression in their cognitive abilities, as evidenced through assessments, observations, and feedback. This section elaborates on the findings from each level of Bloom's Taxonomy, the methodologies employed, and the tools used to achieve these results.

4.1.1 Lower-Order Cognitive Skills: Foundation and Comprehension

The initial weeks of the course (Weeks 1-3) focused on developing lower-order cognitive skills, such as remembering and understanding. Activities like memory games (Week 2) and matching exercises reinforced students' foundational knowledge of SDG

principles and concepts. For instance, students matched specific SDG goals to their associated global challenges, such as linking SDG 1 (No Poverty) to income inequality statistics and SDG 5 (Gender Equality) to female labor force participation rates. These activities aimed to establish a solid foundational knowledge of the Sustainable Development Goals (SDGs), ensuring students could accurately identify, recall, and explain key concepts. This foundation was critical for preparing students to engage with higher-order thinking tasks in later weeks. Table 1 below summarizes the results from the class activity.

Table 1. Activity 1

Activity 1: Memory Games (Week 2)	
Description	Students participated in an interactive memory game designed to enhance their recall of the 17 SDGs and their corresponding icons, colors, and descriptions.
Methodology	- Classroom Observations: A structured observation checklist was used during the activity to document student behaviors indicative of engagement, such as participation in discussions, active attempts to match cards, and visible enthusiasm (e.g., cheering for correct matches and peer collaboration). Indicators of engagement included physical involvement (e.g., flipping cards), verbal communication (e.g., discussing potential matches with peers), and emotional responses (e.g., expressions of excitement or determination). - Instructor Facilitation: The instructor fostered a supportive environment by clearly explaining the rules, encouraging participation, and providing immediate feedback during the activity. The competitive yet cooperative nature of the game (e.g., students working in pairs or groups) contributed to maintaining interest and motivation.
Preparation	Cards featuring SDG logos, brief descriptions, and key terms (e.g., "No Poverty" or "Climate Action") were distributed in pairs (one card with a description and another with the SDG name or icon).

Set-Up	Cards were shuffled and laid face down in a grid. Students worked in pairs or small groups to match the corresponding cards by flipping them over two at a time.
Objectives	The goal was to match as many pairs as possible within a given time frame, reinforcing students' ability to recall and associate key SDG information.
Outcomes	- Observations revealed high levels of engagement, with 90% of students actively participating. - Students reported that the activity was enjoyable and helped them internalize basic SDG information. - Post-activity quizzes showed a 95% accuracy rate in identifying SDG names and icons.

The observed 90% active participation demonstrates the success of the activity design in engaging students. The hands-on and interactive format of the memory game aligned with the preferences of active learners as defined in the Felder-Silverman Learning Styles Model (Felder & Silverman, 1988). Additionally, the novelty of the game format likely contributed to sustained attention, which is critical in achieving lower-order cognitive goals in Bloom's Taxonomy.

Immediately after the activity, students were asked to complete a brief survey designed to measure subjective experiences. Questions included: "Did you find the activity enjoyable?" (Likert scale: 1 = Not enjoyable, 5 = Very enjoyable) and "How effective was the activity in helping you understand the SDGs?" (Likert scale: 1 = Not effective, 5 = Very effective).

The positive feedback reflects the activity's alignment with the principles of experiential learning, which emphasizes learning through active participation and enjoyment (Kolb, 1984). The interactive nature of the task, combined with its competitive element, made the learning process engaging while promoting memory retention. Students' self-reported internalization of SDG information highlights the role of active, hands-on methods in reinforcing foundational knowledge.

A short quiz was administered immediately after the memory game to measure the retention of SDG names, icons, and key terms. The quiz consisted of Multiple-Choice Questions (students identified the correct descriptions for specific SDGs). Responses were scored using a predefined rubric where accuracy in matches and correct multiple-choice answers were counted. Scores were then analyzed to calculate the average accuracy rate for the group. The quiz was administered immediately after the activity to minimize the effects of memory decay, ensuring the results directly reflected the impact of the activity. The high accuracy rate (95%) indicates the effectiveness of the memory game in achieving the remembering and understanding levels of Bloom's Taxonomy. The structured repetition of SDG names and icons within the game reinforced memory retention, a critical step in laying the foundation for higher-order cognitive processes. The immediate post-activity quiz ensured that the data captured the activity's direct impact on student learning.

4.1.2 Higher-Order Cognitive Skills: Critical Thinking and Analysis

The activities designed for Weeks 4-7 and the final week of the course (Week 15) aimed to develop higher-order cognitive skills in analyzing, evaluating, synthesizing, and creating. These activities were aligned with Bloom's Taxonomy, emphasizing advanced cognitive engagement through critical thinking, problem-solving, and innovation. Table 2 below briefly describes Activity 2.

Table 2. Activity 2

Activity 2: Case Study Discussions (Week 6)	
Description	- Case Study Examples: Students analyzed real-world case studies, such as:
	1) Urban poverty in Southeast Asia: Examining social housing initiatives in Thailand.
	2) Gender disparities in global labor markets: Reviewing gender wage gaps and policies promoting female workforce participation.
	- Discussion Format:
	1) Students were divided into small groups, each assigned a specific case study.

	2) Groups identified key challenges, evaluated existing policies, and proposed solutions to improve inclusivity and sustainability.
	3) A debate format followed, where groups presented their findings, responded to counterarguments and received feedback from peers and the instructor.
	- Example Discussion:
	Case: A policy initiative targeting urban poverty in Thailand, such as the Bangkok Social Housing Program.
	- Debate Topics:
	Evaluating the policy's impact on marginalized communities.
Methodology	- Classroom observations
	A structured observation checklist was employed to document student behaviors indicative of engagement and critical thinking during the case study discussions. Observers focused on identifying both individual and group dynamics that reflected active participation, analytical depth, and evaluative skills. Key indicators included:
	1) Physical Involvement: Participation in group activities, such as reviewing case study materials and preparing arguments.
	2) Verbal Communication: Frequency and quality of contributions, including posing critical questions, providing counterarguments, and articulating solutions.
	3) Collaborative discussions within groups, with students brainstorming and debating potential policy improvements.
	4) Cognitive Engagement: Demonstrating evaluative reasoning, such as weighing the pros and cons of policies or justifying alternative solutions.
	- Instructor Facilitation:
	The instructor played a pivotal role in fostering a supportive and dynamic learning environment by:

	1) Setting Clear Expectations: Beginning the session with an overview of the case study objectives and relevance to SDG 1 (No Poverty) and SDG 5 (Gender Equality). Also, providing guiding questions to structure group discussions, such as: 1. What are the main strengths and weaknesses of the policy? 2. How does this policy address (or fail to address) the needs of marginalized communities? 3. What improvements would you suggest to make the policy more inclusive or effective? 2) Encouraging Collaboration: Dividing students into diverse groups to ensure a mix of perspectives and skills, promoting peer-to-peer learning and providing Immediate Feedback: During debates, the instructor posed counterarguments to challenge students' reasoning, encouraging them to refine and strengthen their positions.
Preparation	Case studies were curated from credible sources, such as reports by the United Nations Development Programme (UNDP) and the World Bank. Each case included key facts, policy descriptions, and outcomes. Rubrics for evaluating student participation, analysis, and argumentation were designed before the activity.
Set-Up	- Pre-Activity Briefing: The instructor introduced students to SDG 1 and SDG 5, providing contextual background on urban poverty and gender equality issues. - Group Formation: Students were divided into groups of 4-5 to encourage collaborative analysis and discussion. - Guided Questions: Each group was provided with a set of guiding questions, such as: 1) What does the policy address the key challenges? 2) How effective is the policy in achieving its objectives? 3) What alternative solutions could make the policy more inclusive? - Activity Execution:

	1) Group Analysis: Students worked collaboratively to dissect their assigned case, identify policy gaps, and prepare a presentation.
	2) Debates: Groups presented their findings, followed by a Q&A session where peers and the instructor posed counterarguments and sought clarification.
	- Assessment: A rubric evaluated students on criteria such as:
	1) Analytical Depth: Ability to evaluate evidence and identify policy strengths and weaknesses.
	2) Clarity of Argumentation: Logical structure and persuasiveness of arguments.
	3) Creativity in Solutions: Originality and feasibility of proposed improvements.
Objectives	To develop analytical and evaluative skills by engaging students in critical discussions of real-world issues related to SDG 1 (No Poverty) and SDG 5 (Gender Equality). This activity aimed to enhance students' ability to assess policy effectiveness, identify challenges, and propose viable solutions through collaborative and interactive learning.
Outcomes	- Observations documented 85% active participation, with students posing critical questions, engaging in debates, and demonstrating enthusiasm during group discussions.
	- Survey responses indicated that 90% of students found the activity engaging and beneficial for understanding real-world policy challenges. One student commented, "The debate format made me think critically about the complexities of poverty and gender issues."

The Case Study Discussions held during Week 3 of the course were designed to develop students' analytical and evaluative skills, aligning with the higher-order thinking skills (HOTS) of Bloom's Taxonomy. These discussions focused on real-world issues related

to SDG 1 (No Poverty) and SDG 5 (Gender Equality), engaging students in a critical examination of policies, collaborative problem-solving, and evidence-based debates. The activity was structured to ensure deep engagement and meaningful learning, using a combination of small group collaboration, guided analysis, and a dynamic debate format. These methods provided the foundation for the outcomes observed during the activity, including 85% active participation and 90% positive feedback on its effectiveness in fostering critical thinking.

The activity began with the assignment of curated case studies, such as urban poverty initiatives in Southeast Asia and gender disparities in global labor markets. Groups of 4-5 students were tasked with dissecting the case studies to identify key challenges, evaluate policy effectiveness, and brainstorm actionable improvements. Each group used guiding questions to structure their analysis, such as evaluating the inclusivity of policies and proposing alternative strategies to enhance their impact. For example, in a case study examining urban poverty in Thailand, students analyzed the effectiveness of a social housing program and debated ways to integrate vocational training and microfinancing for marginalized communities. This collaborative setup encouraged students to pool diverse perspectives, fostering a rich exchange of ideas and critical engagement.

Following the group discussions, a debate format was used to deepen critical thinking and evaluative skills. Each group presented their findings and proposed solutions to the class, after which peers and the instructor posed counterarguments and questions. This interactive element required students to defend their positions using evidence and logical reasoning, pushing them to refine their analyses and think on their feet. Observations during the debates documented 85% active participation, with students engaging enthusiastically by asking probing questions, challenging assumptions, and articulating well-reasoned arguments. For instance, one student questioned the scalability of a proposed microfinancing initiative, prompting the presenting group to justify their approach with additional data from the case study.

The outcomes of this activity were assessed through multiple tools. A structured observation checklist was employed to document student behaviors indicative of engagement, such as verbal contributions during discussions, physical involvement in

reviewing materials, and emotional responses like animated debates or visible determination. The instructor's facilitation played a key role in maintaining focus and encouraging deeper inquiry, as they provided immediate feedback, posed challenging questions, and highlighted key takeaways from each debate. Assignments based on the case studies revealed that 80% of students demonstrated strong analytical and evaluative skills, as evidenced by their ability to identify policy gaps, construct logical arguments, and propose actionable solutions. A rubric was used to assess these assignments, evaluating criteria such as analytical depth, clarity of argumentation, and the feasibility of proposed recommendations.

Post-activity surveys further validated the activity's effectiveness, with 90% of students reporting that the case study discussions were engaging and beneficial for understanding real-world policy challenges. One student noted, "*The debate format made me think critically about the complexities of poverty and gender issues, and it challenged me to justify my arguments with evidence.*" These survey responses underscored the importance of interactive and problem-based learning in fostering higher-order cognitive skills. By dissecting policies, debating solutions, and proposing improvements, students actively engaged with analysis, evaluation, and synthesis, the core components of Bloom's HOTS.

In summary, the design of the case study discussions, supported by collaborative group work, dynamic debates, and structured assessments, directly contributed to the documented outcomes. The activity's alignment with Bloom's Taxonomy ensured that students not only mastered theoretical concepts but also applied them critically and creatively to address real-world sustainability challenges. This approach provided a transformative learning experience, equipping students with the skills necessary to engage with complex global issues.

4.2 Assess the Role of Learning Styles in Promoting Inclusivity and Engagement

The implementation of the Felder-Silverman Learning Styles Model in the classroom was integral to fostering inclusivity and engagement in teaching the Sustainable Development Goals (SDGs). Over 14 weeks, activities were carefully designed and aligned with distinct learning preferences: active, reflective, visual, and

verbal learners, to ensure that all students could effectively participate and benefit from the course. Each activity was structured with specific objectives, methodologies, and assessments to maximize its effectiveness. The detailed approach ensured that students developed critical thinking, problem-solving, and reflective skills essential for understanding and addressing global SDG challenges. Thus, the following table (Table 3) provides an overview of key activities, their alignment with the Felder-Silverman Learning Styles Model, and the outcomes observed in the classroom as follows.

Table 3. Activity 3

Week	Activity	Learning Styles Addressed	Objective	Methodology	Outcome
1	Interactive Lecture with Visual Aids	Visual, Verbal	Introduce students to the SDGs and their significance.	Infographics and videos for visual learners; instructor-led explanations and Q&A sessions for verbal learners.	90% accuracy in identifying SDG goals in a short quiz post-lecture.
3	Case Study Discussions	Active, Reflective	Foster critical thinking and collaborative problem-solving.	Group discussions, debates, and written reflections based on curated real-world case studies.	85% active participation was observed; assignments revealed strong analytical depth among 80% of students.
4	Concept Mapping	Visual, Active	Analyze interconnections between SDGs.	Collaborative creation of color-coded	88% of students reported that

				mind maps to identify relationships among SDGs.	the activity was effective for understanding SDG relationships.
5	SDG Photo Hunt	Visual, Active	Connect theoretical SDG concepts to real-world examples.	Students explored campus or local areas, capturing photos to represent sustainability practices.	Enthusiastic participation: 75% of submissions demonstrated a clear understanding of SDG principles.
6	Storytelling and Debate	Verbal, Reflective	Communicate sustainability ideas creatively and persuasively.	Students crafted narratives on SDG impacts and participated in debates to present their viewpoints.	80% demonstrated advanced verbal communication skills through storytelling and debate sessions.
14	Storybook Reflection	Reflective, Visual	Reflect on personal connections to SDGs.	Students created illustrated storybooks linking their personal	80% of storybooks showcased critical reflection and creativity in linking

				experiences to specific SDGs.	personal actions to SDGs.

Accordingly, from Table 3, the explanation of the class activities regarding the Learning Styles is described as follows.

1) Week 1: Interactive Lecture with Visual Aids

The first week of the course set the stage for exploring the Sustainable Development Goals (SDGs) by introducing students to their framework, significance, and global relevance. This session was designed to provide a comprehensive foundation of knowledge while catering to diverse learning preferences, ensuring that all students could engage effectively from the outset. The interactive lecture incorporated visually rich materials and dynamic teaching strategies to maximize understanding and participation.

The session began with the instructor presenting a visually engaging slideshow that included infographics and high-quality videos sourced from organizations such as the United Nations Development Programme (UNDP) and the World Economic Forum. These materials provided an overview of the 17 SDGs, highlighting their interconnected nature. For instance, an infographic demonstrated how achieving SDG 4 (Quality Education) could contribute to SDG 5 (Gender Equality) and SDG 1 (No Poverty). This approach was particularly effective for visual learners, who benefited from the clear, color-coded representation of complex relationships. The videos added depth by showcasing real-world examples, such as community-led renewable energy projects or initiatives to reduce hunger in rural areas.

To engage verbal learners, the instructor used an interactive lecture format, weaving detailed explanations with periodic pauses to invite student input. For example, after presenting the key objectives of SDG 13 (Climate Action), the instructor prompted students to share their thoughts on how climate change impacts their local communities. This discussion created a collaborative atmosphere where students felt encouraged to ask questions and contribute their perspectives.

The lecture also incorporated structured pauses for guided reflection. At key intervals, the instructor posed open-ended questions, such as "Which SDG do you feel is the most urgent for our region, and why?" This exercise allowed students to connect global goals with local realities, fostering a sense of relevance and engagement. To ensure inclusivity, the instructor invited both volunteers and quieter students to share their thoughts, creating a balanced dialogue.

The session concluded with a short quiz designed to assess students' understanding of the SDGs introduced during the lecture. The quiz featured matching questions, where students paired SDG icons with their respective goals, and short-answer questions requiring them to identify key objectives of specific SDGs. The results showed that 90% of students could accurately identify the SDGs and articulate their primary aims. These outcomes demonstrated the effectiveness of combining visual and verbal teaching strategies, as well as the importance of active participation in reinforcing foundational knowledge.

To close the session, the instructor summarized key points and provided students with additional resources, such as online tools and recommended readings, to explore the SDGs further. This practice not only reinforced the material covered but also encouraged independent learning, setting a tone of curiosity and active engagement for the weeks ahead.

The interactive lecture exemplified good classroom practice by blending visual aids, verbal engagement, and participatory activities to accommodate different learning styles. It established a strong foundation for the course, enabling students to approach subsequent activities with confidence and clarity. Through this well-rounded approach, the instructor ensured that all students began their journey into SDG education with a thorough understanding of the framework's significance and practical applications.

2) Week 3: Case Study Discussions

In Week 3, the focus shifted from foundational knowledge to the application of critical thinking and collaborative problem-solving skills through case study discussions. This activity was meticulously designed to engage students in analyzing real-world scenarios related to SDG 1 (No Poverty) and SDG 5 (Gender Equality),

encouraging them to evaluate policy effectiveness, identify gaps, and propose actionable solutions. The structured format ensured participation from both active learners, who thrived in dynamic group interactions, and reflective learners, who contributed thoughtful analyses and written reflections.

The session began with the instructor introducing two curated case studies, for example, Urban Poverty Reduction in Thailand: A Social Housing Initiative Aimed at Addressing Income Inequality and Improving Living Conditions for Marginalized Communities and Gender Wage Disparities in Global Labor Markets: A policy framework focusing on increasing female workforce participation and reducing wage gaps. Each group, comprising 4–5 students, was assigned one of these case studies. To guide their analysis, students were provided with a worksheet featuring structured questions: What are the key objectives of the policy? How effective has the policy been in addressing its goals? What challenges or gaps remain unaddressed? What improvements can you propose to make the policy more inclusive or impactful?

Next, students were given 20 minutes to work collaboratively within their groups, discussing the challenges highlighted in their case study and brainstorming potential improvements. Observers noted high levels of engagement during this phase, with group members actively exchanging ideas, questioning assumptions, and leveraging data from the provided materials to support their arguments.

Following the group discussions, a debate format was introduced to deepen critical thinking. Each group presented their findings and recommendations to the class, defending their positions in response to counterarguments posed by peers and the instructor. For instance, a group analyzing the urban poverty reduction initiative proposed integrating vocational training programs for marginalized residents to enhance long-term economic sustainability. During the debate, peers questioned the scalability of this solution, prompting the presenting group to refine their argument using additional data.

The debate was particularly effective in engaging active learners, who excelled in articulating their points and responding dynamically to challenges. At the same time, reflective learners made meaningful contributions by drawing on their written

reflections to provide deeper insights into policy implications. From these activities, the outcomes of this activity were significant, for example, 85% active participation was observed during the discussions and debates, reflecting high levels of engagement and enthusiasm. Moreover, post-activity assignments revealed that 80% of students demonstrated strong analytical depth, effectively identifying policy gaps and proposing innovative solutions. For example, one student's written reflection on the gender wage gap case study suggested introducing mentorship programs for women in male-dominated industries, supported by evidence from the case material.

The instructor played a critical role in facilitating this activity, maintaining a balanced and supportive environment. By posing probing questions and providing constructive feedback, the instructor encouraged students to explore complex issues more deeply and articulate their ideas clearly. This activity exemplified the integration of Bloom's Taxonomy's higher-order thinking skills, analysis, evaluation, and synthesis into classroom practice. It provided students with an opportunity to connect theoretical concepts to real-world challenges, preparing them to engage with sustainability issues in future sessions critically. Moreover, the combination of collaborative and reflective tasks ensured inclusivity, allowing students with different learning styles to excel. Week 3's case study discussions set a strong precedent for the analytical and creative activities that followed, establishing a foundation for sustained critical engagement with the SDGs.

3) Week 4: Concept Mapping

In Week 4, students explored the interconnections between SDGs through a concept mapping activity designed to deepen their analytical skills and foster collaboration. This activity focused on helping students visualize the relationships between different goals, such as SDG 13 (Climate Action) and SDG 15 (Life on Land), and understand the systemic nature of global challenges. The task was structured to engage visual learners, who excelled in organizing information visually, and active learners, who thrived in collaborative brainstorming sessions.

The session began with the instructor providing a brief introduction to the importance of understanding SDG interconnections. Using an example, the instructor

demonstrated how achieving SDG 7 (Affordable and Clean Energy) could contribute to SDG 3 (Good Health and Well-Being) by reducing pollution from fossil fuels. This demonstration set the stage for students to create their concept maps.

Next, students were divided into groups of 4–5 and assigned a central SDG, such as SDG 13 or SDG 5. Each group was tasked with identifying at least five related SDGs and visually mapping the connections. Groups were provided with large sheets of paper, colored markers, and access to digital tools like Lucidchart or Miro for those preferring to work digitally. Groups began by placing their assigned SDG at the center of the map and drawing arrows to related goals. For example, a group working on SDG 13 (Climate Action) linked it to:

- SDG 7 (Affordable and Clean Energy): Highlighting the role of renewable energy in reducing greenhouse gas emissions.
- SDG 12 (Responsible Consumption and Production): Emphasizing the impact of sustainable consumption on climate mitigation.
- SDG 15 (Life on Land): Noting the importance of forest conservation in carbon sequestration.

This activity provided a platform for students to engage with the interconnected nature of SDGs, reinforcing the importance of systems thinking in addressing global challenges. The collaborative format allowed students to combine their ideas and learn from peers, while the visual representation made abstract concepts tangible and easier to understand. Each connection was annotated with a brief explanation, encouraging students to articulate their reasoning. Once completed, the groups presented their concept maps to the class, explaining the relationships they identified. The instructor and peers provided feedback, suggesting additional connections or refinements.

After the class, 88% of students reported that the activity enhanced their understanding of SDG relationships, as evidenced by survey responses collected post-activity. Observations highlighted high levels of engagement, with students actively debating and refining their maps. One group noted that linking SDG 11 (Sustainable Cities and Communities) to SDG 6 (Clean Water and Sanitation) helped them see how urban planning influences water quality and availability. The instructor facilitated the

activity by circulating among groups, posing probing questions, and encouraging deeper analysis. For example, when a group linked SDG 13 to SDG 1 (No Poverty), the instructor prompted them to explore how climate resilience could support economic stability in vulnerable communities.

4) Week 5: SDG Photo Hunt

In Week 5, the course transitioned to a highly interactive and practical activity with the SDG Photo Hunt, designed to connect theoretical concepts of the Sustainable Development Goals (SDGs) to real-world examples. This activity aimed to engage students in exploring their immediate surroundings, such as on campus or in nearby areas, to identify and document sustainability practices that aligned with specific SDGs. The hands-on nature of the task made it particularly effective for active learners, who enjoyed the exploratory and participatory approach, and visual learners, who excelled in analyzing and interpreting visual representations of sustainability.

The instructor began by briefing students on the objectives and expectations of the photo hunt. Each student or small group (2–3 members) was tasked with identifying examples of sustainability in action, such as renewable energy systems, waste management practices, or green infrastructure, and capturing photos to document these observations. The activity focused on making connections between these real-world examples and specific SDGs. Students received a checklist of SDGs, along with example scenarios to guide their exploration. For instance:

- SDG 7 (Affordable and Clean Energy): Look for solar panels or other renewable energy installations.
- SDG 12 (Responsible Consumption and Production): Identify recycling bins or sustainable consumption campaigns.

The instructor emphasized the importance of not only capturing images but also providing explanations of how the images represented specific SDGs. Students were given 45–60 minutes to explore designated areas on campus or nearby locations, using their smartphones or cameras to document examples. During the exploration, students engaged in discussions about potential connections between their observations and SDGs, fostering collaboration and shared learning. After the photo hunt, students

submitted their photos along with a brief description of how each image aligned with an SDG. For example, a photo of a composting station was linked to SDG 13 (Climate Action) and SDG 12 (Responsible Consumption and Production), with an explanation of how composting reduces waste and supports sustainable practices.

In a follow-up session, students shared their findings in small groups, discussing the sustainability practices they observed and the challenges or gaps they identified in their surroundings. The instructor facilitated a whole-class discussion, highlighting exemplary submissions and prompting students to reflect on how these practices could be scaled or improved.

Enthusiastic participation was observed, with students actively exploring their environments and engaging in discussions about sustainability. For instance, 75% of submissions demonstrated a clear understanding of SDG principles, as students effectively linked their photos to specific goals with well-reasoned annotations. For instance, one student captured a rainwater harvesting system and connected it to SDG 6 (Clean Water and Sanitation), explaining how the system contributes to water conservation and sustainability. The instructor supported the activity by providing clear instructions, examples, and encouragement throughout the process. During the follow-up discussion, the instructor highlighted exemplary submissions, posed questions to deepen analysis, and encouraged students to consider how similar practices could be implemented in other contexts.

5) Week 6: Storytelling and Debate

Week 6 introduced a dual activity of storytelling and debate designed to develop students' abilities to communicate sustainability concepts both creatively and persuasively. This activity built on the foundational and analytical skills developed in previous weeks, challenging students to craft narratives that illustrated the impacts of specific Sustainable Development Goals (SDGs) and defend their viewpoints in dynamic debates. By engaging verbal learners, who excelled in articulating ideas, and reflective learners, who demonstrated depth in narrative construction, the activity fostered higher-order thinking and collaborative learning.

The session began with a brief lecture by the instructor on the importance of storytelling and debate in advocating for sustainable practices. Examples of effective narratives were shared, such as a community-driven renewable energy project aligned with SDG 7 (Affordable and Clean Energy) or an initiative to reduce urban poverty under SDG 1 (No Poverty). Students were encouraged to reflect on these examples as they prepared their own stories.

First, students were asked to select an SDG that resonated with their personal experiences or interests. Individually or in small groups (2–3 members), students crafted a short narrative (2–3 minutes long) illustrating the impact of their chosen SDG. Narratives could draw from personal observations, real-world case studies, or hypothetical scenarios. For example, one student narrated the story of their family transitioning to solar energy, linking it to SDG 7, while another shared insights from volunteering with a local education program addressing SDG 4 (Quality Education).

Next, each student or group presented their narrative to the class, receiving constructive feedback from peers and the instructor. The instructor guided the feedback process by asking questions such as: How effectively does this narrative illustrate the chosen SDG? and What aspects of the story could be expanded to deepen its impact?"

Following the storytelling session, students participated in structured debates on sustainability-related topics linked to the SDGs. For instance: Should governments prioritize economic growth over environmental protection?" and Is individual action more important than corporate responsibility in achieving sustainability? Students were divided into teams (pro and con) and given 15 minutes to prepare their arguments, using evidence from class discussions, personal insights, and their narratives. During the debate, each team presented opening statements, rebuttals, and closing arguments, followed by questions from the audience.

Observations revealed that 80% of students demonstrated advanced verbal communication skills, effectively articulating their ideas in both storytelling and debates. Narratives showcased creativity and a strong connection to SDG principles, with students providing concrete examples to support their points. For instance, one narrative highlighted a community recycling initiative, aligning it with SDG 12

(Responsible Consumption and Production), and proposed scaling the initiative through school partnerships. During debates, students demonstrated critical thinking and persuasive argumentation, often referencing examples from their stories to strengthen their positions. The instructor facilitated the activity by providing clear guidelines for crafting narratives and structuring debates. By posing probing questions and offering constructive feedback, the instructor encouraged students to refine their ideas and arguments. For example, when a team debated the role of government in climate action, the instructor challenged them to consider alternative perspectives, such as the impact of grassroots movements.

This activity underscored the power of storytelling and debate in enhancing students' understanding and communication of sustainability concepts. The narratives allowed students to connect personally with the SDGs, while the debates honed their ability to defend their ideas persuasively and respond to counterarguments. The combination of creative and analytical elements ensured that students developed a well-rounded skill set essential for addressing global sustainability challenges.

6) Week 14: Storybook Reflection

The Storybook Reflection in Week 14 served as the culminating activity of the course, enabling students to synthesize their learning by linking their personal experiences to specific Sustainable Development Goals (SDGs). This reflective and creative task encouraged introspection, critical thinking, and artistic expression, making it particularly effective for reflective learners, who excelled in thoughtful analysis, and visual learners, who thrived in the creative process of designing illustrated storybooks.

The session began with the instructor introducing the concept of storytelling as a powerful tool for reflecting on and sharing personal connections to sustainability. Examples of illustrated narratives were shared to inspire students, including stories that connected small actions, like starting a home composting system, to broader SDGs, such as SDG 13 (Climate Action) and SDG 12 (Responsible Consumption and Production). Students were given a week to reflect on their personal experiences with sustainability, identifying moments where they had contributed to or witnessed actions related to the SDGs. They were encouraged to focus on real-life examples, such as

community projects, household practices, or individual initiatives, ensuring authenticity and depth.

Using materials such as sketchpads, colored markers, and online tools like Canva or Adobe Spark, students designed storybooks with 5–7 illustrated pages. Each page featured a narrative segment accompanied by visual elements, such as drawings, charts, or photographs. For example, a student narrated their experience volunteering at a recycling program, connecting it to SDG 12 (Responsible Consumption and Production). Another student illustrated their family's transition to solar energy, linking it to SDG 7 (Affordable and Clean Energy). To guide their storytelling, students were encouraged to structure their books with the following elements:

- Introduction: A personal anecdote or observation related to sustainability.
- Challenge: An issue or barrier they encountered.
- Action: Steps they or their community took to address the challenge.
- Outcome: The impact of their actions and their connection to the SDGs.

During the session, students presented their storybooks in small groups, explaining their narratives and visual choices. Peers provided constructive feedback on clarity, creativity, and the depth of SDG connections, fostering a collaborative and supportive environment.

From the activity, 80% of the storybooks demonstrated critical reflection and creativity, with students effectively linking personal actions to SDGs. For instance, One story detailed a student's role in organizing a neighborhood cleanup, connecting it to SDG 15 (Life on Land) by emphasizing the benefits of preserving local biodiversity. Another storybook highlighted water-saving practices at home, aligning with SDG 6 (Clean Water and Sanitation). Peer feedback revealed that many students found inspiration in their classmates' stories, gaining new perspectives on sustainability actions and their global impact. The instructor provided guidance throughout the activity, offering tips on storytelling structure and visual design. During the presentations, the instructor highlighted exemplary storybooks, posing reflective questions such as: How could this action be scaled to create a broader impact? Or, What lessons from this story can be applied to other SDGs?.

Finally, the Storybook Reflection activity allowed students to personalize their learning, making abstract SDG concepts tangible and relatable. By linking their experiences to global goals, students not only demonstrated a deep understanding of sustainability principles but also gained a sense of ownership and agency in contributing to these goals. The creative format encouraged students to explore new ways of communicating their ideas, fostering both individual expression and peer learning.

Thus, based on the weekly activities and outcomes observed throughout the course, the effectiveness of different learning styles in teaching Sustainable Development Goals (SDGs) can be categorized into three key dimensions: knowledge production, engagement, and applicability in classroom settings. These categories highlight the strengths of each learning style in fostering a comprehensive and impactful SDG learning experience, as shown in Table 4 below.

Table 4. Activity 4

Category	Best Learning Style	Rationale	Effective Activities
Knowledge Production	Reflective and Verbal	Encourages critical thinking, analysis, and clear communication.	Case Study Discussions, Storybook Reflection, Storytelling and Debate, Interactive Lecture.
Engagement	Active and Visual	Promotes excitement, collaboration, and hands-on exploration.	SDG Photo Hunt, Concept Mapping, Case Study Discussions.

Classroom Applicability	Integrated Active-Reflective and Visual-Verbal	Balances engagement with critical analysis, accommodating diverse learning preferences effectively.	Concept Mapping, Storytelling and Debate, Storybook Reflection.

4.2.1 Most Effective for Knowledge Production: Reflective and Verbal Learning

Reflective and verbal learning styles emerged as the most effective approaches for fostering deep and meaningful knowledge about the Sustainable Development Goals (SDGs). These styles encourage students to critically engage with complex concepts, analyze challenges, and articulate their understanding with clarity, aligning with the higher-order thinking skills outlined in Bloom's Taxonomy (Anderson & Krathwohl, 2001). Through introspection and dialogue, these learning styles allowed students to connect theoretical frameworks to real-world applications, ensuring robust knowledge production.

Reflective learning fosters introspection and critical analysis, enabling students to evaluate and synthesize complex information. This was evident during the Case Study Discussions (Week 3), where students reflected on real-world challenges such as urban poverty initiatives and gender equity policies. Students were tasked with identifying gaps in existing policies, evaluating their effectiveness, and proposing actionable solutions. For instance, one group analyzed a microfinance program aimed at reducing poverty and suggested integrating vocational training for long-term economic empowerment. Assignments revealed that 80% of students demonstrated advanced analytical skills, with reflections showcasing nuanced evaluations of policy impacts (Shulla et al., 2020). These findings align with prior research emphasizing the role of reflective practices in developing critical thinking and problem-solving abilities (Mezirow, 1997).

Similarly, the Storybook Reflection (Week 14) activity enabled students to connect personal or community experiences to specific SDGs. This introspective task encouraged them to critically examine their contributions to sustainability and articulate these connections through creative storytelling. For example, one student narrated their family's adoption of solar energy, linking it to SDG 7 (Affordable and Clean Energy) and reflecting on its broader implications for environmental sustainability. Another student described organizing a neighborhood cleanup, connecting it to SDG 15 (Life on Land) by emphasizing its impact on local biodiversity. Outcomes showed that 80% of storybooks demonstrated critical reflection and creativity, underscoring the effectiveness of reflective learning in fostering meaningful connections between individual actions and global goals (Sterling, 2011).

Verbal learning, which emphasizes dialogue and communication, proved particularly effective in activities requiring the articulation of ideas and collaborative discussion. During the Interactive Lecture with Q&A (Week 1), verbal learners thrived as the instructor combined visually rich materials with interactive explanations and open discussions. This approach enhanced comprehension and retention, as demonstrated by the 90% accuracy rate in the post-lecture quiz on SDG goals. Research supports the effectiveness of verbal interaction in promoting active engagement and cognitive retention, particularly when combined with participatory teaching methods (Biggs & Tang, 2011).

The Storytelling and Debate (Week 6) activity further highlighted the impact of verbal learning. Students crafted narratives to illustrate the impacts of specific SDGs, such as a community recycling program linked to SDG 12 (Responsible Consumption and Production). These narratives were then presented and defended during structured debates, requiring students to articulate their ideas persuasively and respond to counterarguments. Observations revealed that 80% of students demonstrated advanced verbal communication skills, effectively using evidence and logic to support their points. This aligns with the findings by Murugiah (2020), who highlights the role of storytelling and debate in fostering analytical reasoning and collaborative learning.

The integration of reflective and verbal learning styles created a synergistic effect, allowing students to analyze and effectively communicate their understanding

of SDGs deeply. Reflective learning enabled students to internalize and evaluate information, while verbal learning facilitated the articulation and dissemination of their insights. For example, a student reflecting on the limitations of a gender equity policy (reflective learning) later presented their analysis persuasively during a debate (verbal learning), demonstrating the complementary nature of these styles. These findings are supported by educational theories emphasizing the importance of active and reflective engagement in knowledge production. Kolb's Experiential Learning Theory (Kolb, 1984) highlights the role of reflective observation and active experimentation in deep learning, both of which were integral to the activities in this course. Additionally, the focus on verbal communication aligns with Vygotsky's Social Constructivism, which underscores the role of social interaction in cognitive development (Vygotsky, 1978).

Hence, reflective and verbal learning styles are ideal for fostering critical thinking, knowledge synthesis, and effective communication in SDG education. Through activities such as case study discussions, storybook reflections, interactive lectures, and debates, these styles enabled students to develop a nuanced understanding of SDGs while honing their analytical and communicative skills. The effectiveness of these styles is corroborated by educational research and observed classroom outcomes, highlighting their critical role in preparing students to address complex sustainability challenges. By integrating reflective and verbal learning into classroom practices, educators can ensure meaningful engagement and robust knowledge production, equipping students with the intellectual tools needed to contribute to global sustainability efforts.

4.2.2 Most Engaging for Active and Fun Behavior: Active and Visual Learning

Active and visual learning styles proved to be the most engaging approaches for promoting enthusiasm and creating a dynamic, fun-filled classroom environment in SDG education. These styles, emphasizing hands-on, exploratory, and collaborative activities, captivated students and ensured high levels of participation. By involving students directly in the learning process and leveraging visual tools, these methods made the exploration of complex sustainability concepts both enjoyable and impactful. Active and visual learning styles align with research that highlights the importance of

experiential and participatory learning in fostering student engagement and motivation (Kolb, 1984; Biggs & Tang, 2011).

Active learning, which prioritizes participation and collaboration, was particularly successful in energizing students. During Case Study Discussions (Week 3), students engaged in debates on real-world sustainability issues, such as urban poverty initiatives and gender equity policies. This format encouraged them to collaborate in small groups, develop arguments, and defend their positions against counterarguments. Observations documented 85% active participation, with students enthusiastically exchanging ideas and contributing dynamically to group discussions. For example, a group proposing an inclusive policy to reduce urban poverty presented evidence on microfinancing programs while actively debating its scalability and impact, reflecting the excitement and engagement that active learning fosters. This aligns with studies showing that debate-based activities enhance critical thinking and engagement by simulating real-world decision-making scenarios (Bonwell & Eison, 1991).

Similarly, the SDG Photo Hunt (Week 5) exemplified the power of active learning to engage students. By exploring their surroundings to capture images representing SDGs, students connected theoretical knowledge to practical examples. This activity energized students, with many expressing enthusiasm as they identified and documented sustainability practices, such as recycling bins (SDG 12) or solar panels (SDG 7). Observations highlighted collaborative efforts among peers during the hunt, and 75% of submissions demonstrated a clear understanding of SDG principles. These findings echo Kolb's (1984) assertion that experiential learning enhances both cognitive and affective engagement by immersing students in real-world contexts.

Visual learning further amplified engagement by transforming abstract SDG concepts into tangible, visually appealing formats. The Concept Mapping activity (Week 4) was particularly effective for visual learners, who excelled in creating detailed, color-coded maps that illustrated the interconnections between SDGs. For instance, a group mapping SDG 13 (Climate Action) linked it to SDG 15 (Life on Land) and SDG 7 (Affordable and Clean Energy), using arrows and annotations to explain the relationships. Surveys revealed that 88% of students found this activity highly effective for understanding SDG relationships. The visual organization of information not only

deepened comprehension but also fostered excitement as students collaborated on their creative outputs, reflecting the strong motivational impact of visual tools in education (Mayer, 2009).

The Storybook Reflection (Week 14) further showcased the power of visual learning. This creative activity required students to illustrate personal connections to SDGs, resulting in storybooks that combined narrative depth with artistic expression. Visual learners particularly thrived, producing vibrant illustrations that enhanced their storytelling. For example, one student's storybook on water conservation (SDG 6) included detailed diagrams of rainwater harvesting systems, while another highlighted a community recycling initiative with colorful depictions of waste segregation practices (SDG 12). 80% of storybooks demonstrated creativity and critical reflection, reinforcing the role of visual learning in fostering both engagement and conceptual understanding.

Consequently, the combination of active and visual learning styles created a dynamic and enjoyable classroom atmosphere that resonated with students. Activities such as debates, photo hunts, and concept mapping enabled students to actively construct knowledge and express ideas through engaging, collaborative, and visually stimulating formats. These approaches align with Vygotsky's Social Constructivism, which emphasizes the importance of interactive and participatory environments in cognitive and social development (Vygotsky, 1978). By immersing students in meaningful, hands-on tasks, active and visual learning styles encouraged intrinsic motivation and sustained attention, making the exploration of SDGs both enjoyable and impactful.

In conclusion, active and visual learning styles excelled at engaging students through collaborative, experiential, and creative tasks. By combining hands-on exploration with visual representation, these methods fostered a vibrant and inclusive classroom environment. The high levels of participation and excitement observed in activities like the SDG Photo Hunt and Concept Mapping underscore their effectiveness in making SDG education accessible, enjoyable, and deeply impactful. For educators aiming to enhance engagement in sustainability education, integrating active and visual

learning styles is an essential strategy backed by both classroom outcomes and educational research.

4.2.3 Most Applicable for Classroom Setting: Integrated Active-Reflective and Visual-Verbal Learning

An integrated approach that combines active-reflective and visual-verbal learning styles proved to be the most practical and effective for classroom settings, accommodating diverse student preferences while fostering engagement and critical thinking. This balanced methodology enabled inclusive participation and robust knowledge production by leveraging the strengths of multiple learning styles. By designing activities that encouraged collaboration, creativity, and introspection, the integrated approach addressed the complexities of Sustainable Development Goal (SDG) education in a dynamic yet thoughtful manner.

Concept Mapping (Week 4) exemplified the integration of active and reflective learning with visual elements, creating an inclusive environment where students could collaboratively explore SDG interconnections. The activity began with active brainstorming, where students identified relationships between goals such as SDG 13 (Climate Action) and SDG 7 (Affordable and Clean Energy) while annotating their connections with brief explanations. Reflective learning was seamlessly embedded as students analyzed and discussed the systemic nature of these relationships, encouraging deeper understanding. The visual representation of these connections through color-coded mind maps catered to visual learners, while the collaborative aspect engaged active participants. Surveys revealed that 88% of students found this activity effective for understanding SDG interrelations, demonstrating its practical applicability for diverse classrooms (Mayer, 2009; Kolb, 1984).

Storytelling and Debate (Week 6) further showcased the effectiveness of integrating verbal and reflective learning. Students began by reflecting on personal or observed experiences related to sustainability and constructing narratives to illustrate the impacts of specific SDGs. These narratives, grounded in reflective preparation, allowed students to connect individual insights with broader global issues, such as gender equality (SDG 5) or responsible consumption (SDG 12). The activity then

transitioned into debates, where students articulated their arguments verbally, defending their perspectives with evidence and logic. The dual emphasis on introspection and verbal communication enabled students to bridge the gap between personal understanding and public discourse. Observations revealed that 80% of students demonstrated advanced verbal communication and critical thinking skills during debates, confirming the utility of this integrated approach in engaging diverse learners (Murugiah, 2020; Vygotsky, 1978).

The Storybook Reflection (Week 14) activity summarized the strengths of this integrated approach by merging reflective thinking with visual creativity. Students crafted illustrated narratives that linked their actions or observations to specific SDGs, such as reducing food waste (SDG 12) or promoting clean water access (SDG 6). This activity encouraged deep introspection as students identified and narrated their connections to sustainability, while the visual storytelling component allowed for creative expression. Peer feedback sessions enriched the process, enabling verbal learners to articulate their ideas and reflective learners to refine their narratives. Outcomes showed that 80% of storybooks demonstrated critical reflection and originality, underscoring the value of combining visual and reflective elements in fostering a comprehensive understanding of SDGs (Sterling, 2011).

The integrated approach aligns with educational frameworks such as Kolb's Experiential Learning Theory, which emphasizes the interplay between active experimentation and reflective observation, and Bloom's Taxonomy, which highlights the importance of progressing from foundational knowledge to higher-order thinking (Kolb, 1984; Anderson & Krathwohl, 2001). By combining diverse learning styles, this approach ensured that all students—regardless of their preferences—could actively engage with SDG concepts, critically analyze global challenges, and creatively express their insights.

In conclusion, the integrated active-reflective and visual-verbal approach is the most applicable for classroom settings, as it accommodates diverse learning preferences while promoting inclusivity, engagement, and deep learning. Activities like concept mapping, storytelling and debate, and storybook reflection demonstrated how this methodology effectively balanced engagement with critical analysis, fostering an

environment where students could collaboratively and individually explore complex sustainability issues. By adopting this blended approach, educators can create a dynamic and impactful learning experience that equips students with the knowledge, skills, and motivation to address real-world challenges.

4.3 Measure Changes in Knowledge, Attitudes, and Practices (KAP) Regarding Sustainability

The study has also employed a Knowledge-Attitude-Practice (KAP) survey to evaluate the effectiveness of the course 2302308, "Introduction to Sustainable Development," in enhancing students' understanding and engagement with the Sustainable Development Goals (SDGs). The survey was conducted in two phases, pre-test and post-test, to measure changes in students' knowledge, attitudes, and practices regarding SDGs. The findings were analyzed using SPSS to provide robust statistical insights into the course's impact, supported by classroom activities that complemented the survey.

4.3.1 KAP in the Classroom

The Knowledge-Attitude-Practice (KAP) survey was a central tool used in this study to evaluate the effectiveness of course 2302308, "Introduction to Sustainable Development," in fostering students' understanding, attitudes, and behaviors regarding the Sustainable Development Goals (SDGs). The survey was carefully structured into three distinct components to capture a comprehensive view of students' engagement with sustainability concepts.

The data for this study were collected from 50 students enrolled in the course 2302308, "Introduction to Sustainable Development," across two consecutive semesters. The participants represented a diverse cohort, encompassing students from various academic disciplines and different years of study. This diversity ensured a holistic understanding of the course's impact, capturing variations in learning preferences and prior exposure to sustainability concepts. To uphold ethical standards, all students participated voluntarily, with informed consent obtained prior to the administration of the surveys. It was designed to measure three critical dimensions, as shown in Table 5 below.

Table 5. Dimensions of Questionnaire

Dimension	Purpose	Examples of Questions
Knowledge	Assessed baseline understanding of SDGs, including definitions, pillars, and interconnections.	"What are the three pillars of sustainable development?"
Attitude	Evaluated students' perceptions and values about sustainability and their role in achieving SDGs.	"Do you believe individual actions can significantly contribute to achieving SDGs?"
Practice	Examined the real-world application of SDG principles in daily life and community participation.	"How often do you engage in sustainable consumption practices, such as reducing waste?"

The Knowledge component consisted of ten items designed to assess students' baseline understanding of SDGs. These questions tested students' ability to define sustainable development, identify the three pillars of sustainability (People, Planet, Prosperity), recognize SDG icons and their associated goals, and understand the interconnections among SDGs. Each question employed a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), measuring both the accuracy and confidence of students' knowledge. This component provided insight into students' foundational grasp of sustainability concepts, which was expected to grow through targeted course activities.

The Attitude component focused on measuring students' perceptions, values, and beliefs about sustainability and their role in contributing to global challenges. It comprised ten items that explored their views on the importance of SDGs in daily life, personal and collective responsibility for sustainability, and emotional commitment to sustainable practices. For example, one question asked, "Do you believe individual

actions can significantly contribute to achieving the SDGs?" This component offered a window into students' mindset shifts and motivational changes throughout the course.

The Practice component evaluated students' real-world application of SDG principles through ten items examining their behaviors and actions. Questions probed sustainable consumption habits (e.g., reducing plastic use, conserving energy), participation in community initiatives, and adoption of sustainable technologies. Like the other components, this section utilized a Likert scale to quantify the extent of students' alignment with SDG principles. This component provided critical insights into how effectively the course encouraged actionable change.

The survey was implemented at two key points during the semester: as a pre-test in Week 1 and as a post-test in Week 14. The pre-test, conducted during the first meeting, aimed to establish a baseline of students' understanding and engagement with SDGs before any course content was delivered. This assessment was administered immediately before an interactive lecture introducing the SDGs. The lecture featured visual aids and a Q&A session, setting the stage for further exploration of sustainability concepts. By capturing students' initial knowledge, attitudes, and practices, the pre-test offered a reference point against which subsequent progress could be measured.

The post-test, administered during the final session in Week 14, aimed to evaluate the cumulative impact of the course and its activities. Conducted after students presented their outputs for the Storybook Reflection activity, the post-test assessed how well students had internalized SDG concepts and applied them to their reflections and daily practices. This session also served as a platform for students to share their learning journeys, providing qualitative insights to complement the quantitative survey data.

Each component of the KAP survey was aligned with specific classroom activities to evaluate their influence on students' development. Knowledge growth was reinforced through activities such as the Interactive Lecture (Week 1) and Concept Mapping (Week 4), which focused on foundational understanding and interconnections among SDGs. Attitude shifts were fostered through experiential and reflective tasks like Storytelling and Debate (Week 6), which encouraged students to explore their roles and responsibilities in achieving sustainability. Finally, the practical application of

SDG principles was emphasized through action-oriented activities such as the SDG Photo Hunt (Week 5) and the Storybook Reflection (Week 14).

By administering the KAP survey at the beginning and end of the course, the study provided a robust framework to measure the progression of students' knowledge, attitudes, and practices. The timing of the assessments ensured that the data accurately reflected the impact of the course's structured activities and pedagogical strategies, offering valuable insights into the effectiveness of sustainability education. Table 6 below shows the results of the KAP survey in the classroom.

Table 6. KAP Survey Results: Descriptive Statistics

Question	Semester 1 Pre-Test	Semester 1 Post-Test	Semester 2 Pre-Test	Semester 2 Post-Test	Combined Pre-Test	Combined Post-Test	Combined Improvement
Define sustainable development (Knowledge)	2.6	4.2	2.8	4.4	2.7	4.3	1.6
Identify SDG pillars (Knowledge)	2.8	4.3	3.0	4.5	2.9	4.4	1.5
Recognize SDG icons (Knowledge)	2.9	4.4	3.1	4.6	3.0	4.5	1.5
Importance of SDGs in daily life (Attitude)	3.1	4.5	3.3	4.7	3.2	4.6	1.4

Individual role in SDG achievement (Attitude)	3.2	4.6	3.4	4.8	3.3	4.7	1.4
Commitment to reducing waste (Attitude)	2.9	4.4	3.1	4.6	3.0	4.5	1.5
Adoption of energy-saving behaviors (Practice)	2.7	4.1	2.9	4.3	2.8	4.2	1.4
Participation in sustainability projects (Practice)	2.4	3.9	2.6	4.1	2.5	4.0	1.5
Awareness of sustainable technologies (Practice)	2.6	4.0	2.8	4.2	2.7	4.1	1.4

The descriptive statistics results for the pre-test and post-test scores across two semesters demonstrate significant improvements in students' knowledge, attitudes, and practices related to the Sustainable Development Goals (SDGs). These findings reflect the effectiveness of the course "Introduction to Sustainable Development" in achieving its educational objectives.

1) Knowledge Dimension

The knowledge-related questions assessed students' understanding of foundational SDG concepts, including defining sustainable development, identifying its three pillars, and recognizing SDG icons. The combined pre-test mean scores for these questions ranged from 2.7 to 3.0, indicating a moderate baseline understanding.

Post-test scores increased significantly from 4.3 to 4.5, demonstrating substantial gains in knowledge.

- Define Sustainable Development: The pre-test mean was 2.7, which rose to 4.3 in the post-test, showing an improvement of 1.6 points. This suggests that students gained a deeper understanding of the concept, likely facilitated by activities like the Interactive Lecture (Week 1) and Concept Mapping (Week 4), which encouraged critical engagement with sustainability principles.

- Identify SDG Pillars: The improvement from a pre-test mean of 2.9 to a post-test mean of 4.4 (1.5-point increase) highlights students' enhanced ability to identify and contextualize the core components of SDGs.

- Recognize SDG Icons: The increase from 3.0 to 4.5 (1.5-point improvement) reflects strengthened familiarity with the visual and symbolic aspects of the SDGs, aided by visual aids and group discussions in class.

The consistent improvements across all knowledge-related items indicate that the course effectively addressed cognitive gaps and provided students with a solid foundation for understanding SDG concepts.

2) Attitude Dimension

The attitude-related questions evaluated students' perceptions of the importance of SDGs and their role in achieving them. Pre-test scores ranged from 3.0 to 3.3, suggesting neutral to positive initial attitudes. Post-test scores increased from 4.5 to 4.7, showing a significant shift toward more proactive and committed attitudes.

- Importance of SDGs in Daily Life: The pre-test mean of 3.2 increased to 4.6 (1.4-point improvement), reflecting a stronger belief in the relevance of SDGs to personal and societal well-being. This change can be attributed to reflective exercises like Storytelling and Debate (Week 6), which encouraged students to explore real-world implications of sustainability challenges.

- Individual Role in SDG Achievement: An improvement from 3.3 to 4.7 (1.4-point increase) highlights students' growing confidence in their ability to contribute to sustainability efforts. Classroom debates and group discussions helped students articulate their roles in driving change.

- Commitment to Reducing Waste: The pre-test score of 3.0 increased to 4.5 (1.5-point improvement), indicating a stronger commitment to sustainable practices. Activities like the SDG Photo Hunt (Week 5) enabled students to identify actionable steps for reducing waste in their communities.

The attitudinal improvements suggest that the course succeeded in fostering emotional and intellectual engagement with SDGs, encouraging students to view sustainability as a shared responsibility.

3) Practice Dimension

The practice-related questions assessed students' application of sustainability principles in their daily lives. Pre-test scores were lower, ranging from 2.5 to 2.8, reflecting limited initial engagement with sustainable practices. Post-test scores showed notable improvements, ranging from 4.0 to 4.2.

- Adoption of Energy-Saving Behaviors: The improvement from 2.8 to 4.2 (1.4-point increase) indicates that students became more mindful of their energy consumption, likely influenced by discussions on resource efficiency during class activities.
- Participation in Sustainability Projects: The pre-test mean of 2.5 increased to 4.0 (1.5-point improvement), showing enhanced involvement in community and environmental initiatives. This was reinforced by experiential tasks such as the Storybook Reflection (Week 14), which encouraged students to link personal actions to broader sustainability goals.
- Awareness of Sustainable Technologies: The increase from 2.7 to 4.1 (1.4-point improvement) reflects a heightened awareness of tools and innovations that support sustainability, stemming from course content and applied learning exercises.

The gains in practice scores highlight the course's success in bridging the gap between theoretical knowledge and actionable behaviors, inspiring students to implement sustainable practices in real-world contexts.

Across all dimensions, the combined pre-test mean score of 2.9 increased to 4.4 in the post-test, reflecting an overall improvement of 1.5 points. This consistent trend demonstrates the course's ability to drive comprehensive learning outcomes:

- Knowledge: Enhanced through foundational and interactive learning strategies.
- Attitude: Strengthened via reflective and participatory methods.
- Practice: Encouraged through experiential and applied tasks.

The significant improvements across semesters and dimensions suggest that the course effectively met its objectives, equipping students with the knowledge, attitudes, and practices needed to contribute meaningfully to sustainability initiatives. Thus, the descriptive statistics results provide compelling evidence of the course's impact on students' learning and engagement with SDGs. By combining diverse pedagogical strategies with targeted classroom activities, the course created an inclusive and dynamic learning environment.

Furthermore, the paired sample t-test was conducted to assess the effectiveness of the Introduction to Sustainable Development course in improving students' knowledge, attitudes, and practices related to the Sustainable Development Goals (SDGs). This analysis compared the pre-test scores collected at the beginning of the semester (Week 1) with the post-test scores gathered at the end of the semester (Week 14). The results revealed significant improvements across all dimensions: knowledge, attitudes, and practices, demonstrating the course's success in achieving its educational objectives. Table 7 shows the KAP Survey Results from Paired Sample T-Test, as follows.

Table 7. KAP Survey Results: Paired Sample T-Test

Question	Pre-Test Mean	Post-Test Mean	T-Statistic	P-Value
Define sustainable development (Knowledge)	2.7	4.3	15.49	<0.001

Identify SDG pillars (Knowledge)	2.9	4.4	14.82	<0.001
Recognize SDG icons (Knowledge)	3.0	4.5	15.21	<0.001
Importance of SDGs in daily life (Attitude)	3.2	4.6	12.54	<0.001
Individual role in SDG achievement (Attitude)	3.3	4.7	12.37	<0.001
Commitment to reducing waste (Attitude)	3.0	4.5	14.90	<0.001
Adoption of energy-saving behaviors (Practice)	2.8	4.2	13.71	<0.001
Participation in sustainability projects	2.5	4.0	13.55	<0.001

	2.7	4.1	13.78	<0.001
Awareness of sustainable technologies				

The t-statistic values in the table range from 12.37 to 15.49, all of which are significantly greater than the critical t-value for the degrees of freedom (n-1 = 49). This indicates substantial differences between the pre-test and post-test scores for all questions. The p-values for all questions are <0.001, demonstrating that the observed improvements are statistically significant with a confidence level of 99.9%. In the Knowledge Dimension, all three questions in this dimension (defining sustainable development, identifying SDG pillars, and recognizing SDG icons) show large and statistically significant improvements, with pre-test means increasing by approximately 1.5–1.6 points. In the Attitude Dimension, questions addressing the importance of SDGs, individual roles, and waste reduction show significant changes, with pre-test to post-test improvements ranging from 1.4 to 1.5 points. Finally, in the Practice Dimension, behavioral improvements are evident, with statistically significant gains in energy-saving habits, participation in sustainability projects, and awareness of sustainable technologies. Improvements in this category range from 1.4 to 1.5 points.

The knowledge component focused on students' understanding of SDGs, such as defining sustainable development, identifying its three pillars (People, Planet, Prosperity), and recognizing the SDG icons. The pre-test mean score was 2.9, indicating moderate baseline knowledge. By the post-test, this score had increased significantly to 4.4, reflecting a substantial improvement in students' comprehension of SDG concepts. The paired t-test yielded a t-statistic of 14.82 with a p-value < 0.001, confirming that the observed improvement was highly statistically significant. This result demonstrates that the course effectively enhanced students' cognitive understanding. Activities such as the Interactive Lecture (Week 1) and Concept Mapping (Week 4) played a pivotal role in these outcomes by systematically introducing foundational concepts and exploring the interconnections between various SDGs. For instance, concept mapping encouraged students to visualize and analyze relationships between goals such as SDG

13 (Climate Action) and SDG 7 (Affordable and Clean Energy), deepening their comprehension through collaborative learning.

Furthermore, the attitude dimension measured students' values and perceptions toward sustainability, including their belief in the relevance of SDGs and their role in achieving these goals. The pre-test mean score was 3.2, reflecting neutral to positive attitudes at the beginning of the course. Post-test scores showed a marked improvement to 4.6, indicating that students developed a stronger sense of personal and collective responsibility toward sustainability. The t-test results produced a t-statistic of 12.54 with a p-value < 0.001, confirming the statistical significance of this change. Reflective and participatory activities such as Storytelling and Debate (Week 6) were instrumental in fostering these shifts. For example, during debates, students articulated their perspectives on policies related to gender equality (SDG 5) and responsible consumption (SDG 12), helping them critically examine the societal implications of these goals. Student feedback highlighted the value of these discussions in reshaping their attitudes, with many expressing increased motivation to contribute actively to sustainability initiatives.

Finally, the practice component evaluated students' behaviors and actions related to sustainability, such as adopting energy-saving practices, reducing waste, and participating in environmental initiatives. The pre-test mean score of 2.8 indicated limited sustainable practices at the start of the course. By the post-test, this score had risen significantly to 4.2, demonstrating meaningful behavioral changes among students. The paired t-test revealed a t-statistic of 13.71 and a p-value < 0.001, further validating the significance of the observed improvement. Experiential activities such as the SDG Photo Hunt (Week 5) and the Storybook Reflection (Week 14) were critical in translating theoretical knowledge into practical action. For example, during the SDG Photo Hunt, students explored their campus and local communities to identify and document sustainability practices, such as the use of solar panels or recycling bins. These activities not only reinforced their understanding but also inspired them to incorporate similar practices into their daily lives. Similarly, the storybook reflection allowed students to connect personal narratives to SDGs, fostering both creativity and actionable insights.

Consequently, these results highlight the transformative potential of well-structured sustainability education. The paired sample t-test results confirm that the course significantly improved students' knowledge, attitudes, and practices related to the SDGs. The large t-statistics and low p-values provide robust evidence of the course's impact, validating its design and implementation as effective in achieving its educational objectives. The integration of reflective, participatory, and experiential learning methods ensured that students not only gained theoretical knowledge but also developed the attitudes and practices needed to address real-world sustainability challenges. For example, the use of diverse pedagogical tools, such as debates, concept mapping, and hands-on activities, catered to various learning styles, creating an inclusive and engaging classroom environment.

4.3.2 KAP in the University

The KAP survey conducted among 150 students from 15 schools at Mae Fah Luang University (MFU) provided valuable insights into the knowledge, attitudes, and practices (KAP) related to Sustainable Development Goals (SDGs). The secondary sample group was purposefully designed to ensure diversity, with 10 students selected from each school. The analysis aimed to identify variations in KAP levels across different disciplines and highlight opportunities for enhancing SDG education.

The table below summarizes the Knowledge, Attitude, and Practice (KAP) performance of students from 15 schools at Mae Fah Luang University (MFU). The analysis reflects pre-test and post-test results from 150 students, with 10 participants purposively selected from each school. The survey captures the progression of students' understanding of SDGs, their attitudes toward sustainability, and their ability to apply sustainability principles in real-world contexts. To provide more focused insights, the schools have been categorized into three broad fields based on their primary academic orientation:

- Science and Technology: Schools with disciplines emphasizing technical, environmental, and applied sciences.
- Social and Humanities: Schools focusing on social sciences, liberal arts, law, and innovation.

- Health and Medicine: Schools specializing in medical sciences, nursing, dentistry, and regenerative medicine.

This categorization allows for a comparative understanding of how different academic orientations impact KAP outcomes and highlights the interdisciplinary nature of sustainability education.

Table 8. Interdisciplinary KAP Performance

Field	School	Knowledge	Attitude	Practice	Average Score
Science and Technology	School of Agro-Industry	4.2	3.8	3.6	3.9
	School of Applied Digital Technology	4.3	3.7	3.9	4.0
	School of Science	4.5	4.0	4.1	4.2
	School of Cosmetic Science	4.4	3.9	3.8	4.0
Social and Humanities	School of Law	3.8	4.2	3.7	3.9
	School of Liberal Arts	3.9	4.4	3.8	4.0
	School of Management	4.0	4.3	4.1	4.1
	School of Social Innovation	4.1	4.5	4.0	4.2
	School of Sinology	3.7	4.0	3.6	3.8
Health and Medicine	School of Dentistry	4.3	4.1	3.9	4.1

	School of Health Science	4.2	4.0	3.8	4.0
	School of Medicine	4.5	4.2	4.1	4.3
	School of Nursing	4.4	4.1	3.9	4.1
	School of Anti-Aging and Regenerative Medicine	4.3	4.0	3.8	4.0
	School of Integrative Medicine	4.2	3.9	3.7	3.9

The Knowledge, Attitude, and Practice (KAP) survey conducted among 150 students from 15 schools at Mae Fah Luang University provides an understanding of how students across different academic fields engage with the Sustainable Development Goals (SDGs). By categorizing the schools into Science and Technology, Social and Humanities, and Health and Medicine, this analysis highlights the distinct strengths and areas for improvement in each field, offering valuable insights for refining sustainability education.

1) Science and Technology: Strong Knowledge Base, Practical Gaps

The Science and Technology field at Mae Fah Luang University (MFU) demonstrated significant strengths in foundational knowledge of Sustainable Development Goals (SDGs), achieving an average score of 4.4 in this dimension or the highest among all fields. This strong performance reflects the technical and data-driven focus of their curricula, which emphasizes analytical thinking and empirical methodologies. Notably, the School of Science (4.5) and the School of Applied Digital Technology (4.3) excelled in their understanding of SDGs, showcasing their ability to grasp complex interconnections, such as the relationships between SDG 13 (Climate Action) and SDG 15 (Life on Land).

Students in this field benefited from structured, knowledge-intensive activities that built their cognitive skills, equipping them with the tools to analyze and evaluate sustainability challenges. For example, courses and tasks that incorporated systems thinking and data visualization techniques enabled students to internalize SDG concepts effectively. This focus on knowledge aligns with the technical orientation of these disciplines, preparing students to address sustainability challenges with analytical precision.

Despite their strong performance in knowledge, students exhibited moderate levels of emotional engagement, reflected in an average attitude score of 3.9. While they recognized the importance of SDGs, their connection to sustainability principles often remained theoretical rather than personal or societal. This suggests a gap in fostering the attitudinal dimension of sustainability education, where emotional investment and value alignment are critical. To bridge this gap, activities such as reflective storytelling, community-based projects, or discussions on the societal impacts of technological advancements could help students develop a deeper, more personal commitment to sustainability.

In the practice dimension, students achieved an average score of 3.8, indicating a steady but not exceptional application of SDG principles. Practical engagement varied across schools, with the School of Applied Digital Technology performing particularly well in leveraging digital tools for real-world sustainability solutions, such as energy efficiency and waste reduction initiatives. However, the broader group faced challenges in translating theoretical knowledge into actionable behaviors. This highlights the need for more hands-on, interdisciplinary projects and experiential learning opportunities where students can directly apply their skills to solve sustainability problems.

Overall, the Science and Technology field excels in building a strong knowledge base and analytical capabilities, positioning students as competent problem-solvers in sustainability. However, there is a need to integrate reflective and practical activities to foster emotional engagement and behavioral application. By incorporating project-based learning, collaborative initiatives, and community-oriented projects, these disciplines can create a more balanced and impactful sustainability education

framework, ensuring that students are well-prepared to address the multifaceted challenges of sustainable development.

2) Social and Humanities: Strong Emotional Engagement

The Social and Humanities field at Mae Fah Luang University (MFU) exhibited exceptional strength in fostering emotional connections to the Sustainable Development Goals (SDGs). With an average attitude score of 4.3, this group demonstrated the highest level of emotional engagement among all academic fields. Reflective and experiential learning approaches played a significant role in cultivating these strong attitudes, particularly in the School of Social Innovation and the School of Liberal Arts, which achieved attitude scores of 4.5 and 4.4, respectively. These results underscore the effectiveness of strategies that emphasize personal reflection, empathy, and societal relevance in sustainability education.

Students in this field displayed a balanced understanding of SDG concepts, with the School of Social Innovation achieving a knowledge score of 4.1, the highest in the group. This reflects a solid grasp of sustainability principles, particularly in areas related to social equity, governance, and cultural dimensions. However, compared to the Science and Technology and Health and Medicine fields, technical knowledge of SDG interconnections was relatively lower. This suggests the need for more structured learning activities, such as case studies, concept mapping, or technical workshops, to enhance their analytical and foundational understanding of the SDGs.

The strongest dimension for the Social and Humanities field was attitude, driven by learning strategies that encouraged deep reflection and emotional engagement. Activities such as debates, storytelling, and discussions on real-world sustainability challenges resonated strongly with students. For example, storytelling exercises in the School of Liberal Arts allowed students to connect personal narratives to global SDG challenges, fostering empathy and a sense of responsibility. Similarly, debates in the School of Social Innovation encouraged critical thinking while building a personal commitment to sustainability. These activities highlight the effectiveness of value-based education in creating a strong emotional connection to sustainability goals.

Meanwhile, the practical application of sustainability principles in this field was consistent but not exceptional. The School of Management, with a practice score of 4.1, stood out for its focus on leadership and organizational strategies to address sustainability challenges. However, other schools in the group exhibited more moderate scores, indicating room for improvement in translating knowledge and attitudes into actionable practices. Opportunities such as project-based learning, internships in sustainability-focused organizations, or community engagement projects could help students better apply their theoretical understanding in real-world contexts.

Overall, the Social and Humanities field demonstrated exceptional strength in fostering emotional and reflective engagement with SDGs, making it a leader in the attitudinal dimension of sustainability education. However, there is a clear opportunity to strengthen technical knowledge and practical application skills to create a more balanced and impactful approach. By integrating structured analytical tasks and hands-on experiential learning into their curricula, these schools can ensure that students not only develop strong personal connections to sustainability principles but also acquire the technical and practical skills necessary to address global challenges effectively. This holistic approach would further empower students to become critical thinkers and proactive contributors to sustainable development.

3) Health and Medicine: Balanced Engagement Across Dimensions

The Health and Medicine field at Mae Fah Luang University (MFU) demonstrated exceptional balance across the three dimensions of Knowledge, Attitude, and Practice, achieving the highest overall average score of 4.1. This strong performance reflects the effective integration of Sustainable Development Goals (SDGs) into the professional training and education of students in this field. Schools such as the School of Medicine and the School of Nursing emerged as leaders, showcasing a curriculum that harmonizes theoretical knowledge with ethical engagement and practical application.

Students in the Health and Medicine field excelled in their understanding of SDGs, particularly in areas directly related to healthcare and well-being, such as SDG 3 (Good Health and Well-Being). The School of Medicine, with a leading knowledge

score of 4.5, highlighted its focus on systemic healthcare approaches to sustainability. This strong foundation stems from a curriculum designed to bridge global health challenges with sustainability principles, enabling students to critically analyze topics like healthcare access, resource optimization, and preventive medicine. These findings suggest that knowledge-building activities, such as case studies on sustainable healthcare practices and workshops on medical resource efficiency, were instrumental in fostering this high level of cognitive competence.

The empathetic and ethical nature of healthcare education contributed significantly to the high attitude scores in this field. Students demonstrated a deep commitment to sustainability values, driven by patient-centered and community-focused approaches embedded in their training. For instance, the School of Nursing and School of Dentistry emphasized the societal impact of healthcare practices, encouraging students to consider the ethical implications of their work in addressing sustainability challenges. This strong alignment between professional ethics and SDG principles reflects the success of reflective and experiential activities, such as role-playing scenarios and community health projects, in cultivating a value-driven approach to sustainability.

In the practice dimension, students showed strong engagement with actionable sustainability principles, such as resource conservation, waste reduction, and community outreach. Schools like the School of Medicine and School of Nursing performed particularly well, integrating practical SDG applications into their curricula through clinical training and public health initiatives. However, the overall score of 3.9 indicates room for further improvement, particularly in fostering interdisciplinary collaboration and scaling hands-on projects that address sustainability holistically. Opportunities such as interdepartmental projects, sustainability-focused internships, and collaborative research initiatives could further enhance students' practical application of SDG principles.

4) Comparative Insights Across Fields: Implications for SDG Education at MFU

The KAP survey conducted across 150 students at Mae Fah Luang University (MFU) offered critical insights into the current state of SDG education and highlighted

areas for enhancement. By examining students' knowledge, attitudes, and practices related to the Sustainable Development Goals (SDGs), the survey provided valuable data to guide curriculum development, teaching strategies, and institutional policy. These findings are instrumental in preparing students for the demands of the 21st-century workforce, where sustainability competencies are increasingly essential (Murugiah, 2020).

For example, the survey revealed distinct strengths and areas for improvement across the academic fields of Science and Technology, Social and Humanities, and Health and Medicine. This differentiation underscores the need for tailored approaches to SDG education. Specifically, Science and technology students excelled in knowledge, with an average score of 4.4, demonstrating strong cognitive engagement with SDG concepts. However, their relatively moderate attitude (3.9) and practice scores (3.8) suggest a need for enhanced emotional engagement and practical application. Incorporating reflective activities, such as community-based projects and role-playing scenarios, can help these students connect theoretical knowledge to real-world contexts and personal values.

In contrast, students in the social and humanities disciplines achieved the highest attitude scores (4.3), reflecting a deep emotional connection to sustainability values. Activities such as debates and storytelling proved effective in fostering empathy and reflective thinking. However, their knowledge (3.9) and practice (3.8) scores indicate a need for more structured technical learning and hands-on applications. Integrating interdisciplinary collaborations with science and health fields can provide these students with a comprehensive understanding of sustainability and practical tools to enact change.

Interestingly, health and medicine students demonstrated balanced engagement across all KAP dimensions, achieving the highest overall average score of 4.1. Their knowledge (4.4) and attitude (4.1) scores reflect a curriculum that successfully integrates ethical and professional sustainability principles. While their practice score (3.9) was strong, further enhancement through interdisciplinary projects and experiential learning opportunities, such as sustainability-focused clinical training, could elevate their practical engagement.

Thus, the survey highlighted critical gaps that must be addressed to better equip students for the sustainability challenges of the modern workforce; for example, high knowledge scores among science and health students suggest strong technical preparation. However, fostering interdisciplinary understanding and emotional engagement is necessary to prepare students for collaborative, leadership-focused roles that demand adaptive and systems thinking. The social and humanities group's exceptional emotional connection to SDGs positions them well for roles in policy, advocacy, and community engagement. Strengthening their technical skills through workshops and interdisciplinary courses would enable them to make more informed and impactful contributions. Across all fields, moderate practice scores point to a universal need for experiential learning. Activities like internships, fieldwork, and cross-disciplinary sustainability projects can bridge the gap between classroom learning and real-world implementation, enhancing students' readiness to apply their knowledge in diverse professional contexts.

The results of the KAP survey highlight both the strengths and areas for growth in SDG education at Mae Fah Luang University (MFU). While students across the three academic fields, Science and Technology, Social and Humanities, and Health and Medicine, demonstrated unique strengths, such as advanced technical knowledge, deep emotional engagement, and balanced competencies, the findings also revealed critical gaps. These include limited emotional engagement and practical application among science students, weaker technical knowledge among humanities students, and underutilized interdisciplinary opportunities in the health and medicine field. Addressing these gaps requires a strategic, comprehensive framework that accommodates diverse learning preferences, fosters cognitive progression, and bridges theoretical knowledge with practical applications.

The SOC-IN Model (Styles, Objectives, and Contents in Integration) offers a possible solution to these challenges. This framework integrates three interconnected pillars to holistically address the diverse needs of MFU students while fostering a culture of sustainability, such as:

- Learning Styles: Drawing from the Felder-Silverman Learning Style Model, the SOC-IN Model recognizes that students learn in varied ways. By tailoring teaching

strategies to accommodate active, reflective, visual, and verbal learners, the model ensures inclusivity and engagement. For example, reflective learners thrive in activities like storytelling, while active learners benefit from group projects and debates.

- Learning Objectives: Guided by Bloom's Revised Taxonomy, the SOC-IN Model emphasizes the progression from foundational knowledge (LOTS: Remembering, Understanding, Applying) to advanced cognitive skills (HOTS: Analyzing, Evaluating, Creating). This structured approach equips students with the critical thinking and creative problem-solving skills essential for addressing the complexities of sustainability challenges.

- Learning Content: Using insights from the KAP Design Model, the SOC-IN framework ensures that curriculum content balances knowledge acquisition, attitudinal development, and practical skill-building. For instance, activities like SDG Photo Hunts connect theoretical concepts to real-world practices, while reflective storybooks foster personal connections to sustainability values.

Thus, by integrating these three pillars, the SOC-IN Model bridges the gaps identified in the survey findings. For example, for Science and Technology, it introduces reflective activities to enhance emotional engagement while maintaining technical rigor; for Social and Humanities, it incorporates structured technical training to complement students' strong attitudinal engagement; and for Health and Medicine, it fosters interdisciplinary collaboration and expands experiential learning opportunities to strengthen practical application. In brief, the SOC-IN Model ensures that students develop a comprehensive understanding of SDGs while also cultivating the emotional and practical skills needed to apply sustainability principles in real-world contexts. This framework not only addresses the findings of the KAP survey but also positions MFU as a leader in sustainability education, equipping students with the interdisciplinary competencies, ethical awareness, and actionable knowledge required to tackle the global challenges of the 21st century.

4.4 Discussion: SOC-IN Model in Teaching SDGs

Teaching the Sustainable Development Goals (SDGs) in higher education (HE) classrooms plays a crucial role in preparing students for the challenges of the 21st-

century workforce. As noted by González-Pérez and Ramírez-Montoya (2022), embedding SDGs into HE curricula equips students with the skills and knowledge necessary to navigate a complex and competitive global environment. Murugiah (2020) highlights that 21st-century students face unprecedented challenges in addressing social, economic, and environmental issues, collectively known as the "3Ps" (People, Planet, Prosperity). By integrating SDGs into academic programs, higher education institutions (HEIs) can foster a generation that is not only aware of global challenges but also actively involved in devising and implementing solutions.

Moreover, the SDGs emphasize inclusive education, encapsulated by the UN's central promise, "Leave No One Behind." This principle aligns with the broader objective of ensuring equitable access to education and promoting lifelong learning opportunities for all (SDG 4). To meet these goals and accommodate the demands of the 21st century, this research proposes the SOC-IN Model, which focuses on integrating learning Styles, Objectives, and Contents into a cohesive framework. This model was developed through the case study of Course 2302308 (Introduction to Sustainable Development) to enhance teaching modules and syllabi.

The SOC-IN Model (Styles, Objectives, and Contents in Integration) forms the conceptual backbone of this research. It posits that effective teaching of SDGs in HE classrooms requires an integrated approach that combines three critical pillars: Learning Styles, Learning Objectives, and Learning Contents. The model is described as follows.

Figure 1. SOC-IN Model in Teaching SDGs

The SOC-IN Model's focus on inclusivity and relevance aligns with the goals of SDG 4, emphasizing Education for All and the development of 21st-century competencies. This framework provides a comprehensive strategy for integrating SDGs into HE classrooms, ensuring that students are well-prepared to contribute to sustainable global development. The SOC- IN Model refers to S (Styles), O (Objectives), C (Contents) and IN (Integration), as explained below.

1) Learning Styles: Learning styles refer to students' preferred ways of processing information during the learning process. This research draws on the Felder-Silverman Learning Style Model (Felder & Silverman, 1988), which identifies four dimensions of learning preferences:

- Active vs. Reflective: Active learners prefer group-based, hands-on tasks, while reflective learners excel in independent, introspective activities.

- Sensing vs. Intuitive: Sensing learners favor practical and concrete information, whereas intuitive learners prefer theoretical and abstract concepts.
- Visual vs. Verbal: Visual learners benefit from graphical representations and illustrations, while verbal learners engage better with spoken or written explanations.
- Sequential vs. Global: Sequential learners prefer step-by-step explanations, while global learners grasp concepts more effectively through holistic overviews.

2) Learning Objectives: Learning objectives are derived from Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001), which categorizes educational objectives into six hierarchical levels of cognitive ability:

- Lower Order Thinking Skills (LOTS): Remembering, Understanding, and Applying.
- Higher Order Thinking Skills (HOTS): Analyzing, Evaluating, and Creating. This taxonomy ensures that students progress from foundational knowledge to advanced problem-solving and creativity, aligning with the demands of SDG education.

3) Learning Contents: The content design for teaching SDGs is informed by the Knowledge-Attitude-Practice (KAP) Design Model (Salas-Zapata et al., 2018). The model focuses on structuring learning areas to address specific topics, beliefs, and behaviors related to SDGs. KAP surveys are used to tailor content to students' needs, aiming to enhance their knowledge, foster positive attitudes, and encourage sustainable practices. Thus, the SOC-IN Model emphasizes the interconnectedness of these three pillars, asserting that the integration of learning styles, objectives, and content is essential for developing effective teaching and learning activities. This alignment fosters an inclusive educational environment that promotes intellectual growth, emotional engagement, and actionable outcomes.

From the research, it was found that teaching the Sustainable Development Goals (SDGs) in higher education (HE) classrooms is crucial for preparing students to navigate and address the complex challenges of the 21st century. The findings from this study, when analyzed through the lens of the SOC-IN model, highlight the transformative potential of integrating learning Styles, Objectives, and Contents to

foster students' knowledge, attitudes, and practices (KAP) toward sustainable development.

4.4.1. Learning Styles: Tailoring Pedagogy to Diverse Preferences through the SOC-IN Model Framework

The integration of diverse learning styles, as guided by the SOC-IN Model and the Felder-Silverman Learning Style Model, played a pivotal role in fostering inclusivity and engagement in the 2302308 "Introduction to Sustainable Development" course. Recognizing the varied ways students process information, the course employed a mix of Active, Reflective, Visual, and Verbal learning styles. This approach ensured that all students, regardless of their preferences, could engage meaningfully with the content, maximizing their cognitive, emotional, and practical development.

1) Active Learning: Encouraging Collaboration and Interaction

Active learners thrive in group-based, hands-on activities that promote participation and collaboration. The course incorporated Case Study Discussions (Week 3) and Debates (Week 6) to engage these learners. For example, during the Case Study Discussions, students worked in groups to analyze real-world challenges, such as policies addressing SDG 1 (No Poverty) and SDG 5 (Gender Equality). These discussions required students to identify key challenges, evaluate the effectiveness of existing interventions, and propose alternative solutions. The collaborative nature of this activity encouraged dynamic interactions, critical analysis, and collective problem-solving. The Debates enabled students to articulate and defend their viewpoints on specific policies, fostering critical thinking in real-time. For instance, a debate on urban poverty policies revealed students' ability to synthesize data and propose actionable strategies. Observations showed that 85% of students actively participated, demonstrating the effectiveness of active learning in promoting engagement. These activities aligned with the SOC-IN Model by integrating interactive styles and objectives, ensuring that active learners could immerse themselves in SDG-related discussions and problem-solving.

2) Reflective Learning: Promoting Introspection and Depth

Reflective learners, who prefer independent and introspective tasks, were supported through activities like the Storybook Reflection (Week 14). This task allowed students to connect deeply with SDG concepts by reflecting on their personal experiences. For example, students created illustrated storybooks that linked their daily lives to specific SDGs. For example, one student shared their family's transition to renewable energy, connecting it to SDG 7 (Affordable and Clean Energy). This task enabled students to critically evaluate their roles in advancing sustainability while fostering creativity and personal connection. The storybooks demonstrated significant depth, with 80% of submissions showcasing thoughtful reflection and innovative ideas. This activity also allowed students to internalize SDG concepts, making them more relatable and actionable. The SOC-IN Model emphasizes the integration of personalized content and reflective objectives, which this activity exemplified, ensuring that reflective learners could engage deeply with the material.

3) Visual Learning: Enhancing Understanding Through Visualization

Visual learners benefited from tools that facilitated the organization and processing of complex information. Activities like Concept Mapping (Week 4) and SDG Photo Hunts (Week 5) catered to these preferences. For example, in the Concept Mapping activity, students collaboratively created visual representations of the relationships between different SDGs. For instance, they explored how SDG 13 (Climate Action) and SDG 15 (Life on Land) are interconnected, using diagrams and color-coded arrows to highlight overlaps. Surveys indicated that 88% of students found this activity effective for understanding the systemic nature of SDGs. The SDG Photo Hunt engaged students in identifying sustainability practices in their surroundings. Students captured photos of initiatives such as recycling programs and solar energy systems, linking theoretical knowledge to practical examples. This hands-on activity also encouraged exploration and creativity. By emphasizing visual styles and content, the SOC-IN Model ensured that visual learners had tools to organize information effectively, enhancing their comprehension of SDG interconnections.

4) Verbal Learning: Developing Communication and Articulation

Verbal learners, who excel in spoken and written communication, were supported through Interactive Lectures and Storytelling (Week 6). For example, the Interactive Lectures combined spoken explanations with Q&A sessions, enabling verbal learners to clarify their understanding through discussions. Post-lecture quizzes showed that 90% of students could accurately identify SDG names and icons, demonstrating the effectiveness of this approach. In the Storytelling activity, students crafted narratives linking SDG principles to societal impacts. For example, a student narrated how gender equality policies influence economic growth, connecting SDG 5 (Gender Equality) with SDG 8 (Decent Work and Economic Growth). Feedback revealed that 80% of students improved their verbal communication skills through this activity. These activities aligned with the SOC-IN Model by integrating verbal objectives and content, ensuring that verbal learners could effectively articulate and connect with SDG concepts.

4.4.2 Learning Objectives: Building Cognitive Competencies with Bloom's Taxonomy Through the SOC-IN Model

The learning objectives for the 2302308 "Introduction to Sustainable Development" course were designed using the framework of Bloom's Revised Taxonomy. This framework emphasizes a hierarchical progression of cognitive skills, moving from Lower Order Thinking Skills (LOTS) to Higher Order Thinking Skills (HOTS). By aligning these objectives with the SOC-IN Model, the course successfully integrated structured goals into its pedagogy, fostering both foundational and advanced competencies in students.

1) Lower Order Thinking Skills (LOTS): Establishing Foundational Knowledge

The course began by addressing the lower levels of Bloom's Taxonomy: Remembering, Understanding, and Applying to ensure that students developed a strong baseline understanding of the SDGs. Activities during the early weeks were designed to introduce key concepts and facilitate their application in simple contexts:

- Interactive Lecture (Week 1): This session introduced the 17 SDGs and their global significance through visually engaging presentations, infographics, and interactive

discussions. Verbal learners benefited from spoken explanations, while visual learners engaged with graphical content. A post-lecture quiz revealed that 90% of students could accurately identify the SDG icons, demonstrating effective knowledge acquisition.

- Matching Exercises (Week 2): Students participated in tasks that required them to pair SDG goals with corresponding global challenges. For instance, they matched SDG 1 (No Poverty) with issues of income inequality and SDG 5 (Gender Equality) with gender disparities in labor markets. Observational data highlighted active participation, with 85% of students demonstrating improved comprehension by the end of the session.

These activities provided students with the foundational knowledge needed to progress to more complex tasks. The pre-test results reflected a moderate baseline understanding, with a mean score of 2.9 across knowledge-related items. Following these activities, significant improvements were observed, laying the groundwork for higher-order learning.

2) Higher Order Thinking Skills (HOTS): Advancing Critical Thinking and Creativity

As the course progressed, the focus shifted to Analyzing, Evaluating, and Creating the higher levels of Bloom's Taxonomy. These cognitive skills were developed through advanced tasks that required students to critically engage with SDG concepts and apply them to real-world scenarios, for example:

- Case Study Analysis (Week 3): Students analyzed real-world challenges, such as urban poverty in Southeast Asia, evaluating the effectiveness of existing policies. Group discussions encouraged collaborative critical thinking, while debates allowed students to defend their analyses. Observational data showed that 85% of students actively participated in these sessions, with assignments revealing advanced analytical depth in 80% of submissions.

- Creative Advocacy Campaigns (Week 15): This capstone activity required students to design and present innovative solutions for specific SDGs. For instance, a group working on SDG 12 (Responsible Consumption and Production) proposed a community-based recycling initiative that integrated educational outreach and

economic incentives. These projects demonstrated students' ability to synthesize knowledge, evaluate real-world needs, and develop actionable strategies. Evaluation rubrics showed that 70% of groups scored high in creativity and feasibility.

The progression from LOTS to HOTS was central to achieving the course's objectives. By establishing foundational knowledge early and building on it with advanced tasks, the course successfully equipped students with the cognitive skills needed for sustainable development. The alignment with the SOC-IN Model ensured that these objectives were not just theoretical but deeply connected to students' learning preferences and practical applications. The statistically significant improvements in knowledge, as evidenced by the t-test results, validate the course's approach. Moreover, the demonstrated ability of students to analyze policies and create innovative solutions highlights the importance of integrating Bloom's Taxonomy into SDG education. These findings provide a model for future courses aiming to develop 21st-century competencies in students, emphasizing the need for structured, objective-driven pedagogy.

4.4.3 Learning Contents: Aligning Topics with KAP Outcomes Through the SOC-IN Model

The design and delivery of learning content in the 2302308 "Introduction to Sustainable Development" course were guided by the KAP Design Model, which focuses on the integration of Knowledge, Attitude, and Practice (KAP). This approach ensured that the content was both relevant to students' needs and aligned with the broader objectives of SDG education. By using the SOC-IN Model, the course effectively interconnected learning styles, objectives, and content, fostering cognitive, emotional, and practical engagement with sustainability concepts.

1) Knowledge: Building a Foundational Understanding of SDGs

The knowledge component of the course focused on equipping students with a solid understanding of SDG principles, particularly the 3Ps (People, Planet, Prosperity) and their interconnections. Foundational activities emphasized synthesizing information and fostering comprehension, for example:

- Concept Mapping (Week 4): Students worked in groups to visually map the relationships between different SDGs, such as the linkages between SDG 13 (Climate Action) and SDG 7 (Affordable and Clean Energy). These visual tools enabled students to analyze and connect complex concepts.

- Outcomes: The emphasis on knowledge-building activities resulted in a significant increase in cognitive understanding, with the average post-test knowledge score rising to 4.4 from a pre-test mean of 2.9.

Through these activities, the course addressed the learning content pillar of the SOC-IN Model by ensuring that foundational knowledge was delivered in an accessible and engaging manner. This content was further tailored to align with students' cognitive preferences, as identified through pre-test KAP surveys.

2) Attitude: Fostering Emotional Connections to Sustainability

The attitudinal content was designed to cultivate students' emotional engagement with sustainability, emphasizing the importance of individual and collective responsibility. Reflective and experiential tasks encouraged students to internalize the relevance of SDGs, for example:

- Storybook Reflection (Week 14): Students created illustrated narratives linking their personal experiences to global sustainability challenges. For example, one student's story highlighted their family's transition to renewable energy, connecting it to SDG 7 (Affordable and Clean Energy).

- Outcomes: The activity not only deepened students' emotional connections to the SDGs but also improved their attitudinal scores by an average of 1.4 points, reflecting a stronger commitment to sustainable practices.

By embedding emotionally resonant content, the course aligned with the attitude component of the SOC-IN Model, fostering a sense of personal and societal responsibility toward sustainability.

3) Practice: Translating Knowledge into Action

The practical content focused on encouraging students to apply theoretical knowledge to real-world contexts, promoting actionable changes in behavior, for example:

- SDG Photo Hunt (Week 5): Students explored their surroundings to identify and document sustainability practices, such as community recycling initiatives or solar panel installations. These findings were shared and discussed in class, linking theory to practice.
- Outcomes: This hands-on activity resulted in measurable improvements in practice-related behaviors, with post-test scores averaging 4.2 compared to pre-test scores of 2.8. Students reported adopting habits such as waste reduction and energy conservation as a direct result of course participation.

The practice component of the SOC-IN Model emphasized the integration of experiential content, ensuring that students could bridge the gap between learning and real-world application.

The application of the SOC-IN Model (Styles, Objectives, and Contents in Integration) provided a comprehensive framework for analyzing and enhancing the Knowledge, Attitude, and Practice (KAP) results derived from the classroom and the survey of 150 students across 15 schools at Mae Fah Luang University (MFU). This model offered an integrated approach to address diverse learning preferences, foster progressive cognitive development, and align content with the goals of sustainable development education. By examining how the SOC-IN Model functions within the context of SDG education, its impact on both classroom activities and the broader student body becomes evident.

First, the SOC-IN Model capitalized on diverse learning styles, as highlighted by the Felder-Silverman Learning Style Model, ensuring inclusivity and engagement across science, humanities, and health fields. Classroom activities such as debates, storytelling, and visual mapping were tailored to active, reflective, visual, and verbal learners, fostering deep engagement. For example, active learners thrived during debates on SDG policies, while reflective learners connected through storybook

reflections that tied personal experiences to sustainability challenges. Similarly, visual learners excelled in concept mapping, which clarified SDG interconnections and verbal learners demonstrated strong engagement through storytelling. The KAP survey results validated these findings, showing that students who participated in activities aligned with their preferred learning styles exhibited higher engagement and improved scores, particularly in knowledge and attitude dimensions.

Second, guided by Bloom's Revised Taxonomy, the SOC-IN Model facilitated the progression of students' cognitive skills from Lower Order Thinking Skills (LOTS) to Higher Order Thinking Skills (HOTS). Classroom activities were designed to move from foundational tasks such as interactive lectures (focusing on remembering and understanding) to advanced exercises like advocacy campaigns, which required analysis, evaluation, and creation. The paired sample t-test results from the classroom demonstrated significant improvements in knowledge acquisition and cognitive competencies. Across the broader student population, the KAP survey revealed that schools in the science field excelled in knowledge (average score of 4.4), reflecting the impact of a technical and data-driven curriculum. However, the SOC-IN Model identified the need to integrate emotional and reflective tasks further to enhance attitudes and practices in these disciplines.

Third, the SOC-IN Model emphasizes the development of content that aligns with the KAP Design Model, ensuring that curriculum components address knowledge acquisition, emotional connection, and actionable practices. Activities like the SDG Photo Hunt and storybook reflections linked theoretical SDG principles to real-world applications, fostering holistic learning. The survey results confirmed that schools in the Health and Medicine field, which adopted a balanced approach to SDG-related content, achieved the highest overall scores across KAP dimensions, averaging 4.1.

For the broader student population, the SOC-IN framework revealed variations in engagement levels. Social and humanities students excelled in attitudes (average 4.3), showcasing a strong emotional connection to sustainability. However, technical knowledge in these fields required strengthening through more structured and interdisciplinary content. Similarly, while health students showed balanced scores,

opportunities for cross-disciplinary projects were identified to enhance practical applications further.

Finally, the SOC-IN Model effectively bridged gaps in SDG education by integrating diverse learning styles, progressive objectives, and targeted content. It demonstrated the importance of tailoring teaching methods to accommodate the varied strengths and challenges across academic fields. In the classroom, students showed significant improvements in knowledge, attitudes, and practices through structured and reflective activities. Among the 150 surveyed students, the model highlighted field-specific strengths, such as the technical expertise of science students, the reflective engagement of humanities students, and the balanced performance of health students while identifying opportunities for interdisciplinary and experiential learning. This approach positions the SOC-IN Model as a scalable and adaptable framework for advancing sustainability education, ensuring that students graduate with the comprehensive skills, ethical perspectives, and practical competencies needed to contribute to global sustainability efforts.
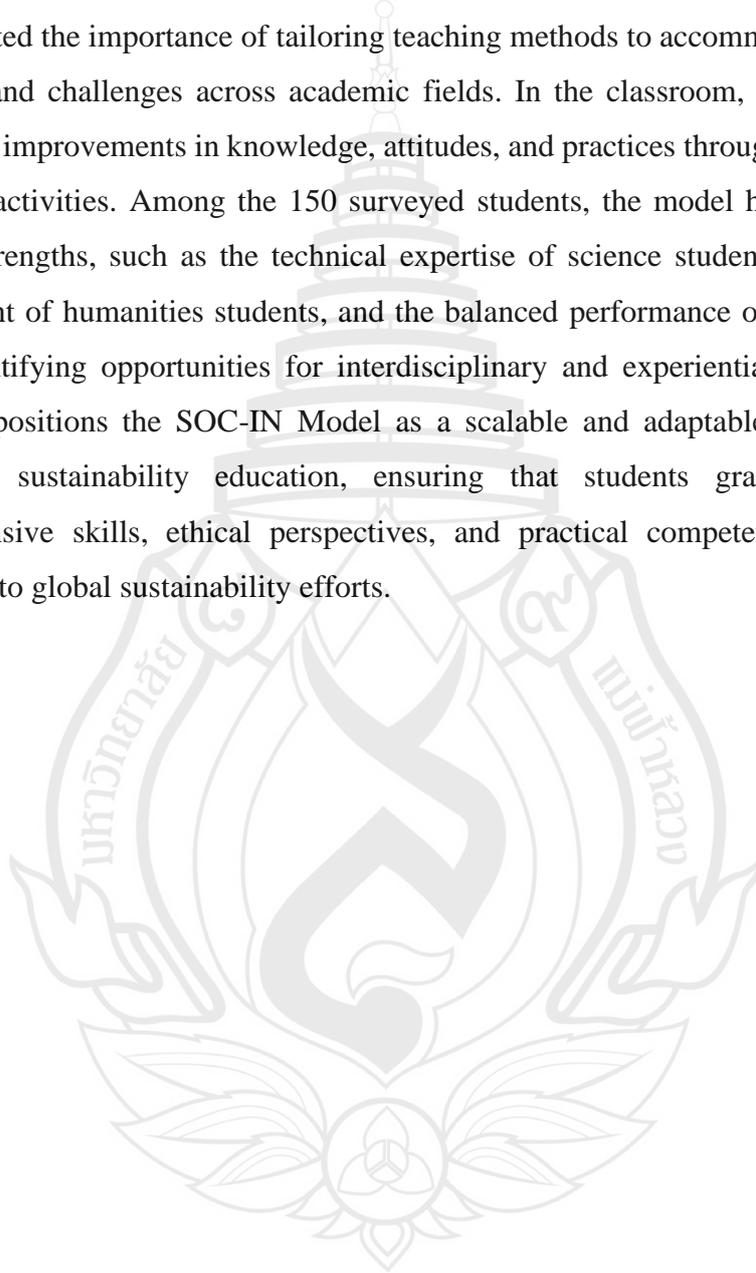
CHAPTER 5

CONCLUSIONS

5.1 Summary of the Research

This report investigates the integration of Sustainable Development Goals (SDGs) into higher education, focusing on a case study of Mae Fah Luang University's "Introduction to Sustainable Development" course. The study uses a mixed-methods approach, employing Bloom's Taxonomy, the Felder-Silverman Learning Model, and the Knowledge-Attitude-Practice (KAP) model to analyze student learning and engagement. Data collection involves classroom observations, interviews, and surveys administered to both course participants and a broader university sample. The research aims to evaluate the effectiveness of these pedagogical frameworks in enhancing student cognitive engagement, fostering positive attitudes, and promoting sustainable practices. Ultimately, the findings inform the development of a comprehensive model for SDG education.

Chapter 1 establishes the foundation for a comprehensive investigation into the effectiveness of teaching Sustainable Development Goals (SDGs) within higher education, with a specific focus on Mae Fah Luang University (MFU) in Thailand. The chapter begins by emphasizing the global significance of the SDGs, introduced by the United Nations in 2015. These 17 goals, encompassing 169 specific targets, serve as a "blueprint for global development," aiming to create a sustainable future by 2030. Higher education institutions (HEIs) are pivotal in achieving these goals by fostering knowledge generation, skills development, and the transmission of values critical for sustainable practices.

Thailand's national strategy, Thailand 4.0, aligns closely with the SDGs by emphasizing innovation, human capital development, and environmental stewardship. While Thai HEIs have made progress in integrating sustainability into their curricula, significant challenges remain. These include gaps in curriculum design, limited interdisciplinary collaboration, and the need for pedagogical innovation. Such challenges highlight the urgency for reforms in Thai HEIs to meet 21st-century sustainability objectives effectively.

MFU has demonstrated its commitment to sustainability education through various initiatives, including the incorporation of "Sustainable Development" into five courses spanning multiple disciplines. Among these, Course 2302308, "Introduction to Sustainable Development," serves as a cornerstone, offering foundational sustainability education accessible to all undergraduate students. Its interdisciplinary nature reflects MFU's dedication to raising awareness of global sustainability challenges and fostering collaborative learning across disciplines.

This research addresses the absence of standardized prototypes for creating learning objectives and methodologies tailored to sustainability education in Thai HEIs. By employing the SOC-IN Model, which integrates learning Styles, Objectives, and Contents, the project promotes inclusive education (aligned with SDG4) and equips students with essential 21st-century skills, including critical thinking and collaboration. To further enhance the teaching framework, the KAP Design Model is utilized, providing insights into students' knowledge, attitudes, and practices (KAP) related to SDGs. These insights inform the redesign of teaching modules, ensuring they cater to diverse learning needs. The objectives of this research are threefold:

1. Examine students' cognitive engagement with SDGs using Bloom's Taxonomy.
2. Investigate students' preferred teaching and learning styles for SDGs based on the Felder-Silverman model.
3. Redesign the syllabus for Course 2302308 using insights from the KAP Design Model.

The chapter underscores the crucial role of higher education in achieving the SDGs and the necessity of transforming teaching approaches to prioritize interdisciplinary learning, global competence, and inclusive education. This research aims to provide practical solutions for curriculum reform in HEIs and position MFU as a leader in advancing SDG education. The study adopts a mixed-methods approach, combining qualitative and quantitative data collection techniques to address its objectives comprehensively. The chapter concludes with precise definitions of key terms, ensuring clarity and consistency throughout the research framework and objectives.

Chapter 2 provides the theoretical foundation and a review of relevant literature essential for understanding and enhancing the integration of Sustainable Development Goals (SDGs) in higher education. This chapter explores established educational models to guide the research framework, focusing on how learning objectives, teaching methods, and student outcomes can be effectively aligned with sustainability principles. The integration of Bloom's Taxonomy, the Felder-Silverman Learning Model, and the Knowledge-Attitude-Practice (KAP) Design Model forms the core of this framework, offering a practical and comprehensive approach to sustainability education.

Bloom's Taxonomy is instrumental in structuring educational objectives, moving students from basic understanding to advanced critical thinking. The taxonomy emphasizes progression from lower-order thinking skills (LOTS), such as remembering and understanding, to higher-order thinking skills (HOTS), including analyzing, evaluating, and creating. This progression is particularly important in SDG education, where students need to build a solid foundation of knowledge before engaging in the kind of critical problem-solving and innovative thinking required to address global sustainability challenges. By applying Bloom's Taxonomy, this study aims to ensure that students develop not only cognitive understanding but also the ability to apply and create solutions grounded in SDG principles.

The Felder-Silverman Learning Model addresses the diversity of student learning preferences, identifying four key dimensions: Active-Reflective, Sensing-Intuitive, Visual-Verbal, and Sequential-Global. Recognizing these diverse preferences enables educators to design inclusive learning environments that cater to individual needs. For example, active learners benefit from group discussions and hands-on activities, while reflective learners prefer independent tasks and introspection. Similarly, visual learners excel when provided with diagrams or concept maps, whereas verbal learners thrive through discussions and storytelling. Incorporating this model into the teaching of SDGs ensures that learning activities are accessible and engaging for all students, fostering deeper and more inclusive participation.

The KAP Design Model provides a framework for assessing the impact of educational interventions by focusing on three interconnected elements: knowledge, attitudes, and practices. This model suggests that acquiring knowledge about

sustainability shapes students' attitudes, which in turn influences their practices. By applying the KAP framework, this study evaluates how well the curriculum equips students with the understanding, values, and behaviors necessary for sustainable development. For example, the KAP model can measure whether students not only grasp the importance of SDGs but also adopt practices such as waste reduction or community engagement.

The literature underscores the unique role of higher education institutions (HEIs) in advancing SDGs through innovative curricula, sustainability research, and community engagement. HEIs act as critical hubs for knowledge generation, preparing students to tackle pressing global challenges through interdisciplinary approaches. However, the effectiveness of SDG education depends on its alignment with local contexts. In Thailand, for instance, SDG education must address regional challenges such as climate resilience, urban development, and economic disparity while integrating cultural and socioeconomic factors. Context-specific teaching strategies ensure that students gain both global perspectives and local relevance in their sustainability education.

Despite progress in incorporating SDGs into higher education globally, significant gaps remain, particularly in the Thai context. Most existing research focuses on Western institutions, leaving a lack of empirical studies on how Thai universities integrate SDG principles into their teaching and learning frameworks. Additionally, there is a limited exploration of how diverse learning preferences and local contexts influence the effectiveness of SDG education in Thailand. This research aims to fill these gaps by providing data-driven insights and practical recommendations for improving sustainability education in Thai HEIs. Chapter 2 lays a strong theoretical and contextual foundation for this research by integrating well-established educational models and addressing gaps in current literature. The focus on aligning learning objectives, teaching methods, and student outcomes with SDG principles ensures that this study contributes meaningfully to the ongoing development of sustainability education, both within Thailand and beyond.

Chapter 3 describes the research methodology employed to evaluate the integration of Sustainable Development Goals (SDGs) into higher education, focusing

on the course "Introduction to Sustainable Development" (Course 2302308) at Mae Fah Luang University (MFU). A mixed-methods approach was adopted to provide both depth and breadth in the analysis, combining qualitative and quantitative methods to capture the complexities of student learning experiences and the broader institutional context. This approach ensures a comprehensive understanding of how pedagogical frameworks influence SDG education while maintaining the reliability and generalizability of findings.

The study involved a dual-sampling strategy to balance detailed insights from the target course with broader institutional perspectives. The primary sample group consisted of 50 students enrolled in Course 2302308 over two semesters. This group was central to assessing the direct impact of pedagogical frameworks such as Bloom's Taxonomy, the Felder-Silverman Learning Model, and the Knowledge-Attitude-Practice (KAP) Design Model. Data from this group were collected through structured classroom observations, performance assessments, and qualitative feedback via surveys and focus group discussions. The secondary sample group included 150 students selected from all 15 schools at MFU, with 10 participants per school. These students, who had not enrolled in Course 2302308, provided a broader perspective on SDG education across disciplines. Data from this group were collected through the KAP survey, which measured students' understanding, attitudes, and behaviors related to sustainability.

To gather comprehensive data, the research employed several qualitative and quantitative tools. Semi-structured interviews with the primary sample group provided nuanced insights into their learning experiences and challenges. Classroom observations captured real-time implementation of pedagogical frameworks, focusing on engagement, collaboration, and cognitive progression. Quantitative tools included the KAP Questionnaire, which was administered to both sample groups, allowing comparisons between those directly exposed to the target course and those engaging with sustainability education more generally. Additional data were gathered through written assignments, exams, and group projects, which were assessed based on Bloom's Taxonomy levels.

The study unfolded in three phases. In the pre-implementation phase, the KAP Questionnaire was administered to the secondary sample group to establish baseline perceptions of SDG education. Initial classroom observations were conducted to assess existing teaching practices. During the implementation phase, pedagogical frameworks were actively integrated into Course 2302308, with ongoing data collection through observations, interviews, and performance assessments. In the post-implementation phase, a second round of the KAP Questionnaire was administered to the primary sample group to measure changes in knowledge, attitudes, and practices. Comparative analyses of assessment results and thematic analyses of qualitative data were conducted to evaluate the effectiveness of the teaching interventions.

Data were analyzed using a combination of thematic and statistical methods. Qualitative data from interviews and observations were analyzed thematically to identify patterns and insights into student engagement and learning outcomes. Quantitative data from the KAP survey and class assessments were summarized using descriptive statistics such as means, medians, and standard deviations. Inferential statistics, including paired t-tests and ANOVA, were used to determine the significance of observed changes between pre-test and post-test scores, providing robust evidence of the impact of the interventions.

Ethical considerations were central to the study design. All participants provided informed consent, and data were anonymized and securely stored to ensure confidentiality. The research adhered to the ethical guidelines established by MFU's Institutional Review Board (IRB), ensuring that the study upheld the highest standards of academic integrity and respect for participants. This chapter highlights the meticulous approach taken to collect and analyze data, emphasizing the integration of diverse research tools and the importance of ethical rigor. The mixed-methods design and dual-sampling strategy created a robust framework for evaluating the effectiveness of pedagogical frameworks in SDG education, offering valuable insights into how teaching strategies can be refined to prepare students for the sustainability challenges of the 21st century.

Chapter 4 presents a detailed analysis of the results and discussion, focusing on the effectiveness of integrating pedagogical frameworks into the course "Introduction

to Sustainable Development" at Mae Fah Luang University. The findings explore how the implementation of Bloom's Taxonomy, the Felder-Silverman Learning Styles Model, and the Knowledge-Attitude-Practice (KAP) Design Model impacted student learning outcomes, engagement, and overall preparedness for sustainability challenges. This chapter systematically addresses the key research questions, offering insights into how these frameworks influenced cognitive development, inclusivity, and actionable sustainability practices.

The integration of Bloom's Taxonomy into the course design effectively guided students' cognitive progression from foundational knowledge to advanced critical thinking and problem-solving skills. In the early weeks of the course, activities such as memory games and matching exercises focused on developing lower-order thinking skills like remembering and understanding. These activities helped establish a solid base, enabling students to engage more deeply with SDG concepts in subsequent weeks. For instance, tasks requiring students to match SDG icons with their corresponding goals were highly effective in reinforcing basic comprehension. In later weeks, higher-order thinking skills were emphasized through activities such as case study discussions and advocacy campaigns. These tasks required students to analyze real-world sustainability challenges, evaluate policy effectiveness, and propose innovative solutions. Observations and assessments revealed significant improvements in students' ability to think critically and apply their knowledge creatively, reflecting the successful alignment of course activities with the higher levels of Bloom's Taxonomy.

The study also explored how the course addressed diverse learning styles, drawing on the Felder-Silverman Learning Styles Model to ensure inclusivity and engagement. By incorporating a variety of activities tailored to different preferences, the course successfully created a dynamic and inclusive learning environment. For example, visual and verbal learners benefited from the use of infographics, videos, and interactive lectures, which provided clear and engaging ways to understand complex sustainability concepts. Active learners thrived in hands-on activities like the SDG photo hunt, where students captured images representing sustainability practices, fostering creativity and practical understanding. Reflective learners, on the other hand, excelled in tasks such as storytelling and the storybook reflection activity, which

encouraged introspection and deeper connections to SDG principles. The varied teaching approaches ensured that all students could effectively engage with the material, demonstrating the value of accommodating diverse learning preferences in SDG education.

The application of the KAP Design Model further enhanced the impact of the course by addressing three critical dimensions: knowledge, attitudes, and practices. The KAP survey results highlighted significant improvements across all dimensions. Students demonstrated a deeper understanding of SDG principles, a stronger belief in their importance, and an increased commitment to sustainable behaviors. For instance, many students reported adopting environmentally responsible habits and participating in community initiatives as a result of the course. These findings underscore the effectiveness of the KAP Design Model in fostering a holistic approach to sustainability education, ensuring that students not only acquire knowledge but also develop the attitudes and behaviors necessary to drive meaningful change.

The SOC-IN Model emerged as a unifying framework for the study, integrating learning styles, objectives, and content to create a comprehensive and impactful approach to SDG education. By aligning these elements, the course successfully bridged the gap between theoretical understanding and practical application, preparing students to address sustainability challenges with confidence and competence. The findings demonstrate the potential of the SOC-IN Model to enhance SDG education not only at MFU but also in higher education institutions more broadly.

Chapter 4 provides compelling evidence of the effectiveness of the integrated pedagogical frameworks in promoting cognitive engagement, inclusivity, and actionable sustainability practices. The results affirm that the thoughtful application of Bloom's Taxonomy, the Felder-Silverman Model, and the KAP Design Model, guided by the SOC-IN framework, can transform SDG education into a powerful tool for equipping students with the skills, knowledge, and values needed to contribute to a sustainable future.

5.2 Recommendations

Based on the objectives outlined in Chapter 1 and the gaps identified in Chapter 4, several actionable recommendations are proposed to enhance the teaching of Sustainable Development Goals (SDGs) in Course 2302308 at Mae Fah Luang University. These recommendations address the need to refine cognitive engagement strategies, accommodate diverse learning styles, and improve the relevance and application of course content to better prepare students for real-world sustainability challenges.

To strengthen cognitive engagement, it is essential to ensure a seamless progression between lower-order thinking skills (LOTS) and higher-order thinking skills (HOTS) within the course structure. While the course effectively incorporated activities targeting both levels, the transition between these stages requires additional scaffolding. One proposed approach is to introduce scenario-based activities after foundational SDG concepts have been taught. For instance, following lessons on remembering and understanding SDGs, students could be presented with hypothetical sustainability problems requiring them to apply their knowledge to practical scenarios. These intermediate activities would prepare students for the more complex analytical and evaluative tasks later in the course, enhancing their ability to engage critically and creatively with sustainability issues.

Diverse learning styles were addressed through various activities during the course, yet the consistency of their integration could be improved. A semester-long plan that systematically incorporates activities tailored to active, reflective, visual, and verbal learners on a regular basis would ensure inclusivity and sustained engagement. This approach could include activities such as group discussions for active learners, journaling for reflective learners, visual tools like concept mapping for visual learners, and structured debates or storytelling sessions for verbal learners. Such planning would create an equitable and dynamic learning environment, ensuring that all students can meaningfully engage with the material.

The course's alignment with the Knowledge-Attitude-Practice (KAP) Design Model successfully fostered improvements in students' sustainability knowledge,

attitudes, and practices. However, the long-term application of sustainable practices beyond the classroom remains an area for development. Integrating a community engagement component into the course could address this gap effectively. For example, students could collaborate with local organizations to develop and implement small-scale projects targeting specific SDGs within the MFU community. Initiatives such as conducting sustainability audits, designing waste reduction strategies, or raising awareness of renewable energy solutions would provide students with hands-on experience while reinforcing the relevance and impact of their learning.

The KAP survey of 150 students across 15 schools at MFU revealed field-specific strengths and weaknesses, highlighting opportunities for interdisciplinary collaboration. Science and Technology students excelled in knowledge but demonstrated moderate scores in attitudes and practices, indicating a need for activities that foster emotional engagement and practical application. Reflective exercises, such as journaling about the ethical implications of technological advancements and community-based projects using technological solutions to address sustainability challenges, could enhance their holistic engagement with SDGs. Conversely, students from the Social and Humanities fields showed strong attitudinal engagement but lacked technical knowledge, limiting their ability to devise comprehensive solutions. Introducing modules on scientific and technical aspects of SDGs, such as renewable energy or sustainable agriculture, supplemented by expert-led workshops or guest lectures, would address these gaps effectively.

Health and Medicine students exhibited balanced performance across knowledge, attitudes, and practices, yet there is potential to expand their interdisciplinary engagement. Collaborative projects involving health students and peers from engineering, social sciences, or business could foster integrated solutions that reflect the interconnectedness of SDGs. For instance, a project to design a sustainable healthcare facility could address both environmental considerations and community needs, demonstrating the value of interdisciplinary collaboration in achieving holistic sustainability goals.

By implementing these recommendations, Mae Fah Luang University can strengthen its SDG education program, equipping students with the cognitive,

emotional, and practical tools needed to address complex global sustainability challenges. These strategies not only align with the university's commitment to fostering interdisciplinary learning but also ensure that graduates are prepared to contribute meaningfully to a sustainable future.

5.3 Implementing SOC-IN Model

To effectively implement the SOC-IN Model encompassing Styles, Objectives, and Contents in Integration and enhance the teaching of Sustainable Development Goals (SDGs) in Course 2302308 at Mae Fah Luang University, several tailored strategies are recommended. These strategies aim to foster inclusivity, ensure cognitive progression, and promote practical engagement with sustainability challenges, creating a holistic educational experience for students.

A key focus of the SOC-IN Model is addressing diverse learning preferences to ensure that all students can engage with the material meaningfully. Drawing from the Felder-Silverman Learning Style Model, the course can adopt a semester-long plan that integrates activities catering to active, reflective, visual, and verbal learning styles. By doing so, students are provided with varied opportunities to approach SDG concepts in ways that resonate with their individual preferences. For instance, when exploring climate action (SDG 13), active learners could participate in debates, reflective learners might write essays, visual learners could create infographics, and verbal learners might deliver presentations. This adaptability not only accommodates different learning preferences but also enriches the learning environment through diverse perspectives.

Equally important is the structured progression of cognitive skills, guided by Bloom's Revised Taxonomy. To bridge the gap between lower-order thinking skills (LOTS) and higher-order thinking skills (HOTS), activities should be designed to increase in complexity gradually. After introducing foundational SDG concepts, scenario-based exercises can encourage students to apply their knowledge to solve hypothetical problems. These preparatory tasks pave the way for more complex activities, such as policy analysis or advocacy campaign design, which require critical evaluation and creative problem-solving. Additionally, clearly articulating learning

objectives for each module or activity helps students understand the cognitive competencies they are expected to develop, aligning their efforts with course goals.

Relevance and engagement in course content are paramount. Using the KAP Design Model, course material can be aligned with students' knowledge, attitudes, and practices, fostering actionable learning. Integrating community engagement components, such as sustainability audits or local project development, enables students to apply theoretical knowledge to tangible challenges. This experiential learning approach deepens understanding, fosters commitment to sustainable practices, and highlights the real-world impact of academic concepts. Moreover, tailoring content to the field-specific strengths and weaknesses identified in the KAP survey enhances its relevance. For instance, science and technology students might benefit from reflective activities to cultivate emotional engagement, while social and humanities students could explore technical aspects of SDGs through workshops or guest lectures. Collaborative projects between health and medicine students and their peers in other disciplines can also provide comprehensive solutions to interconnected sustainability issues.

Successful implementation of the SOC-IN Model requires thoughtful integration of its elements. Employing diverse pedagogical tools, such as debates, case studies, role-playing, and simulations, can cater to various learning styles while supporting cognitive development. Reflective practices, such as journaling or discussions, encourage students to connect their learning to personal and professional aspirations, fostering a deeper commitment to sustainability principles. Additionally, diverse assessment methods, ranging from projects and portfolios to essays and presentations, ensure that students' varied strengths are recognized and evaluated appropriately.

Interdisciplinary collaboration is another critical component, as it mirrors the interconnected nature of SDGs. Encouraging cross-disciplinary teamwork allows students to address sustainability challenges from multiple perspectives, preparing them for collaborative, real-world problem-solving. For example, a joint project on sustainable healthcare could involve contributions from students in medicine, engineering, and social sciences, emphasizing the need for integrative approaches.

By thoughtfully embedding these strategies into the SOC-IN Model framework, Mae Fah Luang University can elevate its SDG education efforts. This comprehensive and inclusive approach not only equips students with the knowledge and skills needed to address sustainability challenges but also nurtures their capacity to lead with empathy, creativity, and action-oriented resolve.

5.4 Key Revisions of Syllabus for Course "Introduction to Sustainable Development" (2302308)

Finally, from the findings and discussion of the research, the revisions to the syllabus of Course 2302308, "Introduction to Sustainable Development," were guided by the findings of the study and the SOC-IN Model, which emphasizes the integration of learning styles, objectives, and content. The changes aim to enhance student engagement, deepen understanding, and promote real-world application of SDG concepts. Table 9 below is a comparative analysis highlighting the key adjustments made to the course framework.

Table 9. Syllabus Revisions

Aspect	Before Revision	After Revision
Learning Outcomes	Focused on SDGs understanding	Includes progression from LOTS to HOTS, real-world application
Activities	Limited interactivity (lectures, discussions)	Diverse, engaging activities (photo hunts, debates, storytelling)
Assessments	Predominantly, exams and assignments	Balanced evaluations (projects, reflections, exams)
Community Engagement	Not included	Integrated through local projects and reflective tasks

The revised syllabus incorporates critical updates to better align with the objectives of fostering comprehensive SDG education. Learning Outcomes have been restructured to follow Bloom's Taxonomy, ensuring a progression from foundational knowledge (LOTS) to advanced cognitive skills (HOTS), such as analyzing, evaluating, and creating. This adjustment provides students with a clear pathway to developing higher-order thinking skills necessary for addressing sustainability challenges.

The introduction of diverse activities, such as SDG photo hunts, storytelling, and role-playing, addresses the diverse learning preferences highlighted by the Felder-Silverman Model. These activities move beyond traditional lectures and discussions, creating an inclusive and dynamic classroom environment where students can actively engage with SDG principles in creative and collaborative ways.

Assessment methods have been diversified to balance traditional evaluations, such as exams, with more innovative formats, including reflective storybooks and group advocacy projects. This approach ensures that students are not only evaluated on their theoretical understanding but also on their ability to apply concepts practically and creatively, reflecting the findings from the KAP survey.

The integration of community engagement marks a significant advancement in the course structure. By involving students in local sustainability projects and reflective journaling, the revised syllabus bridges the gap between theoretical learning and practical application. This component emphasizes real-world impact, encouraging students to connect their academic pursuits with tangible contributions to sustainable development.

Overall, the revisions demonstrate a comprehensive shift toward an interdisciplinary and experiential approach to SDG education. By addressing the gaps identified in the initial syllabus, the revised framework provides a robust foundation for fostering knowledgeable, emotionally engaged, and action-oriented students equipped to tackle global sustainability challenges. Table 10 below shows the suggested revised syllabus for the recommendation of teaching sustainable development at Mae Fah Luang University.

Table 10. Revised Syllabus

Week	Theme	Content	Activity	Objective
1	Orientation and Key Concepts	Overview of SDGs, interdisciplinary nature, and foundational concepts	Interactive Lecture with Visual Aids (infographics, videos, and Q&A)	Build foundational knowledge and engagement
2	Transition from MDGs to SDGs	Evolution, principles, and global impact of SDGs	Memory Matching Games (active learners), Concept Mapping (visual learners)	Strengthen foundational understanding through interactive learning
3	SDG 1 & 11 – Poverty & Urbanization	Addressing multidimensional poverty and sustainable urbanization	Case Study Discussions (active and reflective learners)	Develop analytical skills by evaluating real-world policies
4	SDG 2 & 3 – Food Security & Health	Exploring food systems and healthcare challenges	SDG Photo Hunt (active learners), Group Analysis (reflective learners)	Connect theoretical knowledge with real-world practices
5	SDG 4 & 8 – Education & Decent Work	Role of education and decent work in sustainable development	Drawing and Concept Mapping (visual learners)	Foster creative problem-solving
6	SDG 5 – Gender Equality	Challenges and opportunities in achieving gender equality	Movie Discussion and Storytelling (verbal and reflective learners)	Cultivate empathy and critical perspectives
7	SDG 12 – Responsible Consumption	Ensuring sustainable production and consumption patterns	Role-Playing Scenarios (active learners), Opinion	Enhance understanding of consumption behaviors

			Sharing (verbal learners)	
8	Midterm Review	Consolidating knowledge from Weeks 1-7	Interactive Quiz and Group Reflection	Prepare for midterm
9	Midterm Exam	Midterm assessment covering foundational and applied knowledge	Exam	Assess learning progress
10	SDG 6, 13, 14, 15 – Environmental Challenges	Climate action, biodiversity conservation, and ecosystem management	Clipping Analysis and Group Presentations (visual and verbal learners)	Develop HOTS by analyzing interrelated environmental issues
11	SDG 16 – Peace and Justice	Governance, human rights, and institutional frameworks	Policy Debate (verbal and active learners)	Foster critical thinking and persuasive skills
12	Reflective Practices	Consolidating personal reflections on sustainability	Individual Journaling and Class Sharing	Deepen personal engagement
13	Storybook Reflection	Personal connections to sustainability	Create Illustrated Storybooks (visual and reflective learners)	Deepen emotional engagement with SDGs
14	Group Advocacy Presentation	Advocacy campaigns for chosen SDGs	Group Presentations with Q&A (all learning styles)	Showcase integrated understanding and creative solutions
15	Final Review	Consolidating knowledge from Weeks 1-14	Interactive Quiz and Group Reflection	Prepare for final
16	Final Examination	Final assessment covering all aspects of the course	Exam	Evaluate overall learning

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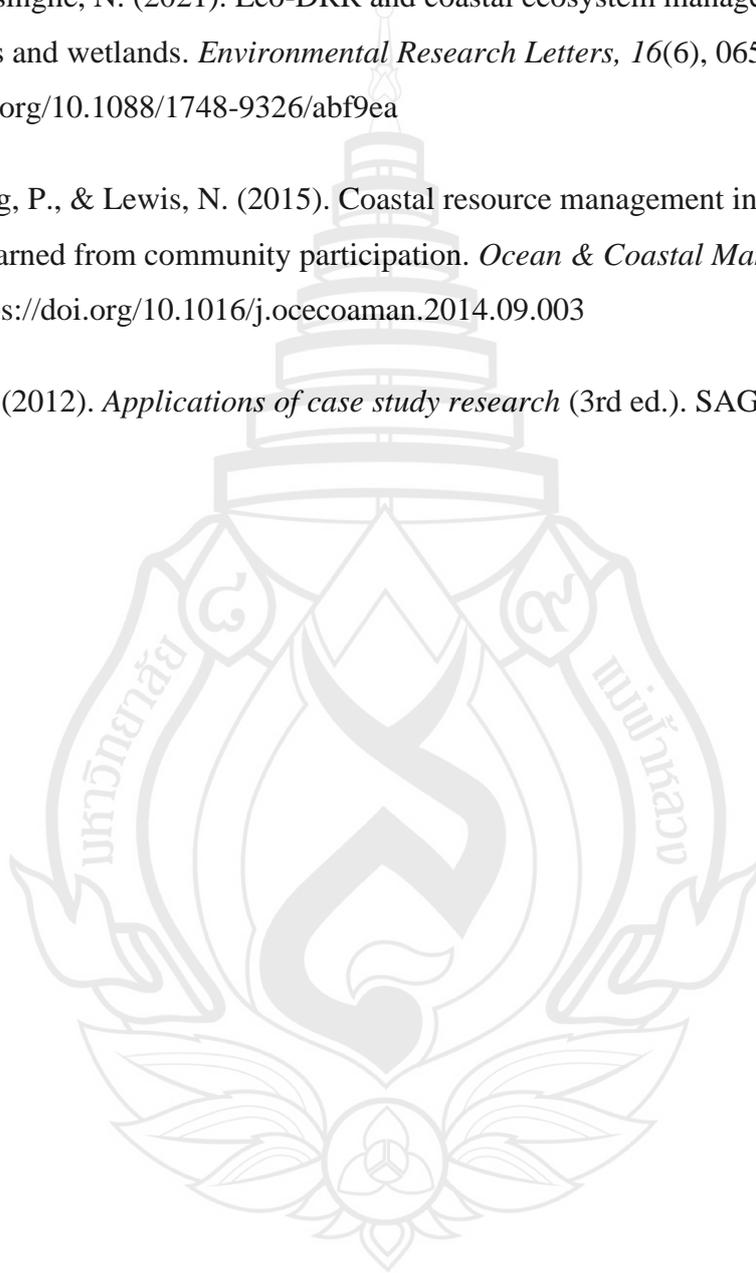
ANNEX A

Syllabus Course "Introduction to Sustainable Development" (2302308) Semester 2/2024

Course Syllabus

I. General Information

Academic Year:	2 / 2024
Course Code:	2302308
Course Name:	Introduction to Sustainable Development
	(ความรู้เบื้องต้นเกี่ยวกับการพัฒนาอย่างยั่งยืน)
Belong to:	Program of International Development, School of Social Innovation
Course Instructor:	Aj. Maya Dania (Maya.Dan@mfu.ac.th)
Credit:	3 (3-0-6)
Type of Course:	Many Programs
Eligible Students:	-
Prerequisite:	-
Class Room:	ME-414
Day and Time:	Wednesday, 16.00 – 18.50 pm
Midterm Examination:	9 March 2025 (13.30 – 16.30 pm) – Afternoon Session, onsite REG (*TBC)
Final Examination:	8 May 2025 (13.30 – 16.30 pm) – Afternoon Session, onsite REG (*TBC)

II. Goals and Objectives

Course Goals: The course briefly introduces scopes and concepts about Sustainable Development. The course introduces a general understanding of the social, economic, and environmental dimensions of Sustainable Development. It prepares the students to identify global challenges that will be useful to explore strategic actions toward a sustainable future under the Sustainable Development Goals (SDGs) agenda 2030. The course looks critically at a wide range of sustainable practices concerning national and regional frameworks for achieving 17 agendas of SDGs. Finally, the course enables students to engage and adopt creative approaches to achieving SDGs in their selected fields of action.

Course Objectives: Upon completing this course, students must be able to:

1. Understand concepts, definitions, purpose, scopes, and history of Sustainable Development;
2. Understand practices of Sustainable Development from local to global issue;
3. Identify real world problems in relation to unsustainable development;
4. Recognize strategies to achieve Sustainable Development Goals (SDGs) toward 2030 future agenda.

III. Course Nature and Implementation

Course Description: An overview of sustainable development concepts and development discourse; its importance; various perspectives, measurements and indices; various tools and sustainable practices such as sustainable and ecological designs, environmental regulations, environmental planning, environmental taxation, biodiversity conservation, environmental movement, participatory approach, and green policies etc.

Number of Hours Per Semester: Lecture; 3 hours per week, for 15 weeks; semester total; 45 hours Self-Study; Student will be assigned weekly homework and/ or group assignments, which require at least 3 hours per week, for 12 weeks; semester total 36 hours.

Counseling Hours:	Monday 13:00 – 16:00 /
	Tuesday 13:00 – 16:00
Office Place:	School of Social Innovation, 4th floor, E1 Building

Office Place: School of Social Innovation, 4th floor, E1 Building

Students may seek up to 5 hours per week for consultation during the office hours. The lecturer will periodically communicate with students through the MFU E-learning system/ Google Classroom; therefore, students are responsible for checking their assigned e-learning account on course webpage regularly. Additionally, students may communicate with the lecturer and peers through email and social media such as Facebook class page.

IV. Development of Students' Learning Outcomes

Learning Outcomes

Students will be familiar with the basic concepts and history of Sustainable Development to cope with real-world problems from the Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs). Moreover, students will be able to identify sustainable and unsustainable practices in various issues of human development, population, economic growth, poverty, globalization, food and healthcare, education, climate change, environmental biodiversity, and clean green energy.

Teaching Strategies

The course is divided into two essential parts. The first half (before Midterm Exam Period) is a lecture-based activities that require students to comprehend key concepts, terminologies, and the practices of Sustainable Development. In this first half part, students are encouraged to read selected basic concepts of Sustainable Development with examples of sustainable and unsustainable practices in various dimensions. The second half (after the Midterm Exam Period) is a discussion-based activities that focus on students' critical and creative thinking to apply the concept of Sustainable Development in the real-world issues. Students are encouraged to select real-world issues and analyze the case studies in Sustainable Development Goals. Classroom discussion, reading assignment, and group presentation are used to enhance students' analytical thinking in their attempts to achieve SDGs.

Course Plan 2024 (Blended Learning)

Theme: "5Ps in Sustainable Development Goals (SDGs)"

People, Planet, Prosperity (Profit), Peace, and Partnership

Week	Topic	Number of Hours Lecture	Brief Content / Activity	Materials
Week 1 8 Jan PEOPLE	Course Orientation – Building Up Ideas of "Sustainable Development"	3	Content: In this chapter, students will be introduced to the interdisciplinary nature of Sustainable Development. They will explore the key concepts and theoretical perspectives that underpin the study of this field. By understanding the interconnections between sustainability and development, students will lay the foundation for examining how various factors shape sustainable development goals outcomes at different scales. Class Activities: Icebreaker Activity: Students will engage in an icebreaker activity to get to know each other and share their interests in sustainable development.	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.
Week 2 15 Jan PEOPLE	Human and Sustainable Development "From MDGs to SDGs"	3	Content: This chapter provides an in-depth exploration of the transition from the Millennium Development Goals (MDGs) to the Sustainable Development Goals (SDGs), focusing on their evolution, principles, and global impact. Students will critically analyze the achievements and limitations of the MDGs and understand how the broader and more inclusive SDGs framework addresses contemporary global challenges. Class Activities: Memory and Mixed Matching Games	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.

Week	Topic	Number of Hours	Brief Content / Activity	Materials
		Lecture		
Week 3 22 Jan PEOPLE	SDG 1 and SDG 11 "No Poverty"	3	Content: This chapter focuses on Sustainable Development Goals SDG 1 and SDG 11, providing an in-depth exploration of strategies, challenges, and initiatives aimed at eradicating poverty globally in urban landscape. Students will examine the multidimensional aspects of poverty, its root causes, and the interconnected nature of poverty with other sustainable development goals, like urbanization. Class Activities: (Activity 5%) Case Study Discussion	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.
Week 4 29 Jan PEOPLE	SDG 2 and SDG 3 "Zero Hunger and Good Health and Well-Being"	3	Content: This chapter focuses on Sustainable Development Goals (SDGs) 2 and 3, focusing on Zero Hunger and Good Health and Well-Being respectively. Students will explore the interconnected challenges of ensuring food security, promoting sustainable agriculture, and improving health outcomes globally (food and healthcare system) Class Activities: (Activity 5%) Photo Hunting	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.
Week 5 5 Feb PEOPLE	SDG 4 and SDG 8 "Quality Education and Decent Work"	3	Content: This chapter focuses on Sustainable Development Goals (SDGs) 4 and 8, examining the critical importance of quality education and decent work in fostering sustainable development and economic growth globally. Class Activities: (Activity 5%) Drawing and Concept Mapping	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.

Week	Topic	Number of Hours Lecture	Brief Content / Activity	Materials
Week 6 12 Feb PEOPLE	SDG 5 "Gender Equality"	3	Content: This chapter focuses on Sustainable Development Goal (SDG) 5, which aims to achieve gender equality and empower all women and girls. It explores the multifaceted challenges and opportunities in promoting gender equality as a fundamental human right and key driver of sustainable development. Class Activities: (Activity 5%) Movie Discussion and Story Telling	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.
Week 7 19 Feb PEOPLE	SDG 12 "Responsible Consumption"	3	Content: This chapter focuses on Sustainable Development Goal (SDG) 12, which aims to ensure sustainable consumption and production patterns. It explores the challenges and opportunities in promoting responsible consumption as a crucial element for achieving sustainable development. Class Activities: (Activity 5%) Sharing Opinion and Class Discussion	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.
Week 8 26 Feb	Midterm review of the course	3	Review of lessons from Week 1-8	Review of lessons from Week 1-7
Week 9: MIDTERM EXAM PERIOD (15%) 9 March 2025 (13.30 – 16.30 pm)				
Week 10 12 March PLANET	SDG 6, 13, 14, 15 "Clean Water and Sanitation, Climate Action, Life Below Water, Life on Land"	3	Content: This chapter explores Sustainable Development Goals (SDGs) 6, 13, 14, and 15, focusing on Clean Water and Sanitation, Climate Action, Life Below Water, and Life on Land respectively. It examines the interconnected challenges and opportunities in addressing climate change, preserving marine ecosystems, and protecting terrestrial biodiversity for sustainable development. Class Activities: (Activity 5%) Clipping and Sharing Opinion	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.

Week	Topic	Number of Hours Lecture	Brief Content / Activity	Materials
Week 11 19 March PROFIT	3Ps in Triple Bottom Line SDG 7, 9, 10 "Affordable and Clean Energy, Industry, Innovation, and Infrastructure, and Reduced Inequality"	3	This chapter explores the concept of the Triple Bottom Line (TBL), which emphasizes the interconnectedness of three key dimensions—People, Planet, and Profit—in achieving sustainable development. It looks into how businesses, organizations, and societies can integrate economic, social, and environmental considerations into their decision-making processes for long-term sustainability. <u>Class Activities:</u> (Activity 5%) Polling and Sharing	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.
Week 12 26 March PEACE	SDG 16 "Peace and Justice Strong Institutions"	3	<u>Content:</u> This chapter explores Sustainable Development Goals (SDGs) 16, focusing on the intersection of sustainable development with peacebuilding, democracy, and the protection of human rights. It explores how promoting peace, fostering democratic governance, and upholding human rights are essential components for achieving sustainable development goals globally. <u>Class Activities:</u> (Activity 5%) Clipping and Sharing Opinion	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.
Week 13 2 April PARTNERSHIP	SDG 17 "Partnership for the Goals"	3	<u>Content:</u> This chapter focuses Sustainable Development Goals (SDGs) 16, focusing on partnership on two key international frameworks that emerged post-2015: the Sendai Framework for Disaster Risk Reduction and the Paris Agreement for Climate Change. It explores how these frameworks contribute to global efforts towards sustainable development by addressing disaster risk reduction and climate change mitigation and adaptation. <u>Class Activities:</u> (Activity 5%) Quiz Multiple Choice	Lecture Slides: Presentation slides introducing the fundamental concepts and objectives of the course. Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.

Week	Topic	Number of Hours Lecture	Brief Content / Activity	Materials
Week 14 9 April	Reflections for Understanding	3	Class Activities: Students will create their own Story Book (individually) where they will showcase their understanding in a specific sustainable development topic. Each student submits Individual Story Book (Submission 5%)	
Week 15 16 April	Group Presentation (10%)	3	Students will participate in a group presentation where they will showcase their advocacy or promotion of a specific development topic. They will effectively communicate their findings, insights, and recommendations to the class, fostering collaborative learning and encouraging critical thinking and discussion.	Students' presentation materials Online Whiteboard and Markers: To facilitate concept mapping and note-taking during discussions.
Week 16 23 April	Final review of the course	3	A dedicated session will be conducted to consolidate course material, address any questions, and aid students in their preparation for the final exam.	
Week 17: FINAL EXAM (25%) 8 May 2025 (13.30 – 16.30 pm)				
Total		45		

Evaluation Plan

Students will be evaluated throughout the course, including group projects, class feedbacks, and oral adjudication, quizzes, assignments, and written/ oral examination. The evaluation plan is shown below:

Activity	Assessment	Time	Proportion
Class Activity	As part of experiential learning, students must be active in class activity to upgrade their knowledge on the current sustainable development issue	Week 3-7; Week 10-14	5% each (Total: 50%)
Midterm	Paper Examination	Week 9	15%
Group Presentation	Group Presentation to Make a Poster of SDG Campaign (Advocacy) with Q&A	Week 15	10%
Final examination	Paper Examination	Week 17	25%
Total			100%

Evaluation criteria:

A	85-100	C	65-69.9
B+	80-84.9	D+	60-64.9
B	75-79.9	D	50.1-59.9
C+	70-74.9	F	0 – 50

Handbook prepared by the lecturer

Dania, Maya. (2022). An E-Book Introduction: Sustainable Development. A Handbook for teaching, Mae Fah Luang University.

Primary Textbooks and Documents

D'Odorico, P., Carr, J. A., Davis, K. F., Dell'Angelo, J., & Seekell, D. A. (2019). Food inequality, injustice, and rights. BioScience, 69(3), 180-190.

Haines, A., & Cassels, A. (2004). Can the millennium development goals be attained?. Bmj, 329(7462), 394-397.

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Khoshnava, S. M., Rostami, R., Zin, R. M., Štreimikienė, D., Yousefpour, A., Strielkowski, W., & Mardani, A. (2019). Aligning the criteria of green economy (GE) and sustainable development goals (SDGs) to implement sustainable development. Sustainability, 11(17), 4615.

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Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2012). An introduction to sustainable development. Routledge. Soubbotina, Tatyana P.. 2004. Beyond Economic Growth : An Introduction to Sustainable Development, Second Edition. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/14865 License: CC BY 3.0 IGO."

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World Commission on Environment and Development (WCED). (1987). Our Common Future: Brundtland Report for Sustainable Development. From: https://www.are.admin.ch/are/en/home/media/publications/sustainable-development/brundtland-report.html

Important Documents and Resources

United Nations. (2021). The UN SDGs Report. https://data.unhcr.org/en/documents/details/88793

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ANNEX B

Questionnaire KAP

"Teaching Sustainable Development Goals (SDGs) in the 21st Century: Case Study of Course
2302308 "Introduction to Sustainable Development" at Mae Fah Luang University

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Researchers: School of Social Innovation, Mae Fah Luang University

1) Maya Dania
2) Reni Juwitasari

KAP Survey on Sustainable Development and SDGs Assessment

Objectives: This KAP survey aims to provide insights into students' Knowledge, Attitude, and Practice related to Sustainable Development and the SDGs. Understanding these aspects is crucial for tailoring educational approaches and interventions to enhance students' overall engagement with sustainable practices in the course 2302308 (Introduction to Sustainable Development).

Knowledge (K): Evaluate students' understanding of key concepts related to Sustainable Development and the SDGs.

Attitude (A): Assess students' attitudes, perceptions, and values regarding Sustainable Development and the importance of SDGs.

Practice (P): Examine the extent to which students integrate sustainable practices and behaviors into their daily lives.

The collected data is for the purpose of study, <u>NOT</u> for any other purposes. Therefore, your cooperation plays an important role in our research. Please answer the following questions by ticking √ in the box you choose.

Section I (Socio-Demographic Characteristics): This part aims to collect information of the respondents' socio-demographic information as the background for the research study.

(Questions 1-9)

1). What is your gender group?

Male ☐   Female ☐

2). What is your current student year group?

Year 1 Student ☐   Year 2 Student ☐   Year 3 Student ☐   Year 4 Student ☐

3). What is your major group?

Science ☐   Social ☐   Technology ☐   Health and Medical ☐

4). What is your GPA level group?

0-1 ☐   1-2 ☐   2-3 ☐   3-4 ☐

5). Where is your province origin?

Northern Thailand ☐   North Eastern Thailand ☐   South Thailand ☐   Central Thailand☐

Eastern Thailand ☐   Foreign Students (Outside Thailand) ☐

6). Before studying at MFU, have you heard about the word "Sustainable Development Goals (SDGs)?"

Yes ☐   No ☐

7). Can you remember all 17 targets of SDGs?

Yes ☐   No ☐

8). Are Sustainable Development and SDGs difficult subjects?

Yes ☐   No ☐

9) Do you think SDGs is important to study for the university students?

Yes ☐   No ☐

======THANK YOU AND PLEASE CONTINUE TO SECTION II==========

Section II (Knowledge): This part aims to Evaluate students' understanding of key concepts related to Sustainable Development and the SDGs.

For questions 10 to 19, please rate the statements using the Likert Scale from 1 - 5.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree (Questions 10-20)

10). I can make definition of the term "Sustainable Development."

   1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

11). I can mention three main components (3Ps) of sustainable development.

   1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

12). I can name at least two targets of Sustainable Development Goals (SDGs).

   1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

13). I can describe at least two issues in sustainable development.

   1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

14). I can describe the relationship between social equality and sustainable development.

   1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

15). I can provide an example of a sustainable lifestyle.

   1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

16). I can provide an example of an un-sustainable lifestyle.

   1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

17). I can explain the relationship between climate change and SDGs.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

18). I can describe at least two renewable energy resources to support sustainable development.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

19). I can understand all 17 different targets in Sustainable Development Goals.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

=======THANK YOU AND PLEASE CONTINUE TO SECTION III=========

Section III (Attitude): This part aims to assess students' attitudes, perceptions, and values regarding Sustainable Development and the importance of SDGs.

For questions 20 to 29, please rate the statements using the Likert Scale from 1 - 5. 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree (Questions 20-29)

20). Sustainable development is essential for the well-being of future generations.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

21). Sustainable development is important for my future life.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

22). I, as an individual, can contribute to the achievement of SDGs

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

23). I have motivation to do sustainable actions in my lifestyle

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

24). Global initiatives have been effective in addressing environmental issues.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

25). My country has been successful in campaigning public awareness of SDGs.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

26). I am confident that my country can achieve all targets of SDGs by 2030.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

27). I am concerned about the impacts of climate change to the community.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

28). Education has an important role in promoting sustainable development and SDGs.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

29). Course "Introduction to Sustainable Development" is effective in enhancing my understanding of SDGs.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

=======THANK YOU AND PLEASE CONTINUE TO SECTION III=========

Section III (Practice): This part aims to examine the extent to which students integrate sustainable practices and behaviors into their daily lives.

For questions 30 to 39, please rate the statements using the Likert Scale from 1 - 5. 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree (Questions 30-39)

30). I am currently practicing sustainable lifestyle in my daily activities.

    1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

31). I am willing to change my habits to adopt more sustainable lifestyles.

1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

32). I have involved in a project or activity about sustainable development in my university.

1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

33). I like to read news in the social media or websites about sustainable development issues.

1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

34). I and my friends have a discussion about SDGs.

1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

35). My understanding about SDGs has influenced the way I consume products.

1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

36). I have made an efforts to raise awareness about sustainable living among my friends.

1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

37). I have made an efforts to raise awareness about sustainable living among my family.

1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

38). My personal values are aligning with sustainable living practices.

1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

39). Education in my university has increased my awareness of global sustainability challenges.

   1 ☐   2 ☐   3 ☐   4 ☐   5 ☐

=======THIS IS THE END OF THE QUESTIONNAIRE============

Thank you for your participation and the researchers would like to deliver our thankful respect for your contribution.
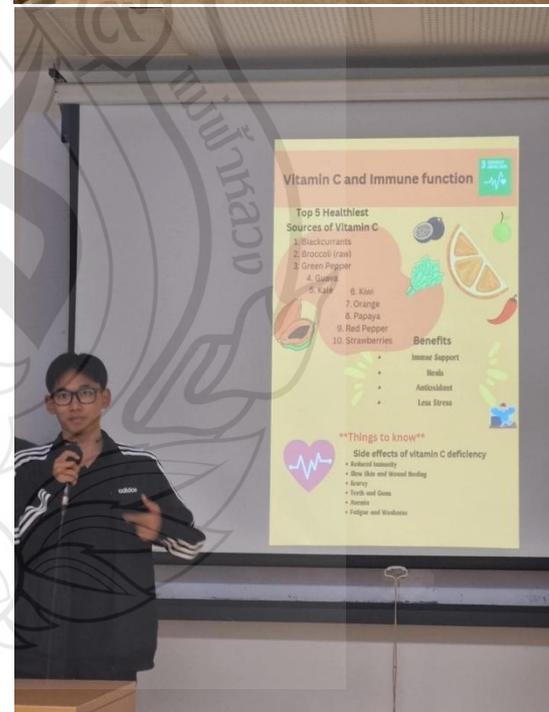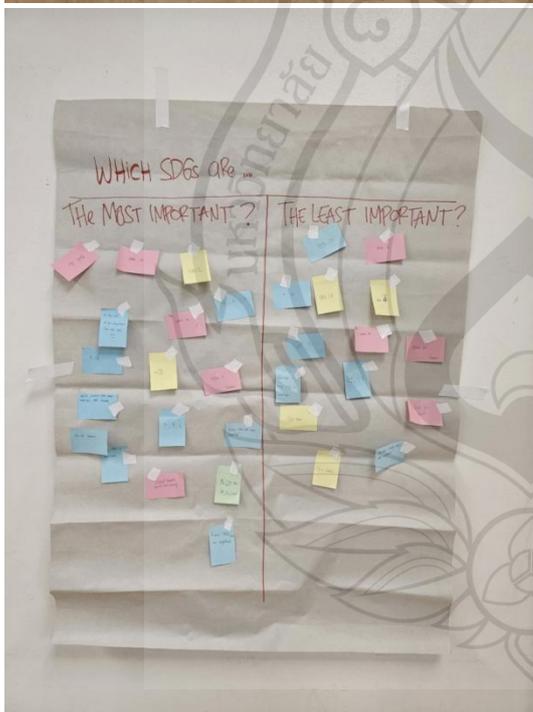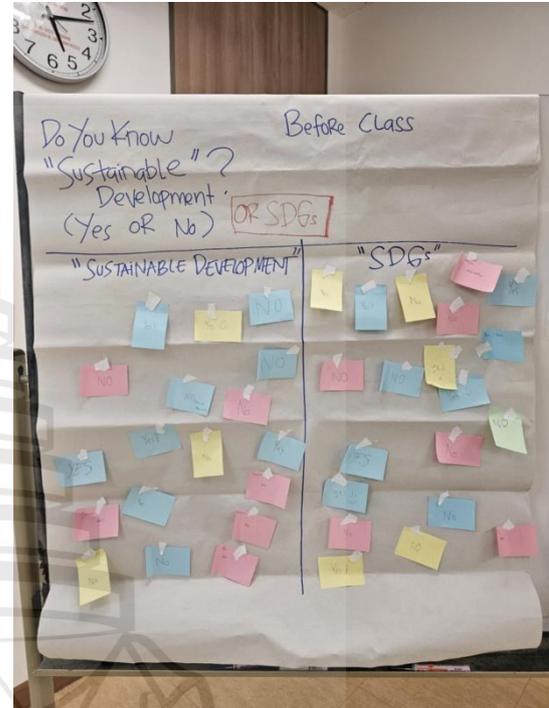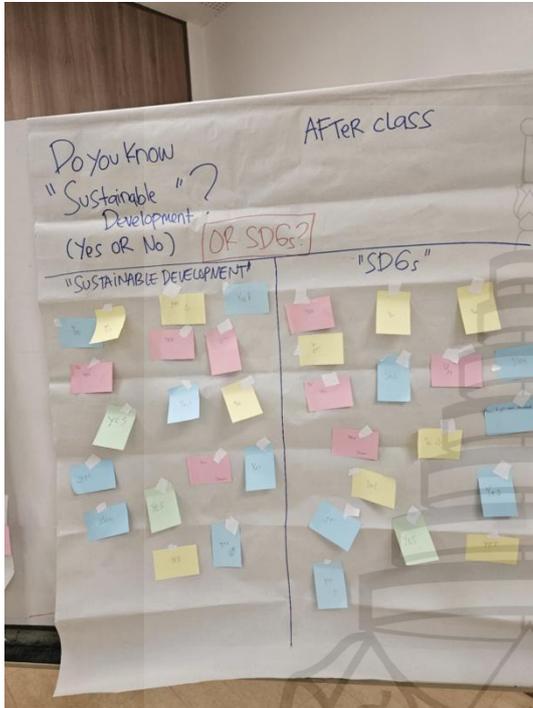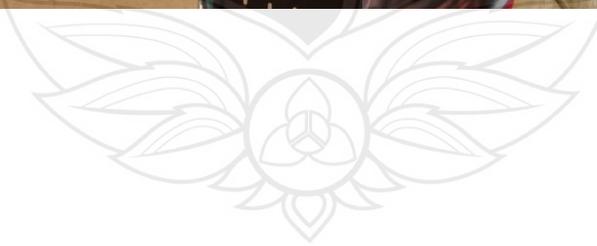
References:

Afroz, N., & Ilham, Z. (2020). Assessment of knowledge, attitude and practice of University Students towards Sustainable Development Goals (SDGs). *The Journal of Indonesia Sustainable Development Planning*, *1*(1), 31-44.
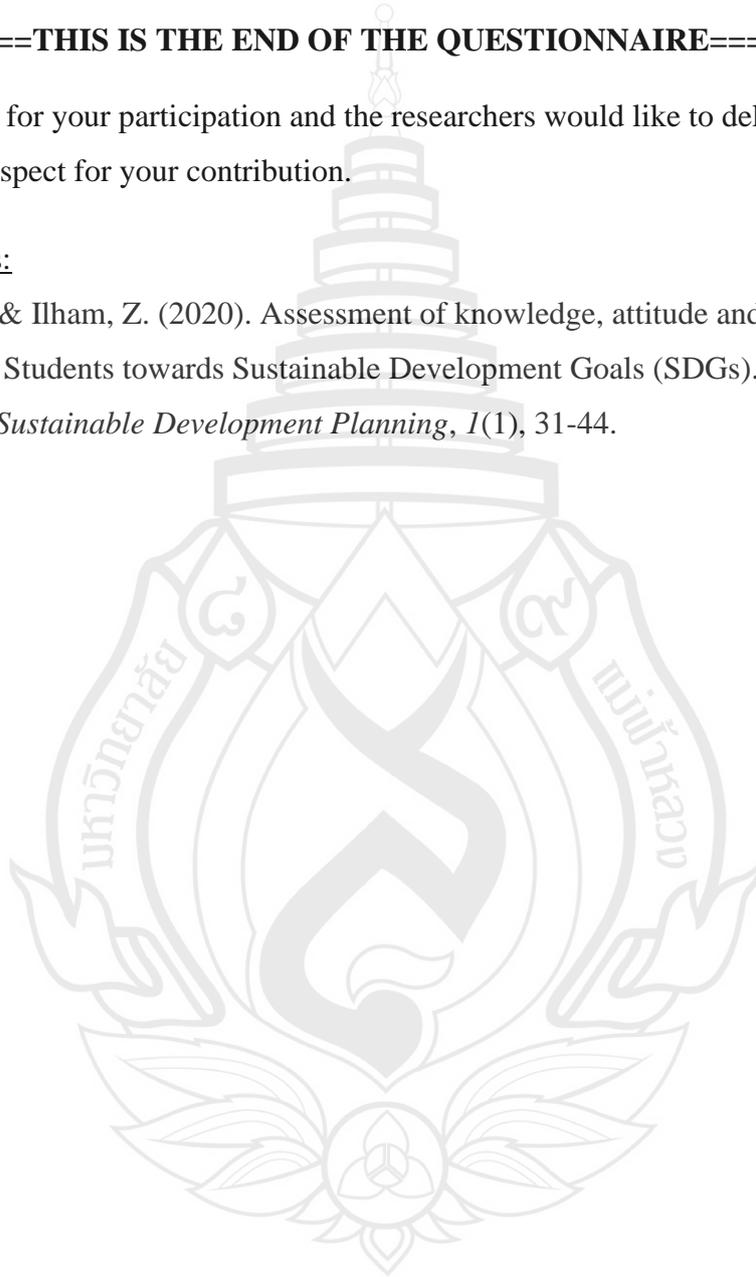
ANNEX C

Class Activity Photos

ANNEX D

CV of Researchers

Head of Research Project

1.   ชื่อ- สกุล (ภาษาไทย/ภาษาอังกฤษ)

Maya Dania, M.A

2.   ตำแหน่งทางวิชาการ

Lecturer, School of Social Innovation

3.   รหัสประจำตัวนักวิจัยแห่งชาติ (ถ้ามี)

1170952

4.   ประวัติการศึกษา

ปริญญา	สาขาวิชา	สถาบัน	ปีที่จบ
Master of Arts (M.A.)	Southeast Asian Studies	Chulalongkorn University, Thailand	2015
Researcher Training (Qualitative Method and International Publication)	Asian Studies	National University of Singapore (NUS), Singapore	2015
Library Research Training (Literature Method)	Gender Studies	Amsterdam University, the Netherlands	2010
Bachelor of Arts (BA.)	Philosophy (minor in Politics and Ideology)	Gadjah Mada University, Indonesia	2008

5.   ประวัติการทำงาน

Year	Position
2018 – now	Lecturer, School of Social Innovation, Mae Fah Luang University, Thailand
2016 – 2018	Lecturer, School of Liberal Arts, Mae Fah Luang University, Thailand

6.	สาขาวิชาการที่มีความชำนาญพิเศษ (แตกต่างจากวุฒิการศึกษา) ระบุสาขาวิชาการ

Disaster Risk Reduction, Resilience, Policy, Gender, Sustainable Development Goals (SDGs)

7.	ประวัติการเผยแพร่ผลงานวิจัย ทั้งภายในและภายนอกประเทศ โปรดระบุชื่อเรื่องผลงาน ชื่อวารสาร ตามระบบสากล

7.1 หัวหน้าโครงการวิจัย: ชื่อโครงการวิจัย

7.1.1 Inpin, W. & Dania, M. (2022). Looking Through Social Capital Lens: Community Evaluation of the Local Government's Resource Capability in Managing Earthquake Emergency in Chiang Rai, Thailand. Political Science and Public Administration Journal Vol.13 No.2 (July-December 2022). Chiang Mai University (TCI-1). (a Publication from MFU Research Fund 2019)

7.1.2 Inpin, W. & Dania, M. (forthcoming, under review 2022). Mapping Research on Disaster Risk Reduction for Sustainable Development in Thailand: Thematic Analysis Approach. Scopus Scimago Q2 (a publication from MFU Research Fund 2021)

7.1.3 Dania, M., Inpin, W.(2021). "Gender Vulnerability and PAR Model Assessment", Journal of Mekong Societies (TCI 1 Indexed Scopus) (a Publication from MFU Research Fund 2019)

7.2	บทความวิชาการ

7.2.1	Dania, M., Inpin, W., et al (forthcoming, under review). The Production of Safety School Space from Climate Disasters in Doi Mae Salong Forest, Upland Northern Thailand. (Scopus Scimago Q1) (a publication from Reinventing Visiting Scholar 2022)

7.2.2	Dania, M & Singhaputargun, N. (2020). Violence Triangle in Context of Indonesian Comfort Women. Asian International Studies Review (AISR) 21(2). 79-94 (Scopus Q2 Scimago).

7.2.3   Dania, M. (2020). Rethinking Sustainable Development Goals (SDGs) among Karen "Longneck" Women Hill Tribe in Northern Thailand. KAMBOTI: Jurnal Sosial dan Humaniora, 1(1), 85-95.

7.2.4   Dania, M. (2019). A Country Report from Thailand. In Human Rights Outlook in Southeast Asia 2018 (pp.141-154). SHAPE-SEA, Mahidol University.

7.2.5   Dania, M. (2019). A Comparative Perspective on Human Rights in ASEAN Regionalism. In Malaysian Perspective on ASEAN Regionalism (pp.97-106). Kuala Lumpur: University of Malaya Press

7.2.6   Dania, M. (2019). Women's Rights in India and Indonesia. In India-ASEAN Engagements Economic and Social Dimensions (pp.25-45). New Delhi: New Century Publications.

7.2.7   Dania, M. (2017). Statelessness in ASEAN: The Rohingya Identity Dispute. Journal of

Apparatus Competency 2 (2). Indonesia : East Java Government Institute of Research and Training, pp. 49-60.

8.   ประวัติการนำเสนอผลงานวิจัยทั้งภายในและภายนอกประเทศ โปรดระบุชื่อเรื่อง ของผลงาน ชื่อการประชุม สถานที่ วัน เวลา ตามระบบสากล

1.   Inpin, W & Dania, M. (forthcoming in 2022).Root Causes, Dynamic Pressure, and Unsafe Living Conditions of Thai Rural Farmers to Climate-Based Drought in Chiang Rai Province: A Social Vulnerability Perspective. SEASIA Conference, BRIN Indonesia and Kyoto University Japan. Proceeding Springer Scopus. (a publication from MFU Research Fund 2021)

2.   Dania, M. (2020). Integrating Gender into Disaster Governance in Northern Thailand: Opportunities and Challenges. Proceedings of Virtual Conference on "New Research in International Development, Human Rights, and International Relations at a Time of Disruptions". MAIDS-GRIDS Chulalongkorn University, RCSD Chiang Mai University, School of Social Innovation Mae Fah Luang University, IHRP Mahidol University, School of Global Studies Thammasat University.

3. Dania, M. (2019). Women after the Earthquake: A Case Study of Yogyakarta Earthquake 2006. ICIRD 2019 International Conference. MAIDS-GRIDS Chulalongkorn University, RCSD Chiang Mai University, School of Social Innovation Mae Fah Luang University, IHRP Mahidol University, School of Global Studies Thammasat University.

4. Dania, M. (2019). Teaching Disaster Mitigation through Local Cosmology: A Case Study of Post-Disaster Crimes Prevention in Yogyakarta's Earthquake 2006. In the Panel: Comparative study of Disaster Education in Myanmar, Thailand, Indonesia, and Japan: Dialectic between SFDRR and Country's Policies and Practices (Panel of Mae Fah Luang University, Graduate School of Policy Studies, Aichi Gakuin University, Japan, and Graduate School for International Development and Cooperation, Hiroshima University, Japan) at CESCam – Siem Reap, Cambodia

5. Transdisciplinary Research in Social Science, Chulalongkorn University, Thailand (9-11 July 2019)

6. Symposium on Approaches to Sustainable Development in Southeast Asia at Southern Institute of Social Science, Ho Chi Minh City, Vietnam (17-19 December 2018)

1. ผลงานวิจัยที่ได้รับการจดทะเบียนทรัพย์สินทางปัญญา หรือผลงานวิจัยที่อยู่ระหว่างการยื่น

ขอจดทะเบียนทรัพย์สินทางปัญญา

2. ประสบการณ์ที่เกี่ยวข้องกับการบริหารงานวิจัยทั้งภายในและต่างประเทศโดยระบุตำแหน่งหน้าที่ในการทำการวิจัย ว่า

เป็นผู้อำนวยการแผนงานวิจัยหัวหน้าโครงการวิจัย

หรือผู้ร่วมวิจัยในแต่ละข้อเสนอการวิจัยและระบุสถานภาพของงานวิจัยด้วย

• งานวิจัยที่ทำเสร็จแล้ว : ชื่อข้อเสนอโครงการวิจัยสัดส่วนที่ทำงานวิจัย (%) คณะผู้วิจัยและสถาบันร่วมวิจัย แหล่งทุน

ปีที่ได้รับทุน การเผยแพร่ผลงานวิจัย

4. MFU Research Fund 2019 Project (100% completed) "การเปรียบเทียบนโยบายฟื้นฟูภัย

พิบัติเชิงเพศภาวะระหว่างประเทศอินโดนีเซียและไทย:กรณีศึกษาพื้นที่หลังเกิดเหตุแผ่นดินไหวในจังหวัด Yogyakarta และ

จังหวัดเชียงราย"

5. MFU Research Fund 2021 Project (100% completed) "การจัดการภัยแล้งความยืดหยุ่นใน

พื้นที่และการกำกับดูแลความเสี่ยงจากภัยพิบัติในภาคเหนือของประเทศไทย: กรณีศึกษาจังหวัดเชียงราย"

Member of Research Project (1)

1. ชื่อ- สกุล (ภาษาไทย/ภาษาอังกฤษ)

Reni Juwitasari

2. ตำแหน่งทางวิชาการ

Research Associates, Asian Research Center for International Development (ARCID),
School of Social Innovation,

3. รหัสประจำตัวนักวิจัยแห่งชาติ (ถ้ามี)

1170953

4. ประวัติการศึกษา

ปริญญา	สาขาวิชา	สถาบัน	ปีที่จบ
Master of Education (M.Ed.)	Educational Administration	Mahasarakham University	2016
Bachelor of Education (B.Ed.)	German Language	Yogyakarta State University Indonesia	2013

5. ประวัติการทำงาน

Year	Position
2019 - now	Research Associate, Asian Research Center for International Development (ARCID), School of Innovation, Mae Fah Luang University
2017 - 2019	Lecturer, School of Liberal Arts, Mae Fah Luang University
2016 – 2017	Lecturer, Faculty of Education, Mahasarakham University

6. สาขาวิชาการที่มีความชำนาญพิเศษ (แตกต่างจากวุฒิการศึกษา) ระบุสาขาวิชาการ

Education for Sustainable Development, Education Policy, Disaster, Climate Change,
Sustainable Development

7.   ประวัติการเผยแพร่ผลงานวิจัย ทั้งภายในและภายนอกประเทศ โปรดระบุชื่อเรื่องผลงาน ชื่อวารสาร ตามระบบสากล

7.1   หัวหน้าโครงการวิจัย: ชื่อโครงการวิจัย

7.1.1 "Developing A Program to Enhance Women Leadership Challenge of Primary School Principals in Banjar-City, West-Java, Province, Indonesia

7.2   บทความวิชาการ

7.2.1 Juwitasari, R. & Miyake, Y. (2022). Sustainability Development and Kaizen Implementation for Vocational Education from Japan's ODA in Thailand: How it Works and Impacts?". Journal of Community Development Research, Naresuan University, Thailand, 25(3).

7.2.2 Juwitasari, Reni. (2020). Embracing an Unprecedented "New Normal" for Indonesians Living in the Time of COVID-19 (an Opinion Editorial). *COVID-19 OP-ED*. SHAPE-SEA: Mahidol University. Retrieved from: https://shapesea.com/op-ed/covid-19/embracing-an-unprecedented-new-normal-for-indonesians-living-in-the-time-of-covid-19/

7.2.3 Juwitasari, Reni. (2020). Community Resilience for Disaster Early Warning System. Based on Saur Sepuh. Concept in Sundanese Coastal Community, West-Java, Indonesia (a Book Series). *Book Series of the Center for Multi-Culture Studies*. Taiwan: National Cheng Kung University.

7.2.4 Juwitasari, Reni. (2019). Education System in ASEAN and South Asia Region: A Comparison (a book chapter) in *India and ASEAN Engagement (ed. Faisal Ahmed and Mohammad Faheem)*. New Delhi: Delhi Press

7.2.5 Juwitasari, Reni. (2019). The Japanese Legacy: What is Still Left in the Education System in Indonesia?. *Thammasat Review*, 22(1), pp. 64 -76.

7.2.6. Juwitasari, Reni. (2019). Disaster Preparedness Management on Tsunami: A Case Study of the Local Government and Coastal Community Resilience in Indonesia. *Proceeding of 6th International Conference on International Relations and Development*. Chiang Rai: Mae Fah Luang University.

7.2.7 Juwitasari, Reni. (2018). The Paradigm Shift in Teaching and Learning Activity in the Classroom: Cooperative Learning in Indonesia. *Proceeding of the 4th National and International Conference on Curriculum and Instruction*. Khon Kaen: Khon Kaen University.

7.2.8 Juwitasari, Reni. (2017). The Women Principals Participation in Southeast Asian School: Role Challenge and School Effectiveness in Indonesia. *Journal Apparatus,* 2(2), pp. 62-70.

7**.**2**.**9 Juwitasari, Reni**. (**2015**).** *Merah Putih di Negeri Gajah Putih.* Indonesia**:** The Embassy of the Republic of Indonesia to the Kingdom of Thailand**.**

8.   ประวัติการนำเสนอผลงานวิจัยทั้งภายในและภายนอกประเทศ โปรดระบุชื่อเรื่อง

ของผลงาน ชื่อการประชุม สถานที่ วัน เวลา ตามระบบสากล

1.   Australian Fellowship on "Research at a Distance: Japan Studies in an age of COVID-19," January 2021 Hosted by Japan Foundation, Sydney, and The University of Melbourne "Door-to-Door Healthcare and Local Community Resilience: Japan's L-TOP Model for Elderly against COVID-19 Spread in Northern Rural Borderland Thailand."

2.   The Best Oral Presenter Award July 2021 at 4th International Interdisciplinary Conference on Green and the Development in Tropical Regions (4 IICGDTR), Andalas University, Indonesia. "Technical and Vocational Education and Training toward Sustainable Development of Japan's Aid Effectiveness for Industrial Human Resource Development in Lower Mekong Basin Countries"

3.   Transdisciplinary Research in Social Science, Chulalongkorn University, Thailand (9-11 July 2019)

4.   AIMC 2019 at University Technology Malaysia (UTM), Johor Bahru, Malaysia (April 30 – May 2, 2019)

5.   Conference of Comparative Education Society of Cambodia; Education for Shared Community and Prosperity in 2019 at Siem Reap, Cambodia, (6-7 December 2019)

6.   The 12th International Indonesia Forum Conference in 2019 at National Cheng Kung University, Tainan, Taiwan (26-27 June 2019).

7.   Symposium on Approaches to Sustainable Development in Southeast Asia at Southern Institute of Social Science, Ho Chi Minh City, Vietnam (17-19 December 2018)

8.   The 14th Asia Pacific Sociological Association Conference in 2018 at Seisa University, Hakone, Japan (5-7 October 2018)

1.   ผลงานวิจัยที่ได้รับการจดทะเบียนทรัพย์สินทางปัญญา หรือผลงานวิจัยที่อยู่ระหว่างการยื่น

ขอจดทะเบียนทรัพย์สินทางปัญญา

2.   ประสบการณ์ที่เกี่ยวข้องกับการบริหารงานวิจัยทั้งภายในและต่างประเทศโดยระบุตำแหน่งหน้าที่ในการทำการวิจัย ว่า

เป็นผู้อำนวยการแผนงานวิจัยหัวหน้าโครงการวิจัย

หรือผู้ร่วมวิจัยในแต่ละข้อเสนอการวิจัยและระบุสถานภาพของงานวิจัยด้วย

-       งานวิจัยที่ทำเสร็จแล้ว : ชื่อข้อเสนอโครงการวิจัยสัดส่วนที่ทำงานวิจัย (%) คณะผู้วิจัยและสถาบันร่วมวิจัย แหล่งทุน

ปีที่ได้รับทุน การเผยแพร่ผลงานวิจัย

i.MFU Research Fund 2020 Project (100% completed) "การศึกษาประสิทธิผลของความช่วยเหลือเพื่อ

การพัฒนาอย่างเป็นทางการของญี่ปุ่น (ODA) ต่อการพัฒนาทรัพยากรมนุษย์ในแง่อุตสาหกรรม (HRD): การประเมินผล

อาชีวศึกษาภายใต้โครงการความร่วมมือระหว่างประเทศ JICA's ในอนุภูมิภาคกลุ่มแม่น้ำโขง