



24-25 APRIL 2025



INTERNATIONAL COLLEGE THAKSIN UNIVERSITY

CONFERENCE
PROCEEDING

THE 2ND INTERNATIONAL
CONFERENCE ON ASEAN
SUSTAINABLE DEVELOPMENT

(ICASD 2025)

SUSTAINABLE DEVELOPMENT GOALS



Accelerating Action:

Collaborative Solutions For
Sustainable Development

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Title: Proceedings of the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025)

Theme: “Accelerating Action: Collaborative Solutions for a Sustainable Future”

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Design:

Dr. Muhammad Hassan Arshad

Published by:

International College, Thaksin University

www.tsu.ac.th

ISBN: 978-974-474-106-6

Publication Year: 2025

Edition: First Edition

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PREFACE

The International College of Thaksin University successfully organized the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025) on April 24–25, 2025, under the theme:

"Accelerating Action: Collaborative Solutions for a Sustainable Future."

The conference was held onsite at the Courtyard by Marriott Phuket Town, Phuket, Thailand. Its primary objective was to provide an academic platform for researchers, scholars, and graduate students to meet, exchange knowledge, and share research experiences focused on sustainable development. ICASD 2025 aimed to:

- Foster interdisciplinary collaboration among regional and international scholars;
- Promote the dissemination and exchange of research that contributes to solving real-world sustainability challenges;
- Strengthen academic partnerships that support policy development and community resilience;
- Encourage the integration of SDGs into education, research, and public policy initiatives;
- Inspire and empower the next generation of leaders and researchers to take concrete action toward sustainable futures.

The conference centered on five key thematic areas aligned with the 17 Sustainable Development Goals (SDGs), also known as the 5 Ps of Sustainable Development:

1. People – End poverty and hunger in all forms and ensure dignity and equality. This dimension focuses on improving human well-being through equitable access to healthcare, education, social protection, and opportunities for all, especially marginalized and vulnerable populations.

2. Prosperity – Ensure prosperous and fulfilling lives in harmony with nature. This area addresses inclusive economic growth, full and productive employment, technological innovation, sustainable industry, and access to affordable energy and infrastructure that improve living standards without compromising environmental integrity.

3. Planet – Protect our planet's natural resources and climate for future generations. This dimension emphasizes urgent action to combat climate change, conserve biodiversity, promote sustainable resource use, reduce pollution, and encourage responsible consumption and production patterns.

4. Peace – Foster peaceful, just, and inclusive societies. Peace focuses on promoting the rule of law, reducing all forms of violence, ensuring access to justice, building transparent institutions, and protecting human rights and fundamental freedoms.

5. Partnership – Revitalize the global partnership for sustainable development. It underlines the importance of multi-stakeholder collaboration across governments, academia, private sector, civil society, and international organizations to mobilize resources, share knowledge, and build capacity to achieve the SDGs.

The SDGs, adopted by all United Nations Member States in 2015, represent a shared global blueprint for peace, prosperity, and the protection of our planet. Their significance lies in promoting inclusive and equitable progress by addressing critical issues such as poverty, inequality, climate change, environmental degradation, peace, and justice. Through discussions and research presented at ICASD 2025, the conference contributed to accelerating collective efforts and regional collaboration in achieving these goals—especially within the ASEAN context, where diverse challenges require unified and innovative solutions.

ICASD 2025 featured two keynote sessions on global trends toward sustainable development, delivered by distinguished speakers from Norway and Korea. A total of 49 oral research presentations were delivered, with additional participation from non-presenting attendees and young researchers representing various international institutions.

The Organizing Committee extends its heartfelt appreciation to all co-hosting institutions, including:

- (1) Institute of Research and Innovation
- (2) Faculty of Economics and Business Administration
- (3) Faculty of Law
- (4) Faculty of Agro- and Bio-Industry
- (5) Center of Excellence for Agricultural Innovation and Bioproducts (ExCAB-TSU).
- (6) International Relations Office
- (7) Université de Moncton, Canada
- (8) University Utara Malaysia
- (9) Myanmar Creative University
- (10) Scientists and Engineering Without Border, Republic of Korea
- (11) IMT – GT (Indonesia – Malaysia – Thailand Growth Triangle)



Message from the President of Thaksin University

On behalf of Thaksin University (TSU), it is my distinct honor to welcome you to the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025), held under the theme “Accelerating Action: Collaborative Solutions for a Sustainable Future.”

I take great pride in the continued success of this meaningful conference, which will undoubtedly yield positive impacts for researchers, scholars, and all individuals committed to the advancement of sustainable knowledge. ICASD 2025 stands as a powerful continuation of our mission to foster global partnerships and drive transformative progress toward the achievement of the Sustainable Development Goals (SDGs).

Hosted by Thaksin University’s International College, this year’s conference is made possible through the invaluable collaboration of our esteemed partners: the Institute of Research and Innovation, Faculty of Economics and Business Administration, Faculty of Law, Faculty of Agro- and Bio-Industry, International Relations Office, and the Center of Excellence for Agricultural Innovation and Bioproducts (ExCAB-TSU). We are also honored to be joined by our international partners: Université de Moncton (UM), Universiti Utara Malaysia (UUM), Myanmar Creative University (MSU), Scientists and Engineers Without Borders, and the IMT-GT network.

The International College of Thaksin University takes immense pride in sustaining this conference as a cornerstone of global academic dialogue – a testament to our unwavering commitment to advancing cross-border collaboration, pioneering research, and actionable solutions for a more sustainable future. Building upon the legacy of its inaugural event, ICASD 2025 serves as a dynamic platform for the exchange of knowledge, insights, and best practices. By bringing together experts, policymakers, researchers, and practitioners from across disciplines and borders, we aim to accelerate meaningful progress on critical issues such as climate resilience, equitable resource management, and inclusive technological innovation.

To all our distinguished participants, speakers, and partners: your presence and expertise are instrumental in shaping a more sustainable and just future for ASEAN and the global community. May this conference inspire bold thinking, shared learning, and concrete steps that translate vision into impact.

In closing, I extend our deepest appreciation to all co-hosting institutions for their steadfast partnership. We are confident that ICASD 2025 will not only mark a significant milestone in academic cooperation but also lay the foundation for further collaborative initiatives, joint research endeavors, and impactful policy engagement.

Looking ahead, we reaffirm our commitment to sustaining this platform for years to come ensuring that it continues to serve as a beacon of innovation, dialogue, and collective progress.

Together, let us accelerate action and forge a legacy of transformative change.

Sincerely,

(Assoc. Prof. Dr. Natthapong Chitniratna)
President of Thaksin University



Message from Vice President for Research and Innovation, Thaksin University

In today's 21st Century, we face complex challenges in achieving sustainable development. Increasingly extreme climate change, alarming environmental degradation, and widening social inequalities. All these challenges threaten not only natural ecosystems but human survival itself. The United Nations has provided a comprehensive definition of sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." This definition should serve as a compass for all global development efforts. Yet in practice, we still encounter significant gaps between theory and implementation.

The critical role of innovation and collaboration are pivotal to technological advancements and innovation of the new hope. Breakthroughs in renewable energy, circular economy, and green technology have shown tremendous potential. However, technical solutions alone are insufficient. We need more fundamental paradigm shifts in how we perceive the relationship between humanity and nature because the truth is that "nature can exist without humans, but humans can't survive without nature."

A holistic approach integrating environmental, social and economic aspects must form the foundation of all development policies. This is where the academic and research community plays a vital role in generating new knowledge and innovative solutions tailored to global sustainable contexts. It is in this context that the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025) under the theme "Accelerating Action: Collaborative Solutions for a Sustainable Future" gains strategic importance. This forum will serve not only as an academic exchange platform but more crucially, as a bridge between theory and practice.

I hope this conference will identify specific challenges in the ASEAN region and strengthen collaborative networks among academics, practitioners and policymakers to formulate innovative solutions appropriate to global challenges.

In conclusion, I emphasize that sustainable development is no longer optional but imperative. Any delay in action will only worsen existing conditions. Let us make ICASD 2025 a pivotal moment to accelerate our transition toward a more sustainable and equitable future.

Sincerely,

(Assoc. Prof. Dr. Samak Kaewsuksaeng)
Vice President for Research and innovation



Message from Dean of International College, Thaksin University

Dear Participants,

It's my great pleasure to welcome you to the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025), right here in the beautiful and historic Phuket Old Town. This year, we come together under the theme "Accelerating Action: Collaborative Solutions for a Sustainable Future"—a call to join hands and create real, lasting impact for our communities and planet.

This conference is more than just a gathering of minds. It's a space where ideas grow, partnerships form, and meaningful conversations happen. With sessions shaped by the UN Sustainable Development Goals (SDGs), we'll explore topics ranging from education and health to climate change, economic growth, and beyond.

I'm especially excited about how this event reflects our shared values—academic excellence, cultural appreciation, and a deep commitment to sustainability. From our eco-conscious choices to the local field trip experiences, every detail aims to reflect our purpose.

A warm thank you to all our speakers, presenters, and participants. I hope you leave this conference feeling inspired, connected, and ready to take action.

Let's make these two days count—for ourselves, for our communities, and for a better future.

Warmest regards,
Dr. Pittayatorn Kaewkong
Chair, ICASD 2025
International College, Thaksin University



Message from the Co-Chair of the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025)

On behalf of the organizing committee, it is my great pleasure to welcome you to the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025). This year, our theme, "Accelerating Action: Collaborative Solutions for A Sustainable Future," reflects our collective commitment to addressing the pressing challenges we face in pursuit of sustainable development across the ASEAN region.

As we gather here, we have a unique opportunity to exchange ideas, share best practices, and forge partnerships that will drive innovative solutions to complex issues such as climate change, resource management, and social equity. The success of our initiatives depends on our ability to collaborate across sectors and borders, leveraging our diverse perspectives and expertise.

We are privileged to have esteemed speakers, scholars, and practitioners joining us, who will enrich our discussions and inspire action. Your participation is vital as we seek to align our efforts and accelerate the implementation of the Sustainable Development Goals (SDGs) in our communities.

Let us embrace this opportunity to connect, learn, and contribute to a shared vision of a sustainable future for all. Together, we can create impactful solutions that will benefit not only ASEAN but the entire globe. Thank you for being with us. I look forward to engaging discussions and fruitful collaborations.

Warm regards,

(Dr. Pinit Duangchinda)
Dean of Economics business and administration
Co-Chair, ICASD 2025



Message from Dean of the Faculty of Agro- and Bio-Industry, Thaksin University

It is with great pride and pleasure that the Faculty of Agro- and Bio-Industry extends its warmest welcome to all participants of the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025).

This crucial academic platform brings together researchers, educators, practitioners, and policymakers from ASEAN and beyond to share knowledge, innovations, and practical solutions for sustainable development. The conference theme aligns with the United Nations Sustainable Development Goals (SDGs) and reflects our shared commitment to addressing global challenges through regional collaboration and scientific advancement.

As one of the co-hosting institutions, the Faculty of Agro- and Bio-Industry is honoured to support this international exchange of ideas to foster sustainability in agriculture, biotechnology, food systems, the environment, and broader socioeconomic contexts.

We believe that this conference's outcomes will spark new collaborations, inspire future research, and contribute meaningfully to sustainable growth and development in the ASEAN region.

We thank all organizers, keynote speakers, presenters, and participants for their valuable contributions. May ICASD 2025 be a memorable and fruitful experience for all.

Assistant Prof. Dr. Rutrada Theppradit
Dean of Faculty of Agro- and Bio-Industry
Thaksin University



Message from Head of Centre of Excellence, Thaksin University

It is with great pleasure and honor that the Center of Excellence for Agricultural Innovation and Biological Products, Thaksin University, welcomes you to the 2nd International Conference on ASEAN Sustainable Development (ICASD 2025) under the theme "Accelerating Action: Collaborative Solutions for A Sustainable Future."

On behalf of the Center of Excellence, we are proud to co-host this significant event alongside the International College, Research and Innovation Institute, Faculty of Economics and Business Administration, Faculty of Law, Faculty of Agro-and Bio-Industry, and the International Relations Office. This integration of expertise from various disciplines reflects the need for cross-disciplinary collaboration to address the complex sustainability challenges.

Our conference theme, "Accelerating Action: Collaborative Solutions for A Sustainable Future," is particularly relevant in the current context where the ASEAN region faces numerous challenges, including climate change, food security, population change, and rapid technological advancements. We must not only analyze these issues but also accelerate our actions and collaborate to create a sustainable future for all. As a Center of Excellence in Agricultural Innovation and Bioproducts of Thaksin University, we recognize the crucial role of agriculture and biotechnology in driving sustainable development, particularly in food security, environmentally friendly agriculture, and the Bio-Circular-Green Economy. We are committed to creating a platform for knowledge exchange, innovation sharing, and collaborations that will lead to practical and contextually appropriate solutions for the ASEAN region.

ICASD 2025 provides an excellent opportunity for academics, researchers, industry experts, and stakeholders from all sectors to jointly analyze challenges, share best practices, and develop collaborative solutions. We hope that this conference will establish strong networks of cooperation that will continue beyond the event and become driving forces for positive change in our region.

We invite all participants to actively participate, share diverse perspectives, and collectively create innovative solutions for the sustainability challenges. Only through interdisciplinary, cross-border, and cross-sectoral collaboration can we achieve our sustainable development goals.

Finally, express our gratitude to all co-hosting units, the organizing committee, speakers, presenters, and participants who have contributed to making this conference possible. We sincerely hope that ICASD 2025 will be informative, inspiring, and lead to practical actions for a sustainable future in the ASEAN region and our world.

With best regards,

(Assist. Prof. Dr. Nantharat Phruksaphithak)



Message from Dean of Faculty of Law, Thaksin University

On behalf of the Faculty of Law at Thaksin University, I am very pleased to co-host the international academic conference with International College, Thaksin University. The conference will be held under the theme, "Research and Social Innovation for Sustainable Development Goals." This conference will serve as an important platform for the exchange of knowledge and the promotion of international academic collaboration, particularly in the context of the ASEAN region.

In the 21st century, the globe is seeing significant changes in various domains, including the environment, society, and economics, and particularly technology, which includes artificial intelligence (AI), blockchain, and big data. These alterations directly impact the social structures, economic systems, and legal systems. While these technological breakthroughs have created wonderful growth prospects, they have also introduced unprecedented legal obstacles. These challenges include concerns about personal data protection, cybersecurity, credibility for artificial intelligence, and equity in access to technology. The law is no longer merely a tool for organizing society; rather, it is an essential component in ensuring that development is sustainable and just and does not leave anybody behind. The Sustainable Development Goals (SDGs) align with this approach, emphasizing the importance of leaving no one behind.

The Faculty of Law acknowledges the role it plays in training graduates to deal with the ever-changing environment. The course includes the development of policy-oriented research and legal recommendations that are in response to the modern world, which necessitates collaboration across disciplinary lines and international borders. All of the organizers deserve our gratitude.

I really hope that this conference will serve as a driving force for continued academic collaboration and contribute to the establishment of meaningful social innovations. This hope is shared by the working committee as well as participants from all regions who came this time to exchange knowledge. Thank you, and I wish this international academic conference immense success.

Sincerely,
Assistant Professor Krisda Apinawatawornkul
Dean of law ,Thaksin University



Message from Vice President of Université de Moncton

It is with honor that the Université de Moncton, in Canada, is once again partnering with Thaksin University, in Thailand, to host the second edition of the International Conference on ASEAN Sustainable Development (ICASD 2025) to be held in Phuket, Thailand.

The Université de Moncton and Thaksin University have a long-standing relationship, with research collaborations in engineering and renewable energy, along with contributions in the activities of the International College at Thaksin University. We also had the privilege of hosting researchers from Thaksin University within our facilities in Canada. These activities have allowed for the sharing of knowledge, the sharing of expertise and building our respective research capacities in the dynamic and rapidly evolving field of renewable energy.

Climate change, energy transition, sustainable development are now part of the narrative of developed nations and emerging economies. The southeast Asian nations are no different to these challenges, and they have embraced these concepts in guiding their development of public policies to achieve sustainability.

The International Conference on ASEAN Sustainable Development (ICASD 2025) is a great opportunity for the dissemination of knowledge and exchange on best practices in an area of great importance in the current era of climate change and demographic challenges. As always, we wish best success to ICASD 2025, and we enthusiastically encourage constructive discussions during the Conference, along with the creation of new research collaborations and new friendships.

(Prof.Dr. Sébastien Deschênes)
Vice President, Université de Moncton, Edmundston Campus



Message from the President of SEWB

Dear respected guests, organizers, and participants of the 2nd International Conference on ASEAN Sustainable Development,

On behalf of Scientists and Engineers Without Borders (SEWB) of Korea, I would like to warmly congratulate you on the opening of ICASD 2025. Thank you to Thaksin University and everyone who worked hard to organize this important event.

The theme of this year's conference, "Collaborative Solutions for a Sustainable Future," is very meaningful and timely. Around the world, people are working together to solve big problems such as climate change, clean energy, education, and health. These goals are part of the United Nations Sustainable Development Goals, and your conference shows how much we can do when we share ideas and work as partners.

At SEWB, we believe that science, technology, and strong partnerships can improve lives and create real change. We hope to continue working with friends in Thailand and across ASEAN to build a better future for all.

Congratulations again on this wonderful event. I wish you all great success and inspiring discussions.

Thank you very much.

(Kwanwoo Shin)
President, Scientists and Engineers Without Borders (SEWB)



Message from the Dean of School of Business Management, UUM

On behalf of the School of Business Management at Universiti Utara Malaysia (UUM) and Thaksin University, it is our great pleasure to extend a warm welcome to all participants of The 2nd International Conference on ASEAN Sustainable Development (ICASD 2025).

This event reflects our shared dedication to fostering a sustainable future, driven by collaboration across institutions and borders. As key advocates of innovation, research, and educational excellence, both UUM and Thaksin University are committed to promoting impactful discussions and tangible progress in sustainable development.

Our support for ICASD 2025 highlights our belief in the power of collective knowledge and the importance of collaborative efforts to address the most pressing environmental, economic, and social challenges faced by the ASEAN region and beyond.

By uniting experts, practitioners, and policymakers, the conference seeks to inspire new insights and actionable strategies for sustainable growth. We are honored to play a pivotal role in supporting conversations on environmental stewardship, responsible resource management, and inclusive economic development—areas that lie at the very heart of our institutional values.

We trust that the exchange of research findings, best practices, and innovative perspectives throughout ICASD 2025 will foster meaningful partnerships and shape the path toward a sustainable ASEAN community. We look forward to the dynamic engagements and breakthroughs that will undoubtedly emerge, and we wish everyone a productive and enlightening conference experience.

(Assoc. Prof. Dr. Shuhymee Ahmad)
Dean, School of Business Management
Universiti Utara Malaysia



Message from Chairman Research Committee Myanmar Creative University

It is my great honor to welcome all participants to the International Conference on ASEAN Sustainable Development 2025 (ICASD 2025). Myanmar Creative University (MCU) is pleased to co-organize this significant event with Thaksin University (TSU) and esteemed academic partners worldwide.

This conference reflects our shared commitment to advancing sustainable development across ASEAN. MCU fully supports the goals of ICASD 2025 and values the opportunity to strengthen academic ties in the region and beyond—especially our close and continuing partnership with TSU.

Although MCU leadership is unable to attend in person due to the ongoing natural disaster in Myanmar—the most severe in decades—we send our sincere support and friendship to all participants. In these difficult times, international academic cooperation remains essential.

The conference’s themes—People, Peace, Planet, Prosperity and Partnership—offer a timely and important foundation for knowledge exchange, research, and collaborative learning. These dimensions are central to sustainable progress in ASEAN and globally.

I sincerely hope ICASD 2025 will be filled with mutual understanding, creativity, and meaningful dialogue that inspires lasting contributions to our shared future.

(Professor Nattaphan Kecharananta)
Chairman, Research Committee
Myanmar Creative University



**The 2nd International Conference
ASEAN Sustainable Development
(ICASD 2025)**

**THEME: "ACCELERATING ACTION:
COLLABORATIVE SOLUTIONS FOR A
SUSTAINABLE FUTURE"**

**Day 1: Academic Conference
(Thursday, 24 April 2025)**

Time	Agenda
08:30 – 09:00	Registration
09:00 – 09:40	<p>Opening Ceremony (MC: Mr. Budy Prastyo and Ms. Chanatip)</p> <ul style="list-style-type: none"> • Music and Video Presentation • TSU Video • Reporting by Dr. Yejin Kim, ICASD Committee, International College, Thaksin University • Opening by Dr. Pittayathorn Kaewkong, Acting Dean of International College, Thaksin University • Photo session
09:40 – 10:30	<p>Keynote Speaker 1 : Prof. Dr. Nils-Kaare Birkeland</p> <ul style="list-style-type: none"> • Topic : Biodegradation of Feather Keratin by Thermophilic Fervid bacterium: Species Structural and Multi-omics Insights
10:30 – 10:50	Refreshment
10:50 – 11:40	<p>Keynote Speaker 2 : Prof. Dr. Min-Soo Maeng</p> <ul style="list-style-type: none"> • Topic : Korea’s policy Directions for International Carbon Reduction and Sustainable International Development Cooperation in response to Climate Change
11:40 – 13:00	Lunch
13:00 – 16:30	<p>Oral Presentations of the Participants</p> <p>Session 1 : People Chair : Assoc.Prof.Dr. Darwina Arshad Co-chair Prof. Dr. Nattaphan Kecharananta Invited Speaker : Assoc.Prof.Dr. Darwina Arshad Title : Enhancing Strategic Decision-Making through Ambidextrous Leadership and Environmental Dynamism in Schools</p> <p>Session 2 : Prosperity Chair : Assoc. Prof. Dr. Hendrik Bin Lamsali Co-chair : Dr. Muhammad Zulqarnain Arshad Invited Speaker : Assoc. Prof. Dr. Hendrik Bin Lamsali Title : Assessing Service Quality of Last-mile Delivery Services and Customer Satisfaction In Malaysia</p>

Time	Agenda
13:00 – 16:30	<p>Oral Presentations of the Participants</p> <p>Session 3 : Planet–Group 1 Chair : <u>Assoc.Prof.Dr. Sompong O-Thong</u> Co-chair : <u>Dr. HyungWoo Lee</u> Invited Speaker : Dr. Edy Kurniawan Title : Optimizing continuous medium-chain fatty acid production from biohydrogenic palm oil mill effluent: Operational parameters and biohydrogenic palm oil mill effluent: Operational parameters and microbial dynamics</p> <p>Session 4 : Planet–Group 2 Chair : <u>Prof. Dr. Yves Gagnon</u> Co-chair : <u>Abdunfatah Masamae</u> Invited Speaker : Norhanizan Usaizan Title : Determining Soil Suitability for Oil Palm (<i>Elaeis guineensis</i>) Cultivation: A Comprehensive Study of Soil Fertility and Nutrient Dynamics</p> <p>Session 5 : Peace and Partnership Chair : <u>Asst. Prof.Dr. Aniwat Kaewjamnong</u> Co-chair : <u>Dr. Yejin Kim</u> Invited Speaker : Asst.Prof.Dr. Aniwat Kaewjamnong Title :</p> <p>Session 6 : Online Presentations 1 Chair : <u>Md Ahababur Rahman</u> Invited Speaker : Presenter: Md Ahababur Rahman Research title: Service Quality and Customer Satisfaction in The Fast-Food Industry of Malaysia</p> <p>Session 7 : Online Presentations 2 Chair : <u>Dr. Muhammad Hassan Arshad</u> Co-chair: <u>Mr Budy Prastyo</u> Invited Speaker : Dr. Muhammad Hassan Arshad Title : The Impact of Green Market Orientation and Green Entrepreneurial Orientation on the Sustainable Performance of SMEs in Thailand</p>
17:00 – 19:00	Free time
19.00 – 21.00	<p>Gala Dinner – Dress Code: International Vibes Welcome!</p> <ul style="list-style-type: none"> • Welcoming by the Dean of International College (IC) – Thaksin University • Music show by “Mock and Friends Saxophone Band” and Lucky Draw • Announcement of Outstanding & Honorable Presentation • Presentation of tokens to Co-hosts • Closing remarks by Asst.Prof.Dr. Aniwat Kaewjamnong, the Deputy Dean of IC-TSU



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**Day 2: Sustainable Development
Field Tour
(Friday, 25 April 2025)**

Time	Agenda/Contents
By 9 AM	Arriving at the Conference Venue (At Courtyard by Marriott Phuket Town, Phuket)
	<p>Participants may select one of the following field tour options through QR Code. (Maximum 30 participants per tour; first come, first served).</p> <p>🌿 Sustainable Phuket Old Town Tour (2-3 hours)</p> <ul style="list-style-type: none"> • Walk Along Thalang Road – Start your morning with a stroll down this famous heritage street. Enjoy the colorful old buildings and visit shops that sell handmade and eco-friendly products. • Visit Thai Hua Museum – Learn about Phuket’s history and see how the community works to protect its culture and traditions in a sustainable way. • See Street Art on Soi Romanee – Explore one of the prettiest alleys in town, full of creative murals that share messages about local life and the environment. • Enjoy a Green Coffee Break– Relax at a café that uses eco-friendly practices like reusable straws and local, organic ingredients. • End with Inspiration– Leave with a better understanding of Phuket’s culture and how sustainability is part of everyday life in the Old Town.

Important Notes

1.Thank you for joining and contributing to the 2nd ICASD 2025.

Your participation makes this event meaningful and impactful.

2.Oral Presentations

- Some articles have been shifted to different sessions to ensure a smooth and coherent schedule. We appreciate your kind understanding.
- Each presenter is allotted **15–20 minutes**, including time for questions and reflections.
- Please use **PDF files** for your presentations and submit them to your **session co-chair during lunch time**.

3.Gala Dinner – Dress Code: International Vibes Welcome!

Celebrate cultural diversity by wearing **traditional or national attire** from any country. Let’s make the evening colorful, lively, and memorable! **A round table will be held during the Gala Dinner to explore future academic and research collaborations for Sustainable Development**

4.Emergency Contact: Dr. Yejin Kim +66 (0)80 547 4500



**The 2nd International Conference
ASEAN Sustainable Development
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**THEME: "ACCELERATING ACTION:
COLLABORATIVE SOLUTIONS FOR A
SUSTAINABLE FUTURE"**

CONFERENCE ORGANIZER

Conference Organizer

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- Dr. Pittayatorn Kaewkong

Vice Chairperson:

- Dr Yejin Kim

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- Assoc. Prof. Dr. Samak Kaewsuksaeng
- Assoc. Prof. Dr. Suttiporn Bunmak
- Asst. Prof. Dr. Pinit Duangchinda
- Asst. Prof. Dr. Rutrada Theppradit
- Asst. Prof. Dr. Nantharat Phruksaphithak
- Asst. Prof. Krisda Apinawatawornkul
- Dr. Pittayatorn Kaewkong

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- Mr. Wittaya Sanboo
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**The 2nd International Conference
ASEAN Sustainable Development
(ICASD 2025)**

**THEME: “ACCELERATING ACTION:
COLLABORATIVE SOLUTIONS FOR A
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Conference Proceeding

Article no.	Research Title
1	<p>Auhtor: Sanit Srichookiat and Wannaporn Boriphan Title: Enhancing Statistical Analysis Skills and Teamwork among Undergraduate Students Through Sequential Training</p>
2	<p>Author: Aniwat Kaewjomnong and Wassana Makkongka Research title: Forecasting Human Resource Skills for New-age Leadership that can use Technology in Educational Management in the Four Southern Border of Provinces of Thailand</p>
3	<p>Author: Ossy Dwi Endah Wulansari, Irfan Saputra, Johanna Pirker and Christian Guetl Research title: Emotion Unleashed: VR Game for Emotional Recognition and Empathy Training</p>
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6	<p>Author: Aniwat Kaewjomnong, Sirichan Phugdee Research title: Economy Analysis of Factors in the Development of Human and Social Skills (Soft Skills) of Undergraduate Student with Predictive Power to Promote Small Business Entrepreneurship in Four Southern Provinces of Thailand</p>
7	<p>Author: Phuanglek lamchamnan,Somkiat Saithanoo, Thaweesak Putsukee and Sompop Intasuwan Research title: Bridging How Carbon Footprint for Organization Contributes to Sustainable Climate Change Mitigation</p>
8	<p>Author: Wassana Suwanvijit Research title: Study of Sustainable Food Tourism Promotion Guidelines in Phuket, Thailand</p>

Article no.	Research Title
9	<p>Author: Kun Anantanawat, Chantinee Boonchai Title: Implementing Circular Economy Concept in Tourism: A case study of Phuket, Thailand</p>
10	<p>Author: Duenpen Kochakornjarupong Research title: Bridging SDGs and Digital Education: A Study on Validated Peer Assessment Models in Higher Education</p>
11	<p>Author: Wilawan Jansri, Prajak ChertChom Research title: Forecasting The Development of Learning Outcomes in Research Methodology and Research Design Skills of Third-Year Students Using Research-Based Learning</p>
12	<p>Author: Wasan Kanchanamukda, Yongyuth Rattanasuwan, Chotiya Hitapong, and Chanticha Buasri Research title: Study of Skills in Using the Express Accounting Software and Learning Behavior Based on Simulated Situations in the Accounting Software Course for Third-Year Undergraduates</p>
13	<p>Author: Duenpen Kochakornjarupong Research title: Fostering Peace and Strong Institutions through Happiness Engineering and Meditation: A Case Study of Thaksin University's Sustainable Education Model</p>
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ENHANCING STATISTICAL ANALYSIS SKILLS AND TEAMWORK AMONG UNDERGRADUATE STUDENTS THROUGH SEQUENTIAL TRAINING

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Abstract: This study aims to enhance statistical analysis skills using SPSS and develop teamwork skills among fourth-year undergraduate students in the Entrepreneurship and Management program, Faculty of Economics and Business Administration. The research employed three out-of-class training sessions, integrating individual skill exercises with blended learning materials and group skill exercises. The training was structured into three weeks: File Preparation and Descriptive Statistics (Week 1), T-test and ANOVA (Week 2), and Multiple Regression Analysis (Week 3). The findings revealed that students demonstrated excellent statistical analysis skills across all three lessons after the training. Regarding teamwork skills, significant improvements were observed in two aspects: Collaborative Planning and Project Contribution. However, no statistically significant improvements were found in three other aspects: Team Environment, Facilitating Team Members, and Conflict Management.

Keywords: Statistical Analysis Skill, Teamwork, Personalized Exercise, Group Exercise, Training

1. Introduction:

Class participation is a crucial factor in student learning, as studies suggest that students who actively engage in learning activities tend to succeed more than those who passively listen to lectures (Dancer & Kamvounias, 2005). Participation fosters essential 21st-century skills such as critical thinking, problem-solving, and communication. However, encouraging participation can be challenging due to various factors like interest levels, personality, attitudes towards learning, and classroom environment (Weaver & Qi, 2005), as well as large class sizes and limited interaction (Fies & Marshall, 2006). Thus, finding effective strategies to boost interactive participation in large classrooms is essential for achieving the desired learning outcomes.

Since participation plays a key role in student success, it is also closely linked to the development of teamwork skills, which are highly valued by employers (Hughes & Jones, 2011). These skills include Collaborative Planning, Team Environment, Facilitating Team Members, Conflict Management, and Project Contribution (Britton et al., 2017; Hastie et al., 2014; Vaughan et al., 2019). These skills can be nurtured through various educational approaches, such as specialized courses (Nudelman et al., 2022), group projects, extracurricular activities (De Prada et al., 2022; Nudelman et al., 2022), and in-class activities (Campbell et al., 2024). These methods not only engage students but also indirectly enhance their academic performance by fostering teamwork.

The researcher encountered these challenges while teaching a research methodology course in entrepreneurship and management, which aims to equip students with the ability to accurately analyze collected data using statistical software. However, based on the researcher's experience, many students lack proficiency in using the software and tend to rely excessively on their group members, a behavior known as the free-riding phenomenon. This results in low participation from some members, leading to a lack of motivation and enthusiasm for learning, ultimately affecting academic performance (Çali et al., 2024; Jagupilla et al., 2024). Additionally, it impacts teamwork skills and group morale (He, 2012; Maiden & Perry, 2011). Contributing factors include the large number of students in the program and the course structure, which emphasizes group work, limiting some students' opportunities for full participation. Furthermore, many students lack fundamental skills in statistical software, preventing them from correctly analyzing the collected data.

To address the challenges of low student participation and inadequate statistical software skills, this study implements a series of three blended skill-training exercises aimed at enhancing both data analysis proficiency and teamwork abilities. Research has shown that well-designed exercises combined with interactive media can significantly improve learning outcomes and engagement (Leggett et al., 2012). By integrating these methods into a short-term training program, this study seeks to address the free-riding phenomenon and improve students' ability to independently analyze data while fostering essential teamwork skills. The findings will provide valuable insights for educators in designing more effective instructional strategies and contribute to students' long-term professional development.

Materials and Methods

2.1 Research Design

This study employs a One-Shot Case Study Design, a pre-experimental approach where a single group undergoes an intervention followed by a post-test observation, without a pre-test or control group (Malhotra, 2010). In this research, the intervention consists of individual skill exercises (X1) and group skill exercises (X2). Subsequently, the outcomes are measured in terms of students' proficiency in using statistical analysis software (O1) and their teamwork skills (O2).

2.2 Population and Sample

The population is defined as fourth-year undergraduate students enrolled in the Entrepreneurship and Management program at the Faculty of Economics and Business Administration, Thaksin University. The sample consists of 67 students who are currently in their fourth year in 2024.

2.3 Learning Content

Training Session 1 (Week 1): Preparing SPSS Files and Descriptive Statistics

Preparing data before analysis is a crucial initial step in using SPSS. This process includes key steps such as importing data into the program, coding numerical values, setting up measurement scales and then performing descriptive statistics using frequency counts and percentages to report sample data.

Learning Outcomes:

- Ability to prepare data in SPSS
- Ability to use the program to perform descriptive statistical analyses
- Teamwork skills
- Achievement Levels of Learning

Achievement Levels of Learning Outcomes illustrates the score levels from Training Session 1, presented as percentages. These scores are categorized into four levels of student learning outcomes, as shown in Table 1.

Table 1 Achievement Levels for Training Section 1

Level	Description	Score Range
Level 4 (Excellent)	The student accurately prepares the SPSS data file and thoroughly describes the demographic characteristics of the sample using frequencies and percentages across all five variables, with minimal errors.	90-100%
Level 3 (Good)	The student correctly prepares the SPSS data file and adequately describes the demographic characteristics of the sample using frequencies and percentages across all five variables.	60-89%
Level 2 (Satisfactory)	The student prepares the SPSS data file correctly but provides minimal description of the demographic characteristics of the sample using frequencies and percentages across the five variables, or makes significant errors.	35-59%
Level 1 (Unsatisfactory)	The student fails to correctly prepare the SPSS data file, leading to subsequent analysis errors.	Below 35%

Training Session 2 (Week 2): Analysis of Independent T-test and ANOVA

Independent t-test and ANOVA are statistical methods used to compare group means. The independent t-test is applied when comparing the means of two groups, whereas ANOVA (Analysis of Variance) is employed when comparing the means among three or more groups; the key requirement is that the samples in each group must be independent. For example, in a scenario using the independent t-test, a company might test whether a new advertisement significantly increases sales by comparing the average sales of stores using the new advertisement with those using the conventional one—thus ensuring that the two groups are independent. Similarly, in a scenario using ANOVA, a company might compare the average sales across branches in different regions (e.g., North, Central, South, East, and West). ANOVA helps determine whether significant differences exist among regions, and if differences are detected, further analysis can pinpoint which regions differ significantly, potentially informing adjustments in marketing strategies or supply chain management.

Learning Outcomes:

- Ability to use SPSS to analyze data using independent t-test and ANOVA.
- Ability to interpret the results from independent t-test and ANOVA.
- Development of teamwork skills.

Achievement Levels of Learning Outcomes illustrates the score levels from Training Session 2, presented as percentages. These scores are categorized into four levels of student learning outcomes, as shown in Table 2.

Table 2 Achievement Levels for Training Section 2

Level	Description	Score Range
Level 4 (Excellent)	The student can accurately perform t-test and ANOVA analyses using the software, including post hoc tests, and is able to correctly interpret and report the statistical values either completely or almost completely.	85-100%
Level 3 (Good)	The student can perform t-test analysis completely and execute ANOVA correctly; however, they are not yet able to interpret the results of the post hoc tests.	55-84%
Level 2 (Satisfactory)	The student can conduct t-test analysis completely and perform a basic ANOVA; however, errors occur in the interpretation of statistics (e.g., selecting the wrong p-value or omitting post hoc tests when necessary).	25-54%
Level 1 (Unsatisfactory)	The student is unable to correctly perform statistical analyses using the software; they might only report the Levene's test results, but interpret them incorrectly.	Below 25%

Training Session 3 (Week 3): Analysis of Multiple Regression

The analysis of Multiple Regression using SPSS involves interpreting various statistical outputs obtained from the software. These include the F-test value to examine the influence of independent variables on the dependent variable, the t-statistic and p-value for each coefficient to test the effect of each independent variable on the dependent variable, the regression coefficient, the standardized coefficient, the coefficient of determination (r^2), and the Variance Inflation Factor (VIF), which is used to detect multicollinearity among the independent variables.

Learning Outcomes:

- Ability to use SPSS to perform Multiple Regression analysis.
- Ability to interpret the statistical results from a Multiple Regression analysis.
- Development of teamwork skills.

Achievement Levels of Learning Outcomes illustrates the score levels from Training Session 3, presented as percentages. These scores are categorized into four levels of student learning outcomes, as shown in Table 3.

Table 3 Achievement Levels for Training Section 3

Level	Description	Score Range
Level 4 (Excellent)	The student can perform a basic Multiple Regression analysis using the software and accurately report Beta, t, p-value, and adjusted R-squared values, including interpreting all reported statistics.	85-100%
Level 3 (Good)	The student can perform a basic Multiple Regression analysis using the software and report Beta, t, and p-value, including interpreting the influence of the predictors.	55-84%
Level 2 (Satisfactory)	The student can perform a basic Multiple Regression analysis using the software and report Beta, t, and p-value.	25-54%
Level 1 (Unsatisfactory)	The student is unable to correctly perform statistical analyses using the software and cannot properly analyze or interpret the results of a Multiple Regression analysis.	Below 25%

2.4 Activities in Training Session

The skill-enhancement training activities are designed with a consistent pattern each week. Each session begins with a lecture covering the planned content. After the lecture, students engage in group exercises, where all groups receive the same set of problems. These group exercises focus on reinforcing analytical skills based on the lesson and fostering teamwork skills. Upon completing the group activities, team members conduct a peer assessment to evaluate each other's teamwork skills. After class, students are assigned personalized exercises, supported by multimedia instructional videos on SPSS analysis, allowing them to work independently if they encounter difficulties. For submission, students must input their individually analyzed numerical results from SPSS into an online form within one week. The accuracy of their analysis results will then be verified (see Figure 1).

Plan for Sequential Training Sessions

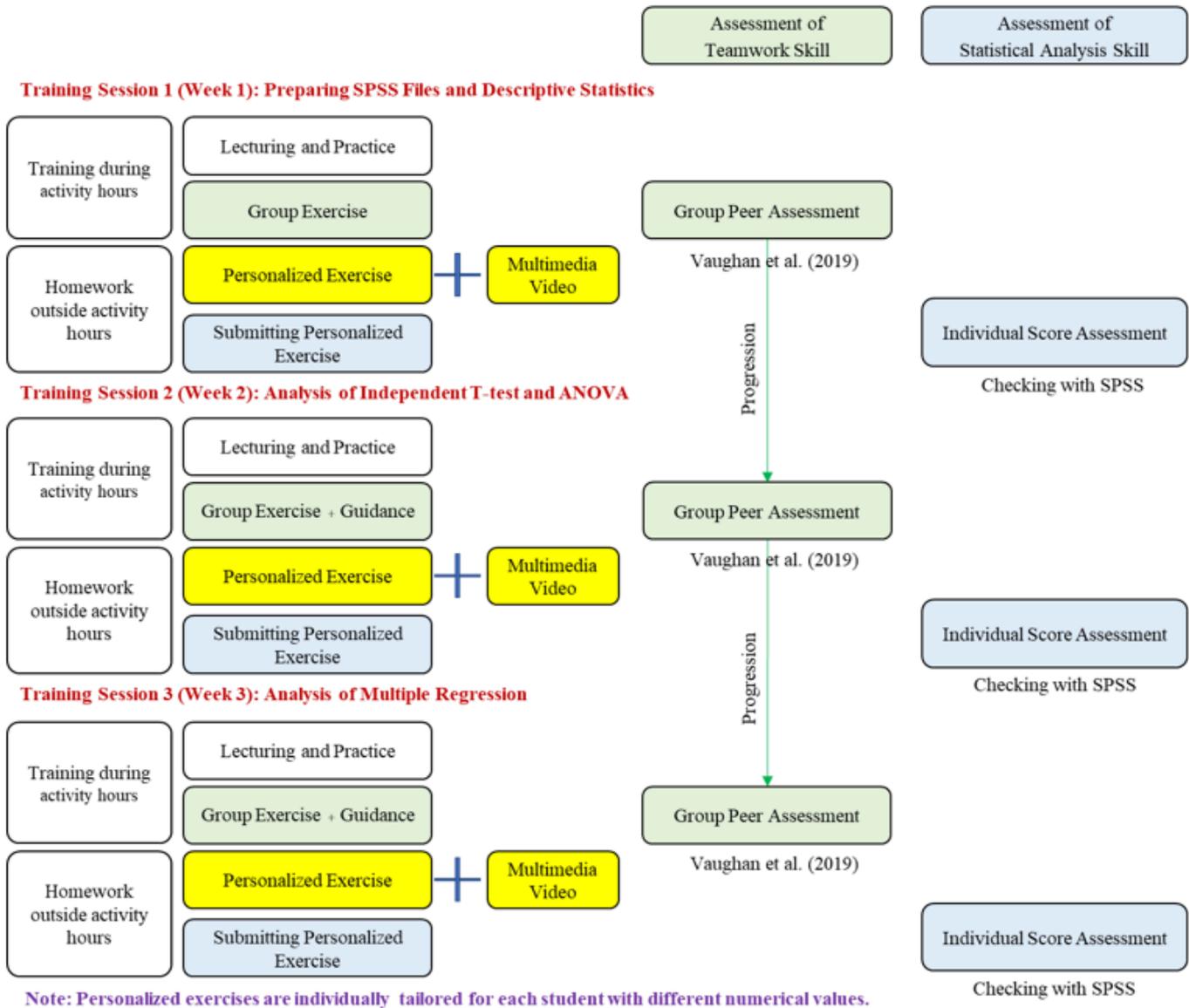


Figure 1 Structured Training Schedule Plan

Group Exercise

Each group is given the same task in the form of an Excel file containing a dataset with 420 observations. The dataset includes demographic variables such as Sex, Age, Marital Status, Education, and Income, along with marketing mix variables (7Ps), which cover opinions on Product, Price, Place, Promotion, Physical Environment, People, and Process. Additionally, the dataset includes the Re-patronage Intention variable, which measures the intention to return for service. Each week, groups are assigned the following tasks:

Training Session 1: Data Preparation and Descriptive Statistics

1. Import the data from the Excel file into SPSS to prepare for analysis.
2. Describe the sample's demographic characteristics.
3. After completing the activity, have group members assess each other's teamwork skill.
4. Submit the group assignment.

Training Session 2: Independent t-test and ANOVA

1. Each group is to plan, divide tasks, and assign team roles for the group skill exercise; allocate 10 minutes for this process.
2. Develop a summary diagram outlining the sequence of procedures for conducting the Independent t-test and ANOVA.
3. Test whether the mean values differ between male and female groups for the following variables: opinions on Product, Price, Place, Promotion, Physical Environment, People, Process, and Re-patronage.
4. Test whether the mean values differ among education level groups (below undergraduate, undergraduate or equivalent, and graduate) for the same set of variables.
5. After completing the activity, have group members assess each other's teamwork skill.
6. Submit the group assignment.

Training Session 3: Multiple Regression

1. Each group is to plan, divide tasks, and assign team roles for the group skill exercise; allocate 10 minutes for this process.
2. Develop a summary diagram outlining the sequence of procedures for conducting the Independent t-test and ANOVA.
3. Test which elements of the marketing mix significantly influence re-patronage.
4. After completing the activity, have group members assess each other's teamwork skill.
5. Submit the group assignment.

Personalized Exercise with Multimedia Teaching Video

Personalized exercises are assigned as homework each week after the lesson. Each student receives a unique numerical data; although the questions are the same, the numerical values differ for each student. This approach ensures that students complete their assigned tasks independently, preventing copying from classmates. Data from each student is used for analysis over the three weeks. Additionally, the instructor has prepared the multimedia video in the form of instructional videos on preparing SPSS files and analyzing data with SPSS for various modules. The individual skill exercise mirrors the variables in the group exercise, with the difference being that the individual exercise uses a sample size of 60 cases, with each student receiving a unique dataset. The weekly individual analysis tasks are as follows:

Training Session 1: Descriptive Statistics

1. Prepare data from an Excel file and import it into SPSS for analysis.
2. View the accompanying instructional video via the provided link.
3. Describe the demographic characteristics of the 60-sample dataset using SPSS.
4. Enter your own responses in the online form.
5. Provide feedback on the exercise for improvements in the following week.

Training Session 2: Independent t-test and ANOVA

1. Using the data prepared in SPSS, compare the mean values of patronage intention between groups defined by the variables Sex and Education Level for your 60-sample dataset (individual task).
2. View the accompanying instructional video via the provided link.
3. Enter your own responses in the online form.
4. Provide feedback on the exercise for improvements in the following week.

Training Session 3: Multiple Regression

1. Using the data prepared in SPSS, test the influence of the marketing mix (7Ps) on patronage intention for your 60-sample dataset (individual task).
2. View the accompanying instructional video via the provided link.
3. Enter your own responses in the online form.
4. Provide feedback on the exercise for improvements in the following week.

2.5 Skill Assessment

Assessment of Statistical Analysis Skill

From the personalized exercises mentioned in the lesson plan above, each student is required to enter their analysis results from SPSS into an online form in Excel format. The researcher has designated specific fields for students to input their answers under their respective student ID. In Excel, formulas are embedded to link the responses, with the correct answers derived from SPSS calculations. If the entered answers are correct, the system will automatically compute the scores (see Figure 2)

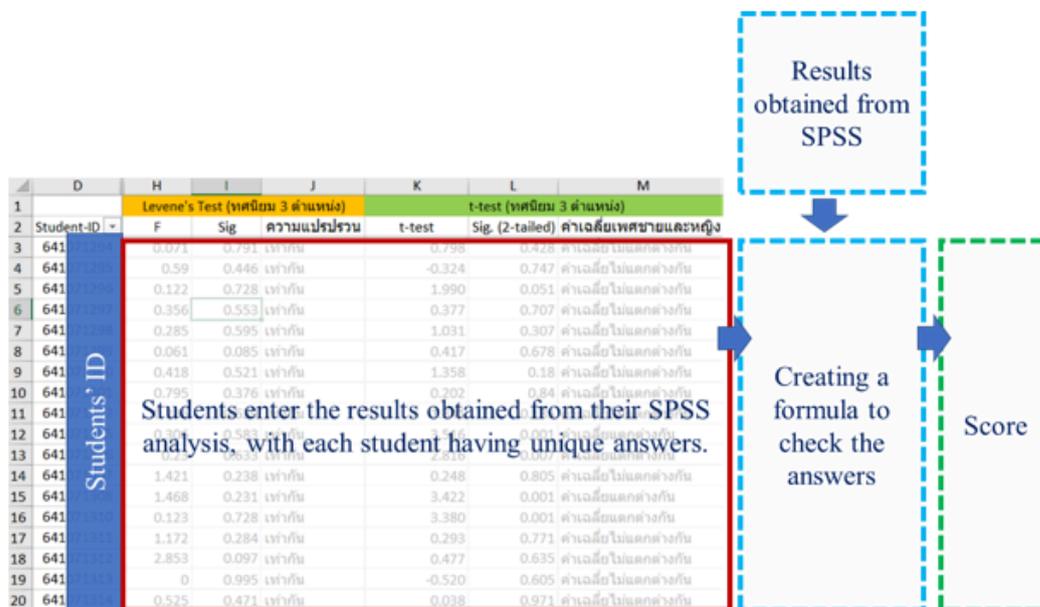


Figure 2 Answer Verification using Excel Online

Assessment of Teamwork Skill

The Teamwork Skill assessment, adapted from Vaughan et al. (2019), consists of a 40-item questionnaire measuring teamwork skills across five dimensions in rated on a 7-point scale:

- 1) **Planning** (7 items): Planning involves a collaborative effort where team members elect and support a project manager, define and agree on shared goals, objectives, and quality standards, and contribute to the development of the plan. It also includes setting realistic timeframes for tasks, allocating roles based on individual skills and learning needs, and ensuring each member commits to completing their assigned role on time and to the required quality standards. This process ensures clarity, alignment, and accountability within the team.
- 2) **Promoting Team Environment** (8 items): Promoting a positive team environment involves maintaining an open, polite, and friendly demeanor while demonstrating self-awareness and emotional regulation. It requires sensitivity to others' feelings—including nonverbal cues—and active participation in discussions to foster collaboration. Team members should cooperate toward shared goals, respectfully acknowledge all contributions (even during disagreements), and follow up supportively if concerns arise. Expressing genuine gratitude and praise strengthens trust and morale, creating a cohesive and productive atmosphere.
- 3) **Facilitating Team Members** (8 items): Facilitating the contributions of others involves rotating leadership roles in meetings, including agenda preparation and minute-taking, to ensure shared responsibility. It requires active participation in team-building, adherence to ground rules, and timely decision-making. Team members should listen attentively, avoid interruptions, and encourage consensus-building by inviting input from all, fostering an inclusive and collaborative environment where everyone's voice is valued.
- 4) **Managing conflict** (9 items): Managing conflict involves maintaining a balanced and assertive approach—avoiding dominance, passivity, or aggression—while addressing concerns constructively. It includes proactive planning to minimize unnecessary disputes, fulfilling responsibilities on time, and engaging in conflict resolution processes with the goal of de-escalation. Team members should stay focused on shared objectives, remain open to constructive criticism, and work collaboratively to transform conflicts into opportunities for growth, ensuring a productive and harmonious team dynamic.
- 5) **Contributing to team project** (8 items): Contributing to a team project involves leveraging relevant technical skills and content knowledge while adhering to academic and quality standards. Team members must complete their assigned tasks on time and to the expected quality, provide constructive feedback on others' work, and collaboratively integrate individual contributions into a cohesive final product. Additionally, they should critically evaluate the overall project, making necessary adjustments to ensure excellence and alignment with team goals. This combination of accountability, collaboration, and continuous improvement drives the project's success.

3. Results and Discussion

3.1 Statistical Analysis Skill

Table 4 showed the students' achievement of statistical analysis skills that was conducted across three training sessions. The first training aimed to equip students with skills in preparing SPSS files and conducting basic descriptive statistics related to sample descriptions. Sixty-seven students participated, achieving a mean score of 98.52 out of 100 (SD = 6.09). Statistical testing indicated a significant improvement ($t(66) = 11.46, p < .001$), suggesting excellent proficiency in these skills. The second training focused on t-test and ANOVA analyses. Sixty-five students attended, with the group obtaining a mean score of 89.34 (SD = 16.24). The analysis revealed a significant achievement in the skills ($t(64) = 2.15, p < .05$), also reflecting excellent proficiency. The third training concentrated on Multiple Regression analysis. All 67 students participated, achieving a mean score of 96.00 (SD = 9.20). Statistical evaluation demonstrated a significant improvement ($t(66) = 9.79, p < .001$), indicating excellent proficiency in this area as well.

Table 4 One Samples t-test of Post-Training Mean Scores

Training Session	n	Level Test	\bar{x} (Score)	SD	t	p
First Training (Week 1)						
File preparation, Descriptive Statistical analysis	67	90 (Excellent)	98.52	6.09	11.46***	< .001
Second Training (Week 2)						
Independent t-tests, ANOVA	65	85 (Excellent)	89.34	16.24	2.15*	< .05
Third Training (Week 3)						
Multiple regression analysis	67	85 (Excellent)	96.00	9.20	9.79***	< .001

* $p < 0.05$ *** $p < 0.001$

Several past studies support the significant achievement of a high level of statistical analysis skills among students. For instance, Chinda et al. (2022) found that students showed improved academic performance after engaging in inferential statistics lessons that incorporated skill exercises. However, other studies, such as Jatnika (2015), did not find significant improvement. Notably, this study applied personalized exercises with multimedia videos, where each student had to independently find the solution, which likely contributed to the improvement of their statistical skills. Wallace & Jefferson (2015) and Leggett et al. (2012) emphasized that skill exercises can significantly enhance both skill development and academic performance. Additionally, incorporating multimedia elements into exercises helps make learning more engaging and enjoyable by stimulating multiple sensory modalities. While some studies (Benedictos, 2022; Teng et al., 2024) did not measure test scores, they noted improvements in students' attitudes, including affective, cognitive, value-related, difficulty, interest, and effort, before and after training on using statistical software.

Theoretically, individual skill exercises that provide each student with unique numerical problems encourage them to solve problems independently, as copying is not possible. Consequently, these exercises reinforce the application of classroom knowledge into working memory, consistent with the concept of Retrieval Practice (The Edron Academy, 2023). Furthermore, the use of blended media in the form of instructional videos enables students to review procedures and reduces the cognitive load on working memory, in line with the Dual-Processing Theory (Mayer & Moreno, 1998), which asserts that simultaneous engagement of both visual and auditory memory systems enhances learning efficiency.

3.2 Teamwork Skill

Figure 3 illustrates the weekly progression of students' teamwork skills across five domains over a three-week period: Planning: the mean scores increased from 6.01 in Week 1 to 6.09 in Week 2 and 6.22 in Week 3; Promoting Team Environment: the mean scores decreased slightly from 6.17 in Week 1 to 6.14 in Week 2 but rose to 6.24 in Week 3; Facilitating Team Members: the mean scores rose from 6.06 in Week 1 to 6.08 in Week 2 and 6.20 in Week 3; Managing Conflict: the mean scores grew from 6.10 in Week 1 to 6.20 in Week 2 and 6.24 in Week 3; Contributing to team project: the mean scores increased from 6.07 in Week 1 to 6.23 in Week 2 and peaked at 6.25 in Week 3. These findings indicate a consistent enhancement in students' collaborative planning and project involvement skills throughout the training period. Overall, the data reveal a consistent enhancement in students' teamwork abilities over the training period. This improvement indicates that the implemented training strategies effectively foster collaborative and supportive behaviors within teams.

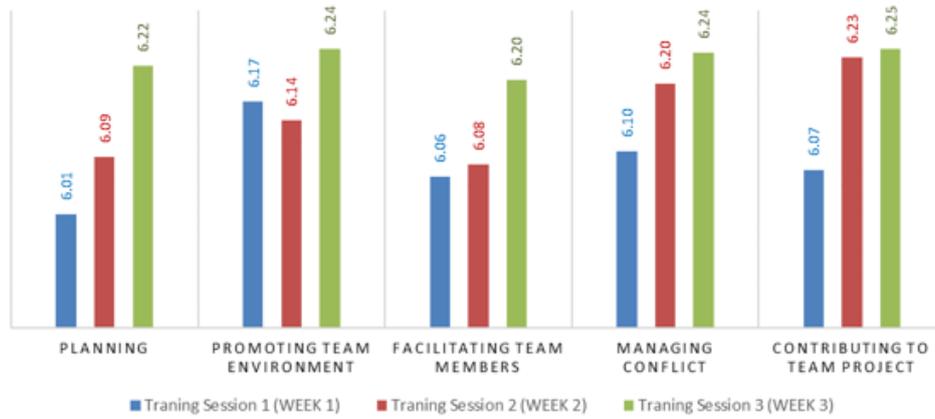


Figure 3 Mean Score of Teamwork Skills Development Throughout the 3-Week Period

Table 5 revealed the significant tests of the teamwork skill improvement, particularly in Planning (Mdiff = 0.210, SE = 0.081, $t(52) = 2.59$, $p < .05$) and Contributing to Team Project (Mdiff = 0.172, SE = 0.063, $t(52) = 2.74$, $p < .01$). However, aspects such as Promoting Team Environment (Mdiff = 0.074, SE = 0.072, $t(52) = 1.03$, $p = .308$), Facilitating Team Members (Mdiff = 0.137, SE = 0.070, $t(52) = 1.94$, $p = .057$), and Managing Conflict (Mdiff = 0.140, SE = 0.075, $t(52) = 1.86$, $p = .068$) showed improvements that were not statistically significant. In summary, the training program, incorporating multimedia-assisted skill exercises, effectively enhanced students' collaborative planning and project contribution abilities. These improvements contributed to more efficient teamwork and increased engagement in activities. Nonetheless, further research is needed to address the less significant changes in other teamwork dimensions.

Table 5 Testing Mean Differences in Teamwork Skills Across 5 Areas: Comparison of Training Sessions 1 and 3

Teamwork Skills	Mean _{diff}	SE	95% CI		t	p
			Lower	Upper		
Planning	.210*	.081	.048	.373	2.59	.012
Promoting Team Environment	.074	.072	-.070	.219	1.03	.308
Facilitating Team Members	.137	.070	-.004	.277	1.94	.057
Managing Conflict	.140	.075	-.011	.291	1.86	.068
Contributing to Team Project	.172**	.063	.046	.298	2.74	.008

* $p < 0.05$ ** $p < 0.01$

The results can be discussed with a focus on the significant improvements observed in two areas, Planning and Contributing to Team Project. The significant improvement may be attributed to the structure of the group activities; for example, during Training Sessions 2 and 3, after assigning the group exercise, the instructor allocated 10 minutes for group discussion and planning before the exercise was completed, which led to a steady increase in the average Planning scores. Additionally, the imposition of submission deadlines required each group member to take on a critical role in achieving the goal within the designated time, resulting in a significant increase in Project Contribution scores. In contrast, although scores for Promoting Team Environment, Facilitating Team Members, and Managing Conflict also increased, these improvements were not statistically significant. This may be because these skills require a longer period of practice than the three-week duration provided by this study, and the simplicity of the weekly group activities may have led students to focus more on achieving the desired outcomes than on further developing these specific teamwork skills.

3.3 Reflection on the Use of Skill Exercises

The researcher, in the role of instructor, provided students with opportunities to offer feedback on the skill exercises each week; feedback was collected during the week following each exercise session. In Training Session 1, the individual exercise assigned to students was notably shorter than the classroom instruction. Specifically, while both lectures and group exercises focused on converting variable values into numerical data in preparation for SPSS file creation, the individual exercise already encompassed the numerical conversion process. Consequently, it is recommended that the individual exercise be revised to commence from the initial stages of data preparation.

In Training Session 2, although the exercise was generally well-designed, discrepancies in terminology were observed between the instruction and the exercise itself. For instance, the instructional content used terms such as “equal means” or “unequal means,” whereas the exercise employed the terms “different” and “not different.” Additionally, the data entry form in the exercise differed from the labels presented in the SPSS output; for example, the SPSS output displayed the Levene Statistic—a type of F statistic used for testing homogeneity of variance—while the form required students to enter only an F value without the label. Regarding group exercises, the workload was considered appropriate; however, some students noted that the division of tasks resulted in certain members becoming specialists in specific areas, necessitating additional research when they later completed individual exercises covering all areas.

In Training Session 3, the individual exercise was well-aligned with the students’ needs and applicable to their own research projects. Nonetheless, an issue was identified with the online Excel data entry form, which did not lock column headers and row labels, thereby complicating the process and increasing the likelihood of errors (e.g., entering data into incorrect fields or misaligning responses). The video links accompanying the weekly instruction were highly valued for allowing students to follow along independently, and the group exercises were effective in reinforcing the instructor’s content and providing timely guidance when problems arose.

4. Conclusions

The primary objectives of this study were twofold: (1) to enhance fourth-year students’ proficiency in utilizing statistical analysis software through multimedia-assisted skill exercises, and (2) to develop their teamwork capabilities. Regarding the first objective, findings indicated that the integration of multimedia-assisted exercises significantly improved students’ skills in using SPSS for data analysis. Students demonstrated excellent performance across all training topics, with statistically significant improvements at the 0.05 level in areas such as file preparation, descriptive statistical analysis, independent t-tests, ANOVA, and multiple regression analysis. Concerning the second objective, the group exercises effectively fostered teamwork skills among fourth-year students, particularly in collaborative planning and active participation in projects. This led to more efficient group work and increased enthusiasm for activities. However, improvements in aspects like team atmosphere, mutual support, and conflict management were observed but not as pronounced.

5. Acknowledgements

This research was supported by a grant from the Faculty of Economics and Business Administrationn Thaksin University.

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FORECASTING HUMAN RESOURCE SKILLS FOR NEW-AGE LEADERSHIP THAT CAN USE TECHNOLOGY IN EDUCATIONAL MANAGEMENT IN THE FOUR SOUTHERN BORDER OF PROVINCES OF THAILAND

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Abstract: This research aims to study the skills of personnel that influence new era leadership in educational institutions in 4 southern border provinces of Thailand and to predict personnel skills for new era leadership that can use technology in educational management. This is quantitative research under the action research paradigm. The sample group is personnel working in educational institutions in 4 southern border provinces. The sample size is 400 people, using simple random sampling. The research instrument is a questionnaire with an overall reliability of .95. Basic statistical analysis was performed using ready-made programs statistical data analysis included correlation coefficient, normal multiple regression analysis and stepwise multiple regression analysis. The research results found that the skills of personnel that influence new-era leadership in educational institutions in the southern region of Thailand include analytical thinking and creativity, decision-making and problem-solving, communication, organizational management, personnel management, teamwork, learning and awareness, and achievement orientation. For the prediction of personnel skills towards new era leadership that can use technology in educational management with statistical significance at the .01 level there are 2 predictive variables: the use of technology in teaching and learning and the use of technology and measurement and evaluation, respectively.

Keywords: Forecasting Human Resource Skills; New-age Leadership; Technology in Educational Management; Four Southern Border of Provinces of Thailand

1.Introduction: Due to the fact that the four southern border provinces, namely Songkhla, Pattani, Yala, and Narathiwat, are areas where people come from various cultures and coexist in a multicultural society, they are home to many leading educational institutions at the basic, vocational, and higher education levels. During the outbreak of the Coronavirus Disease 2019 (Covid-19), higher education institutions underwent rapid changes by incorporating information and digital technology into all missions, while most personnel were in the process of adapting and learning to use these technologies in their work. However, all institutions were able to operate effectively. When the researchers considered the national strategic plan for 2018-2030, which aims to see a balance and development of the public sector management system and enhance personnel competencies to achieve high-performance organizations, it emphasized the need to be prepared for global changes by utilizing innovations and digital technologies, particularly big data, to enhance operational systems and ensure that operations are comparable to international standards (Office of the National Economic and Social Development Council on NESDC, 2018).

From the aforementioned national strategy, if educational institutions are only aware of changes through organizational development by implementing IT but neglect the development of personnel skills to ensure their capability and competency in using IT for all tasks, they may not be able to become high-performing organizations and achieve success effectively while advancing towards international standards. The continuous use of modern information and digital technology requires personnel with specific skills, expertise, and proficiency. Furthermore, research shows that information from educational institutions on this matter is still limited and not current enough to be used for decision-making in educational management. Therefore, the researcher sees the importance of conducting research to obtain data that can be beneficial for the management of educational institutions and is interested in researching this topic. This aligns with Sinchai and Jeyalee (2020), who mentioned the trend in education management, indicating the necessity to develop and increase the use of digital technology in operations as an essential tool for management and teaching in the digital age. Currently, educational institutions must adapt to the changes in lifestyles in the new normal digital society, where both instructors and learners must utilize online systems and work through online platforms to maximize benefits and achieve the desired learning outcomes, thus creating quality human resources that are responsive to changes in the 21st century.

The researcher is educational personnel at the higher education level, involved in the development of personnel skills in the digital age. They see that most educational institution administrators have a need for information on this topic to utilize in managing and developing human resources within educational institutions. However, research has found that there is outdated information regarding personnel skills that can use Information and Communication Technology (ICT). Currently, in the four southern border provinces of Thailand, there are many important educational institutions that want to benefit from this information, leading to limitations or problems in managing and developing human resources to effectively operate using the advanced information technology tools that the organization has implemented. Personnel are still unable to use these tools independently or perform their tasks proficiently for various reasons, such as the inability to effectively implement the use of information technology across all departments, facing different environmental factors, and the lack of skill development among educational personnel to keep pace with technological changes used in their work.

Due to the importance and reasons mentioned above, the researcher sees an urgent necessity to conduct research on " Forecasting Human Resource Skills for New-age Leadership that can use Technology in Educational Management in the Four Southern Border of Provinces of Thailand". The research findings will be beneficial to educational institution administrators in both public and policy aspects, for management and development to be ready to support Thailand's educational policy in the 21st century.

Objectives of the Research

- 1.To study the skills of the new generation of personnel who can use information technology to perform their work in educational institutions in the 4 Southern Border Provinces of Thailand.
- 2.To study the new era leadership the can utilize information technology for operations in educational institutions has a predictive power over the skills of educational personnel in educational institutions in the 4 Southern border provinces of Thailand.

Literature Review

The research by Wongkham & Choosorn (2019) on the development of information technology competencies of high school teachers in Pathum Thani province found that the actual state of teachers' competencies overall is at a high level. Teachers use it for teaching management, self-development, and professional development, and they use legally compliant programs in that order. Meanwhile, the research by Jearrajinda (2020) on information technology and the performance efficiency of workers in the Bangkok area found that respondents had a generally high attitude towards information technology, believing it can be used effectively in their work, particularly regarding the relevance to behavioral and time-related factors. Following that, the aspects of work quantity and work quality were noted. The use of information technology is related to the performance efficiency of workers and can predict or explain the performance efficiency variables of the workers.

Moreover, Janyam's (2022) research found that the skills necessary for youth to enter the labor market in the 21st century in the southern region of Thailand include six skills: communication skills, digital technology usage, creativity, critical thinking, teamwork, and responsibility. This aligns with the research by Meechai, Samoh, Thongkhum, & Boripant (2022), which found that schools in three southern border provinces mostly use information technology in teaching and learning at a rate of 97.40%, utilize the internet for teaching management at a rate of 71.10%, and use it for the development of teaching materials at a rate of 94.70%. It was also found that the key factors affecting the use of information technology in teaching and learning management are personnel, materials and equipment related to information technology, laboratories, and budget, respectively. The most requested support was training in various aspects of information technology, such as network installation, information maintenance, development of teaching materials, and application software to maximize the benefits in teaching management. In summary, schools in the three southern border provinces utilize information technology in various forms.

2. Methodology of Research

The research on this topic is designed as a quantitative study with the following details.

1.1.1) Population is the most specific and clearly defined group (Sudsang, 2016) which consists of individuals working in public educational institutions in 4 provinces of the southern border without knowing the exact number.

1.1.2) The sample group consists of educational personnel working in public educational institutions in 4 southern border provinces. A sample size determination was carried out using the sampling method for populations with uncertain numbers according to Cochran (1997), allowing an acceptable margin of error of 10 percent of the standard deviation from the formula for calculating sample sizes in proportionate sampling. The calculation, which used continuous data, resulted in a sample size of 384 samples (people). To ensure a sufficient sample size and reduce errors in research, an additional 16 samples (people) were added, bringing the total to 400 samples (people) (Srisatidnarakun, 2020). The researchers employed simple random sampling, which assumes that every individual in the sample group has an equal chance of being selected. This simple random sampling method can be analyzed for statistical values and tested for significance using reference statistics (Srisatidnarakun, 2007).

2) Contents

In conducting the research, the researchers applied the concepts of Lee (2008) and Weigel (2012), as well as variables from Namnu's (2018) research, adjusting them to align with the current educational management situation. This led to the identification of 8 personnel skills, namely: analytical and creative thinking skills, decision-making and problem-solving skills, communication skill, organizational management skills, human resource management skills, teamwork skills, leaning and awareness skills, and result-oriented skills.

3) Area

The research team collected data from basic education, vocational education, and higher education institutions in the 4 southern border provinces of Thailand, namely Songkhla Province, Pattani Province, Yala Province, and Narathiwat Province, as they are areas in the lower southern border with very similar multicultural characteristics. There is ongoing exchange of educational learning, communication, and visits among each other all the time (<https://www.sbpac.go.th/?p=50556>)

4) Variables Aspect

4.1 Dependent Variables: Variables are educational personnel skills, including analytical thinking and creative thinking, problem-solving decision-making, communication, organizational management, human resource management, teamwork, learning and quick comprehension, and a focus on performance outcomes

4.2 Independent variables: New-era leadership that can use information technology for operations in educational institutions in the 4 provinces southern region of Thailand, including the use of technology in teaching and learning, the use of technology in management, the use of technology in measurement and evaluation, the ethical use of technology, and the use of technology for innovation creation.

5) Research Instrument

5.1) Researcher used a questionnaire as a research instrument to collect data (Srisuk, 2009). The research team deigned themselves. The design of the research instrument was related to enhancing undergraduate students enrolled in universities in the southern region of Thailand as small business entrepreneurs and their soft skills.

5.2) Quality Inspection of Research Instruments has been conducted using methods to find validity and reliability by revising the questions according to the suggestions of experts before developing them into a real questionnaire for data collection (Kaewjomnong, 2022: 216).

- For validity assessment involves sending the questionnaire to 3 experts who are recognized for their abilities research experience in related topics to examine and evaluate the quality of the research instruments by determining the Index of Item Objective Congruence (IOC) of the content validity o the questions. The results from the quality checks of each question in the validity measurement for this research indicate that the IOC value is greater than 0.5, suggesting that these are high-quality questions that can be used (Ritcharoon, 2008).

- For reliability assessment involved the researcher utilizing a questionnaire that had been modified based on the recommendations of experts to conduct a try-out with a population that had context similar to the sample group (Srisatidnarakun, 2007). Once the tests were returned, the reliability was calculated using Cronbach's alpha coefficients, finding that the questionnaire had a reliability value greater than 0.70. Overall, the reliability value of the questionnaire was .951, indicating that the questionnaire is highly reliable and can be used for data collection purposes (Wadeechareun, Leardnaisatt & Teekasap, 2007).

6) Data analysis

Researcher uses ready-made computer programs and employs descriptive statistics in the analysis of data, including Multiple Correlation Coefficient, and Stepwise Multiple Regression Analysis.

3. Results and Discussion

Data analysis is presented to meet the following objectives:

1) New-era Leadership that can use Information Technology for Operations in Educational Institutions in the Southern region of Thailand

New-era Leadership that can use Information Technology for Operations in Educational Institutions in the Southern region of Thailand		\bar{X}	S.D.	Interpretation
1)	Use of the technology in teaching and learning	4.27	0.52	Most
2)	Use of technology in management	4.26	0.48	Most
3)	Use of technology in measurement and evaluation	4.40	0.44	Most
4)	The ethics use of technology	4.28	0.53	Most
5)	The use of technology for innovation creation	4.33	0.40	Most
Total		4.38	0.45	Most

From table 1: The new generation leadership that can use information technology for work in educational institutions in the southern region of Thailand, the results of the overall data analysis found that it was the highest level (= 4.40, SD = 0.44), next in line were the aspect of using technology for innovation (= 4.33, SD = 0.40), the aspect of having ethics in using information technology (= 4.28, SD = 0.53), and the aspect of using technology in teaching (= 4.27, SD = 0.52), respectively.

2) The prediction of new era leadership that can utilize information technology for operations in educational institutions has a predictive power over the skills of educational personnel in educational institutions in the Southern region of Thailand.

Table 2 Predictive variables of modern leadership that can utilize information technology for operations in educational institutions to predict the skills of educational personnel in educational institutions in the southern region of Thailand

Modern Leadership	B	SE _B	B	T	Sig.
1) Use of the technology in teaching and learning (X1)	.393	.059	.396	6.607**	.000
2) Use of technology in Measurement and evaluation (X3)	.464	.055	.381	8.502**	.000
3) Use of technology in management (X2)	-.137	.045	-.126	-3.036*	.003
4) The ethics use of technology (X4)	.117	.058	.122	2.019*	.044
R = 0.717 R ² = 0.514 SE _{est} = 0.40274 R ² Change = 0.005					
R ² Adj = 0.509 F = 4.076* a = 0.637					

** There is a statistic significant level of .01

From Table 2: The data analysis results show that the multiple correlation coefficient (R) equals 0.717, with a predictive power of 5.14% ($R^2 = 0.514$) and a standard deviation of prediction of 40.27% ($SE_{est} = 0.402$). The overall predictive power is 5.09% ($R^2_{Adj}=0.509$), indicating that the predictive variables positively affecting the skills of educational personnel in Southern educational institutions are statistically significant at the level of .01. There are 2 predictive variables: the use of technology in teaching and learning (X1) and the use of technology and measurement and evaluation (x3), respectively creating the prediction equation in the form of raw scores and standard scores as follows.

The prediction equation in the form of raw scores:

$$Y' = 0.673 + 0.393 (X1) + 0.464 (X3)$$

The prediction equation in the form of standard scores:

$$Z' = 0.396 (Z1) + 0.381 (Z3)$$

1) Discussion The new generation leadership that can use information technology for work in educational institutions in the southern region of Thailand, analysis found that it was the highest level, next in line were the aspect of using technology for innovation, the aspect of having ethics in using information technology, and the aspect of using technology in teaching, respectively. This aligns with the research of Janyam (2022) which found that the necessary skills for youth to enter the labor market in the 21st century, based on a case study in Southern Thailand, consist of 6 skills: communication skills, digital technology usage, creativity, critical thinking, teamwork, and responsibility

2) The overall predictive indicating that the predictive variables positively affecting the skills of educational personnel in Southern educational institutions. There are 2 predictive variables: the use of technology in teaching and learning and the use of technology in measurement and evaluation, respectively. This aligns with the research of Wongkom & Choosoon (2019), it was found that the use of information technology in educational institutions for teachers' self-development requires application, focusing on the achievement of ongoing work development and academic and professional outputs. This aligns with the research of Janpirom, Kunlaya, Rongrong & Kaewurai (2019), with studies and found that information technology is crucial in managing educational institutions to advance into the era of Thailand 4.0.

4. Conclusions

1) The new generation leadership that can use information technology for work in educational institutions in the southern region of Thailand, the results of the overall data analysis found that it was the highest level, next in line were the aspect of using technology for innovation, the aspect of having ethics in using information technology, and the aspect of using technology in teaching, respectively.

2) The overall predictive power is 5.09% ($R^2_{Adj}=0.509$), indicating that the predictive variables positively affecting the skills of educational personnel in Southern educational institutions are statistically significant at the level of .01. There are 2 predictive variables: the use of technology in teaching and learning (X1) and the use of technology in measurement and evaluation (x3), respectively.

Suggestions

1.1) Suggestions for utilizing the data analysis results – based on the analysis of the data above, researcher recommends that educational institution executives in 4 Southern border provinces use this as policy information to make decisions on developing staff skills in all aspects to enhance the skills and competencies of personnel in the organization.

1.2) Recommendations for future research – Researcher suggest conducting research on the design of human resource development programs using information technology to focus on performance outcomes and organizational management to achieve success or on developing a model for decision-making in problem-solving and organizational management to achieve high performance results in educational institutions.

5. Acknowledgements

Thank you to the Faculty of Economics and Business Administration, Thaksin University, for supporting the research grant for the fiscal year 2022, and thanks to everyone who was involved in this research project. This made the research successful, and thus it is considered a collaborative effort in academic work.

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EMOTION UNLEASHED: VR GAME FOR EMOTIONAL RECOGNITION AND EMPATHY TRAINING

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Abstract: Empathy is a fundamental interpersonal skill that all people possess and may be developed. Recognizing others' feelings is the first step toward developing empathy skills. Children learn this talent by copying others and prompting similar emotional responses. Nonetheless, children may suffer in social circumstances if they do not know how to express their emotions. Children with high emotional intelligence can describe their feelings and maintain self-control. The study aims to train children's emotional expressions and recognition using virtual reality games and technology. The objective of this paper is to investigate how well these games train emotion recognition through behavior or body language terms in emotional recognition, more specifically, subject-specific behavioral patterns as a temporary emotional condition or emotional state. This study includes a single lab experiment with twenty-two young toddlers in the age range of 5 to 7 years old. Based on the findings of beta testing (pre-test and post-test), this game successfully introduced human behavioral expressions to toddlers. Comparison of the pre-test and post-test shows that 21 of 22, or 95 percent of participants' post-test scores are increased, besides the result of the User Acceptance Test (UAT) testing yielded a 92.15% score for system utilization by players. The results showed a significant improvement in the recognition of emotional behavior

Keywords: empathy, emotional intelligence, virtual reality, games

1.Introduction: Children aged 5 to 6 learn to distinguish a variety of emotions. Children aged 7 to 8 are regarded as being able to articulate their feelings, but they struggle to understand the emotions of others. Children aged 9 to 10 demonstrate emotional regulation, whereas those aged 10 to 12 understand the context and expectations for appropriate behavior (Atkinson, 2007). Children's emotions can influence their social interactions depending on the responses of those around them (Sukatin et al, 2020). Bullying is a frequently discussed topic in various educational settings for children. This stems from the school system's single emphasis on academic intelligence, which undervalues children's emotional intelligence. Healthy emotional regulation is critical for children because it promotes emotional expression and self-control (Kaliouby, 2017). Emotional intelligence is the ability to understand one's own emotions, particularly when acutely aware of true feelings, which can then be used to make sound judgments (Emerich et al, 2009). Goleman argued that empathy is a separate type of emotional intelligence. According to Goleman's research, emotional intelligence is more important than IQ for overall accomplishment, particularly good leadership (Goleman, 2019)

Children in the range of ages 5 to 6 learn to distinguish a variety of emotions. Children aged 7 to 8 are regarded as being able to articulate their feelings, but they struggle to understand the emotions of others. Children aged 9 to 10 demonstrate emotional regulation, whereas those aged 10 to 12 understand the context and expectations for appropriate behavior (Atkinson, 2007). Children's emotions can influence their social interactions depending on the responses of those around them (Sukatin et al, 2020). Bullying is a frequently discussed topic in various educational settings for children. This stems from the school system's single emphasis on academic intelligence, which undervalues children's emotional intelligence. Healthy emotional regulation is critical for children because it promotes emotional expression and self-control (Kaliouby, 2017). Emotional intelligence is the ability to understand one's own emotions, particularly when acutely aware of true feelings, which can then be used to make sound judgments (Emerich et al, 2009). Goleman argued that empathy is a separate type of emotional intelligence. According to Goleman's research, emotional intelligence is more important than IQ for overall accomplishment, particularly good leadership (Goleman, 2019). Programs for cultivating emotional intelligence are progressively being established in educational institutions around the world.

Empathy is an inherent interpersonal ability that can be trained via education. The preliminary phase is developing the capacity to recognize and differentiate emotions in others (Hudson, 2013). A meta-analysis of over 200 distinct studies comparing kids enrolled in emotional intelligence-based programs indicated a 10 percent increase in good behavior, a 10 percent decrease in negative behavior, and an 11 percent rise in academic success scores. The 'Root of Empathy' research program has been implemented in several nations, including England, Wales, New Zealand, the United States, the Republic of Ireland, Scotland, Germany, Switzerland, and Costa Rica, since 2000. Children participating in this program have demonstrated a significant reduction in aggressiveness levels among schoolchildren through improved empathy and increased emotional or social competence (Kaliouby, 2017). Kaliouby contends that exposure to digital interfaces during formative years diminishes the empathy of newer generations. Emotion is an essential human attribute that is lacking in digital interfaces.

Children may encounter difficulties in social circumstances owing to an insufficient understanding of how to articulate their emotions. Psychological theory identifies six distinct emotions: fear, surprise, anger, disgust, sadness, and happiness. Research on computer-assisted face expression identification commenced in the 1990s. Gestures are considered important in recognizing emotions (McDonald et al, 2011).

Emotional expressions are manifestations that communicate an emotional state or disposition through both spoken and nonverbal means. Humans uncover and comprehend emotional manifestations, rather than originating them. Evaluating an individual's emotional expression is more straightforward and efficacious when conducted through behavior. Emotional Recognition and Empathy Honneth investigates the connection between empathy and recognition, expressed through more positive and specific acts of recognition (Gomes, 2015). As per Hatfield et al., the empathy component that is most frequently associated with facial mimicry is the automatic sharing of observed emotions, which is also referred to as "emotional contagion" or emotional empathy. This phenomenon occurs when the observer's emotions become more similar to those of the person expressing this emotion (Honneth, 2008). Infants may begin to internalize the emotional experience of the other person by imitating facial expressions that are associated with specific emotions (Hatfield, 2017). Empathy is influenced by both biological and environmental factors.

Related Studies Vaughan et al. conducted a study to examine the efficacy of gaming in the context of abusive behavior. In this study, computer games are employed as bullying prevention instruments, facilitating the individualized and cumulative acquisition of prosocial attitudes and social skills. This approach has the potential to reduce bullying behavior and alter the social norms in the classroom (Vaughan, 2011). They asserted that educational gaming is a promising field that enhances the efficacy of early bullying prevention programs for elementary school students. Kurniawan et al. devised a straightforward game to instruct individuals on the subject of human expression. Games were selected as educational media due to their potential to integrate visual and auditory components that are readily comprehensible to autistic children. The game in this research was implemented on an Android mobile device, which is a portable device. The results of this study, which utilized communication observation results and learning outcomes, indicate that this game has the potential to create a pleasant learning environment and that responders may become emotionally invested in it (Kurniawan et al, 2016).

On the other hand, Hasanudin conducted research that resulted in the development of a virtual reality sensor for therapy for autistic children. The results indicated that the utilization of VR technology resulted in enhanced learning outcomes. The pupils were subjected to a mental briefing after the research evaluation results, which were conducted twice over the subsequent two weeks. It has been determined that VR technology can be implemented in the educational process for children with autism (Hasanudin, 2021). Conversely, our investigation into methods for practicing empathy revealed that engaging in prosocial video games can result in empathetic experiences (Wulansari, 2020).

Deficiencies in empathy may result from the abnormal functioning of any of these components (de Wall, 2008). Educational concepts are closely associated with empathy. Researchers discovered a direct correlation between empathy and learning capacity, as well as between individuals who receive empathy from others. It fosters the development of a greater capacity to learn, particularly at a young age (Briggs, 2014).

Currently, a method for emotion recognition is advancing within machine learning research. There exists an opportunity to explore and leverage technology for the training of emotional intelligence. These activities are anticipated to be among the most efficacious mediums for promoting emotional expression in children, enabling them to articulate their feelings and comprehend the emotions of others (Wrigley et al, 2015). The objective is to convey pertinent research and current understanding regarding empathy, particularly in the context of educational and training applications. This study investigates the potential of the VR game Emotion Unleashed to enhance players' emotion recognition skills. We emphasize the following principal research inquiries:

1. How to develop games that implement VR technology to train emotional behavior recognition for children?
2. To what extent may the VR game Emotion Unleashed help children improve their ability to interpret emotional expressions?

The VR Emotion Unleashed games provide several human emotional behavior expressions recognition that are designed using Unity3D to visualize objects of various behaviors that also utilize Virtual Reality features and technology. Players are given instructions to complete missions to direct pointers (objects launched or pointing into the air) that match behavioral expressions. That way, players can distinguish different human behaviors as in real life in the world of Virtual Reality. This application is expected to be one of the effective media to introduce the expression of human emotional behavior in children, so that they can express themselves and understand the emotions of others.

This study contributes to the availability of effective resources for emotion-intelligence training in moral education and experiences with empathy, particularly for novices or young learners.

2. Materials and Methods

2.1. Materials.

The assets in the Emotional Unleashed game were created using Blender software, which consists of several 3D assets in the form of virtual hands and projectiles colored red, blue, green, and purple. In addition, there are assets made using Figma and downloaded through the Unity Asset Store website. The Unleashed Games have been published on [itch.io](https://theonlykross.itch.io/emotion-unleashed-en-pico-4) at the link <https://theonlykross.itch.io/emotion-unleashed-en-pico-4>. The player is free to play these games using a VR headset or VR controller: the Pico 4 or Oculus Rift 3 device.

2.2. Method

2.2.1. Participants

Children in the age range of 5 to 7 are participating in this trial. The total number of participants consisted of twenty-two students from kindergarten and elementary school in Al Khair, Lampung Province, Indonesia.

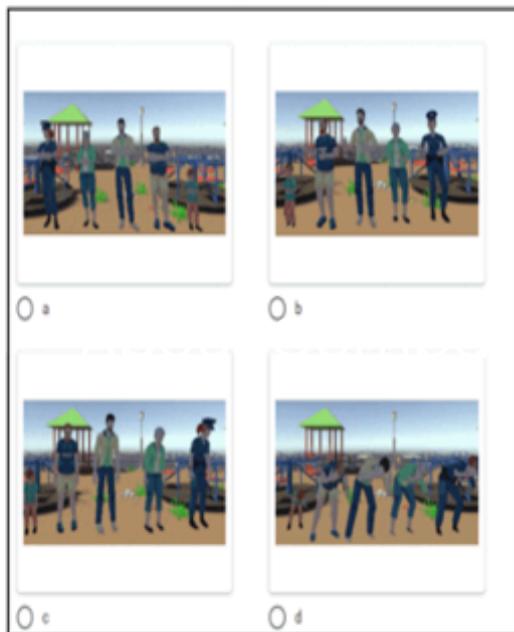
2.2.2. Instruments.

We employed two instruments: the Emotional Recognition Test (for pre- and post-assessment), see figure 1, which shows an example of a question, and User Acceptance Testing (UAT) to evaluate the Emotion Unleashed game. UAT involves assessment by the completion of a questionnaire containing 8 statements and 5 evaluation categories utilizing a 5-point Likert scale.

2.2.3. Procedure

Initially, each participant was directed to complete a pre-test consisting of questions about emotional expression. Subsequently, participants commenced the session by engaging in the game. The player uses a VR headset to explore the game scene and find people with different emotions in the game. The player has four projectiles in the form of emoji emotions, as well as 2D objects in the form of emotion icons that are used to direct the pointer. Enemies are 3D objects that appear randomly with certain behaviors, namely happy, angry, sad, and afraid. To score, players must match the right emotion according to their behavior. Players can choose four kinds of emotion icons with different projectiles if touched, according to the icon, to match them with four kinds of behavior. If the player fails to match correctly, the score will be reduced. However, if the player succeeds correctly, they player will get a score. Success in the game depends on the player's speed and accuracy in identifying and launching projectiles that match the emotional expressions displayed by NPCs (Non-player characters). Correct choices will earn points, while incorrect choices will deduct points. Upon completion of the game, players were instructed to undertake a post-test to assess the extent of their comprehension enhancement attributable to gameplay (Figure 1), as well as to complete the UAT questionnaire, which has 8 aspects (Supportive, Easy, Efficient, Clear, Exciting, Inventive and Leading Edge) 5-point Likert scale (Table 1). The teacher assisted the respondents during the data collection procedure to ensure their comfort and enjoyment of the exercise.

1. Which one is the 'anger' expression behavior?



2. Which one is a 'happy' expression behavior?

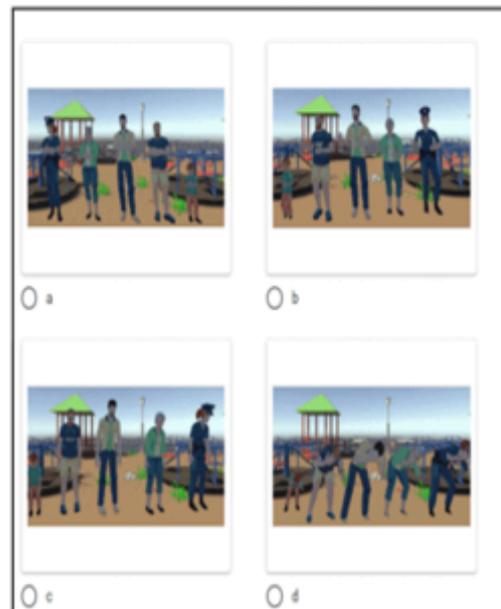


Figure 1. Example of test (pre- and post-test) questions.
Table 1. User Acceptance Test questionnaire

No	Question
1	Supportive: I enjoy playing Emotion Unleashed games about the expression of human behavior.
2	Easy: I easily understand when I see behavioral expressions in the Emotion Unleashed game.
3	Efficient: I feel that the Emotion Unleashed game helps me to understand behavioral expressions.
4	Clear: I can distinguish different people's behavioral expressions clearly in the Emotion Unleashed game.
5	Exciting: I find learning behavioral expressions with the Emotion Unleashed game exciting
6	Interesting: I find playing the Emotion Unleashed game while learning about behavioral expressions interesting
7	Inventive: I like learning about behavioral expressions with the Emotion Unleashed game
8	Leading Edge: I think the Emotion Unleashed game provides a different experience in learning to recognize human behavioral expressions.

3. Results and Conclusion

Emotion Unleashed games have been developed and are available on the website itch.io. There is an expression board for each type of expression that shows the chosen behavior expression, for each type of expression that shows the chosen behavior expression (Figure 2). The game will be run in an environment in the form of a playground, where in the playground there are people with different emotions. Players will explore each point in the park to find people with different emotions until all of them are successfully found using the weapons that players use. In the gameplay scene, players can press one of the icons to launch projectiles according to the selected icon. There is a score to see the number of scores that players produce, and also a timer to see the remaining time in the game. If the timer shows zero, then the game will be finished.



Figure 2. Screenshot of the Emotion Unleashed Game scene and interaction display

In the Emotion Unleashed game, the player must indicate suitable behavior and emotional expression with a virtual hand. Virtual reality displays may occasionally present 3D faces that differ from those depicted on the expression board. The player will receive a score for accurately selecting the correct facial expression. Each level has a time constraint (about 5 seconds); when the time elapses, the game concludes. This game offers players a unique experience in identifying emotional expressions in real life through virtual reality. The player utilizes a pointer hand to select an evocative item that corresponds to the board in a virtual reality environment (see Figure 3 and Figure 4).



Figure 3. In-house Playing Emotion Unleashed game **Figure 4.** In-classroom Playing Emotion Unleashed game

Emotion Unleashed games improved the players' ability to understand emotional expression, according to the findings of our investigation into how effectively these games taught players to perceive emotions through facial and behavioral expressions. The results showed that emotional behavior recognition significantly improved. Figure 5 shows that 21 of 22, or 0,95 percent of participants' post-test scores are increased.

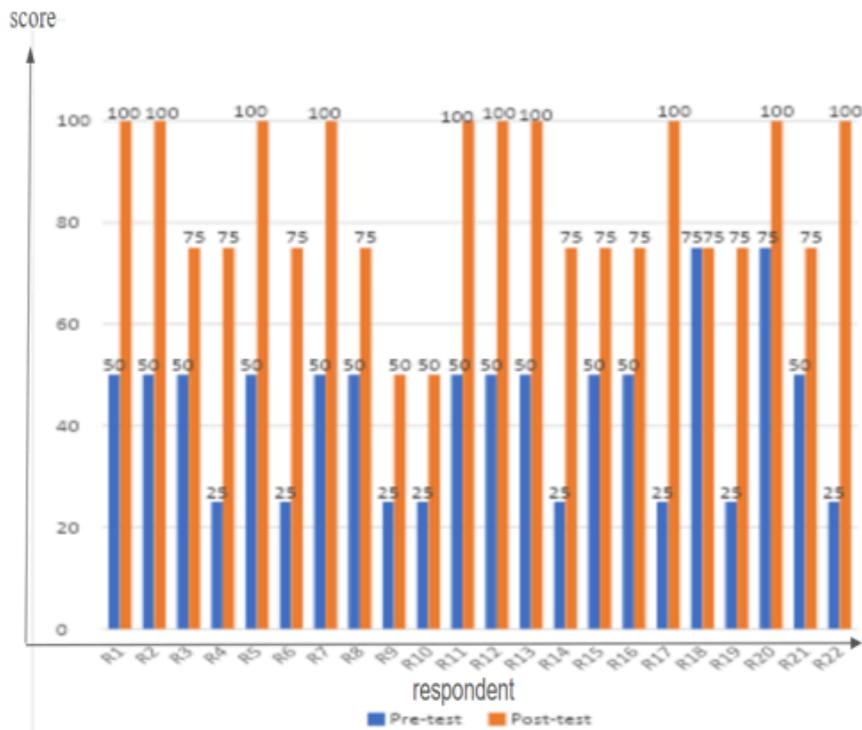


Figure 5. Pre-Test and Post-Test Comparison

Comparison of PreTest and PostTest on the Emotion Unleashed Game. Based on the results, it has been determined that this game has advantages, specifically the gameplay of the Emotion Unleashed game, which can assist in introducing and distinguishing human behavioral emotions while also being easily understood by children. The findings of the game feasibility questionnaire indicate that the game Emotion Unleashed is very nice and practical. The pre-test and post-test results reveal that children's scores increased after playing the Emotion Unleashed game, implying that the Emotion Unleashed game can assist children in learning about human behavior expression. Testing using UAT obtained a score of 92.15% for player use of the system. For calculation, see Table 2. The outcome revealed a notable enhancement in the identification of emotional behavior.

Table 2. Calculation of User Acceptance Test of the Emotion Unleashed Game

Question	Answer (sum of rating scale)					Percentage (%)
	5	4	3	2	1	
1	19	3	0	0	0	$\frac{107}{110} \times 100\% = 97.27$
2	5	8	9	0	0	$\frac{84}{110} \times 100\% = 76.36$
3	12	10	0	0	0	$\frac{100}{110} \times 100\% = 90.9$
4	6	10	6	0	0	$\frac{88}{110} \times 100\% = 80$
5	20	2	0	0	0	$\frac{108}{110} \times 100\% = 98.18$
6	18	4	0	0	0	$\frac{106}{110} \times 100\% = 96.36$
7	21	1	0	0	0	$\frac{109}{110} \times 100\% = 99.09$
8	21	1	0	0	0	$\frac{109}{110} \times 100\% = 99.09$

$$\text{Total} = (5 \times 122) + (4 \times 39) + (3 \times 15) + (2 \times 0) + (1 \times 0) = 811$$

$$S = 5 \times 8 \times 22 = 880$$

$$P = \frac{811}{880} \times 100\% = 92.15\%$$

4. Discussion and Limitations

This study explored the potential of virtual reality (VR) games as tools for enhancing emotional recognition and, by extension, emotional intelligence in children. The results support the growing body of evidence that interactive digital environments, when properly designed, can play a significant role in socio-emotional learning. VR games, with their immersive and engaging nature, offer a unique opportunity to simulate real-life emotional scenarios in a safe, controlled, and repeatable environment. One of the main findings of this study is that VR games can effectively support children's ability to recognize and interpret emotional cues such as facial expressions, body language, and vocal tone. This aligns with existing literature that highlights the importance of multimodal feedback and embodied experiences in emotional learning. By placing children in virtual scenarios that require them to respond empathetically or identify emotions accurately, VR systems can scaffold the development of key emotional intelligence skills such as empathy, emotional regulation, and perspective-taking. Another important aspect is the adaptability of VR environments to different learning paces and styles. Unlike traditional teaching methods, VR games can dynamically adjust the complexity and type of emotional interactions based on the user's performance, creating a personalized learning experience. This adaptability is especially beneficial for children with developmental challenges or those who struggle with traditional social-emotional learning formats. However, the use of VR for emotional training in children also presents certain limitations and considerations. For instance, prolonged screen time and immersion may lead to physical discomfort or cognitive fatigue. Additionally, while VR offers simulated emotional experiences, it cannot fully replace real-world social interactions that are essential for holistic emotional development. Ethical considerations around data privacy, especially when capturing and analyzing emotional responses in minors, must also be carefully managed. Moreover, there are socioeconomic and technological barriers to access. High-quality VR equipment and software may not be affordable or readily available in all educational settings, particularly in under-resourced schools or communities. This raises concerns about equitable access to innovative learning technologies. In conclusion, VR games show significant promise as supplementary tools for developing emotional intelligence in children through emotional recognition training. They offer immersive, interactive experiences that can enhance traditional education methods. Future research should focus on long-term outcomes, cross-cultural applicability, and the integration of VR emotional training within broader emotional intelligence curricula. Collaboration between educators, psychologists, game developers, and policymakers will be key to maximizing the benefits while minimizing potential risks.

The Emotion Unleashed game has limitations, including the requirement that it can only be played on virtual reality headset devices with two controllers, such as the Pico 4 and Oculus Quest 2. Another limitation is that the number of samples is still limited, and the cultural background is also not diverse. In future research to improve the quality of the study, we contemplate increasing the sample size and incorporating a wider range of cultural backgrounds as well.

5. Acknowledgements

I would like to express our deepest appreciation to the members of the research team, [Christian Guetl, Johanna Pirker, Irfan Saputra, and Auliya], for their invaluable contributions and collaborative spirit throughout this research project. Our collective efforts and synergistic teamwork have significantly enhanced the quality and depth of this study. Each member's unique expertise and perspectives have brought forth diverse insights, resulting in a more comprehensive and well-rounded analysis.

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FACTORS AFFECTING WIND POWER GENERATION IN THE UNITED STATES

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Abstract: This study aims to analyze the factors influencing wind power generation in the United States, focusing on the operation and electricity consumption over the past two decades. Wind energy has become a crucial renewable energy source within the power system. The study examines the relationship between electricity generation, investment (INV), and production tax credit (PTC) to determine their impact on wind power production. Even though policy incentives play a significant role in wind power generation, their influence varies depending on regional electricity prices and other benefits that may arise. The research findings indicated that electricity consumption (EC), increasing wind energy production capacity (IWPC), and government subsidies (SUB) were statistically significant predictors of wind power production volume. Electricity generation and the integration of wind energy into the power industry have economic advantages, particularly in job creation and rural community development. Additionally, government policies, such as tax credits (production tax credit) and renewable energy promotion goals, have stimulated investment and the growth of the wind energy sector. However, challenges remain in grid connectivity and the variability of wind energy generation. Advancements in technology to enhance wind energy efficiency and policies that facilitate the integration of renewable energy into the power grid are essential for improving the efficiency and sustainability of the U.S. energy system.

Keywords: Wind energy, electricity generation, government subsidies, electricity consumption, USA

1.Introduction: Wind energy is one of the renewable energy sources that has received attention and has been developed rapidly in the past two decades. With its potential to produce clean electricity, free from pollution and can effectively replace the use of fossil fuels, the United States is currently one of the world's leaders in wind energy, with investment and development of wind energy projects in many states, both onshore and offshore, which has helped to continuously increase the amount of electricity production from renewable energy sources.

According to the American Wind Energy Association (AWEA, 2023), wind energy will account for more than 10% of all electricity generation in the United States in 2023 and is expected to continue to grow. The expansion of wind energy in the country is supported by many factors, including technological advances that help reduce production costs, government support through tax measures and subsidies, and increased demand for clean energy from the industrial sector and consumers.

One of the key measures that has helped promote the growth of wind energy in the United States is the Production Tax Credit (PTC), a tax credit that supports renewable energy producers, resulting in significant increases in investment in wind energy projects (U.S. Department of Energy, 2015). In addition, the establishment of Renewable Portfolio Standards (RPS) targets in many states has also been a driving force in increasing the production and use of renewable energy.

In addition to its environmental benefits, wind energy plays a key role in economic development, especially in rural areas with high wind energy potential. The installation of wind farms creates jobs and stimulates local economies. According to a report from the National Renewable Energy Laboratory (NREL, 2022), the U.S. wind industry is expected to create more than 120,000 jobs by 2023, covering wind turbine design, manufacturing, installation, and maintenance, as well as engineering and project management. In addition, communities with wind farms benefit from land rental income and infrastructure development. However, despite the high potential and good growth rate of wind energy, the industry still faces many challenges, such as the expansion of the electricity grid to accommodate the increasing amount of renewable energy, the uncertainty of wind volume that may affect the stability of the electricity system, and the concerns of environmental and community impacts near the installation of wind turbines (Jacobson et al., 2021). In addition, changes in federal and state policies may affect the future growth of wind energy, especially in the case of reducing tax benefits or reducing financial support. The information obtained from this study can be used to inform energy policy, promote investment in the wind energy industry, and plan the development of renewable energy infrastructure for future energy security.

2. Research Objectives

1. To analyze the factors affecting the amount of electricity production from wind power.
2. To compare past and future wind energy forecast trends.

3. Literature review

Several relevant studies have examined the factors affecting wind power generation in the United States. One such study is cross-state impacts of renewable portfolio standards (RPS) published by the Lawrence Berkeley (2016) National Laboratory and the National Renewable Energy Laboratory (NREL). This work was part of a broader initiative analyzing the policy impacts of renewable energy in the U.S. It evaluates the economic and environmental effects of RPS policies across all 50 states, with a particular focus on comparing the costs and benefits of these policies at both state and interstate levels. The study investigates how RPS policies influence wind energy growth in neighboring states and their broader economic impacts on local communities.

Another significant study is evaluating the economic return to public wind energy research and development in the United States (Wiser and Millstein, 2020). This study outlines the role of wind energy in the U.S. economy, including its contributions to job creation and land lease income from wind farms. It assesses the economic returns from federal investments in wind energy research and development between 1976 and 2017, highlighting benefits such as reduced energy costs and improved public health through decreased air pollution.

Research on the economic impacts of wind farms in rural areas has also emerged, focusing on income effects and social development in communities affected by wind energy installations. Long-term global and U.S. trends in wind energy have been analyzed, particularly regarding its role in reducing greenhouse gas emissions and supporting regional economic growth. According to NREL, wind energy has significant economic and employment impacts in the U.S. Studies emphasize nationwide job creation and economic benefits stemming from wind energy projects. These findings are consistent with analyses by Exactitude Consultancy, which investigates the declining costs of wind energy and their effects on the U.S. energy industry.

The 2019 study wind energy potential in the United States assesses the capacity for wind energy generation across the country, highlighting regions with strong wind resources, such as the central U.S., and identifying suitable areas for wind farm development—an essential first step in establishing a wind energy foundation. The advancement of offshore wind technology is addressed in offshore wind turbine development (2021), which focuses on the design of large-scale turbines that can harness high wind power over oceans. Additionally, optimizing wind farm energy production (2020) explores methods to improve energy output from onshore wind farms by enhancing turbine placement and adapting to varying wind conditions.

Integrating wind energy into the U.S. power grid (Benzohra, Fraija, and Saifaoui, 2022) investigates how to improve grid stability and efficiency by addressing the intermittent nature of wind energy and developing a flexible, adaptive energy grid system.

4. Materials and Methods

This study analyzes the factors affecting wind energy production in the United States, with the variables used in the study shown in Figure 1.

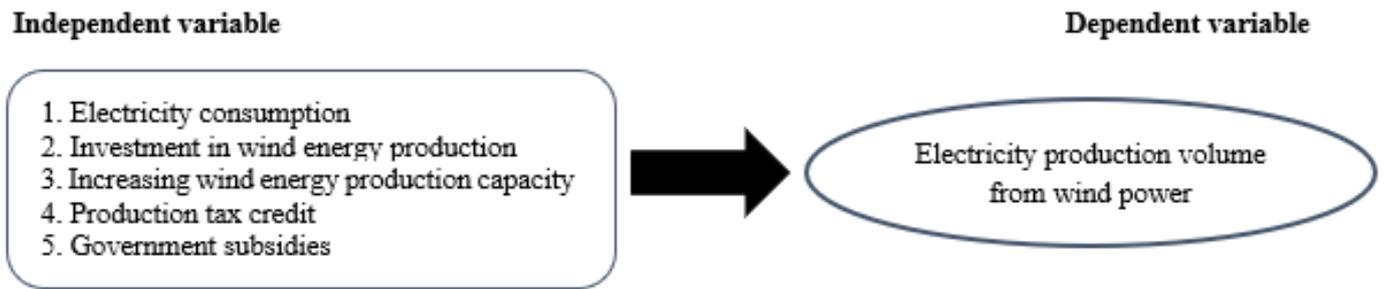


Figure 1 Conceptual framework

4. Materials and Methods

This study analyzes the factors affecting wind energy production in the United States, with the variables used in the study shown in Figure 1.

In order to analyse factors affecting wind power generation in the United States, multiple regression analysis was used to analyze the influential factors and F-test statistics were used to test the hypothesis to compare the mean values of the entire group of countries. The model used in this study consists of two models.

Model 1 (Linear Model)

$$EP = B_0 + B_1EC + B_2INV + B_3IWPC + B_4PTC + B_5SUB + \mu$$

Model 2 (Log-lin Model)

$$\text{Log}(EP) = B_0 + B_1EC + B_2INV + B_3IWPC + B_4PTC + B_5SUB + \mu$$

The variables used in the study are the analysis of factors affecting wind power generation in the United States. In this study, cross-sectional data during 2004 to 2023 from databases such as World Bank, IRENA, BNEF, and OECD were employed. The results of the multiple regression analysis are presented in the following section

5. Results

The result from this study is shown in table 1.

Table 1 Results of factors affecting electricity production from wind power

Variable	Linear Model		Log-linear Model	
	β (t)	Robust S.E	β (t)	Robust S.E
EP				
EC	187.1048*** (3.509968)	53.30671	0.001358*** (4.426918)	0.000307
INV	0.179545 (0.912298)	0.196705	-1.15E-06 (-1.012517)	1.13E-06
IWPC	9.175287** (2.562710)	3.580306	4.00E-05* (-1.940612)	2.06E-05
PTC	-375861.2 (-0.571522)	657649.1	5.285315 (1.396883)	3.783648
SUB	1.01E-09*** (5.749749)	1.75E-10	3.74E-15*** (3.720985)	1.01E-15
R ²	0.983231		0.968356	
F	164.1711		85.68472	
Prob >F	0.0000		0.0000	
Obs	20		20	

Note: * Significant at the 0.1 level ** Significant at the 0.05 level *** Significant at the 0.01 level

From this study, it was found that Model 1 (Linear regression), which consists of 5 independent variables, the linear regression analysis using five independent variables showed a statistically significant result, with Prob > F less than 0.05, indicating the model is valid. The R-Squared value of 0.983231 reflects a high level of explanatory power. The analysis found that changes in the independent variables could significantly explain changes in wind power production at both 0.05 and 0.01 significance levels. The key factors affecting wind power production include electricity consumption (EC), installed wind power capacity (IWPC), and government subsidies (SUB), with all three being statistically significant at the 0.01 level. Among them, IWPC had the highest elasticity, where a 1% increase in IWPC would lead to a 3.51% increase in wind power generation.

Subsequently, Model 2, which uses the Log-linear regression form with 5 independent variables, The second model used a log-log transformation and also included five variables. This model demonstrated similar statistical validity with Prob > F less than 0.05 and an R-Squared value of 0.968356. The results again indicated that EC, IWPC, and SUB were statistically significant predictors of wind power production, confirming the findings from the first model. IWPC remained the most influential variable, showing the highest elasticity in both models, highlighting the crucial role of investment in wind power infrastructure. The effect of federal subsidies (SUB) was also significant, suggesting that policy support plays an important role in promoting renewable energy development.

From this study, the reasons behind the factors influencing wind power generation in the United States can be explained as follows:

Electricity consumption is a key factor that has a positive relationship with wind power generation. This relationship suggests that an increase in electricity consumption leads to a corresponding increase in the amount of electricity generated from wind power.

Government subsidies also play a significant role in supporting wind power generation. The analysis indicates a positive correlation, whereby an increase in government financial support results in a higher level of electricity production from wind energy.

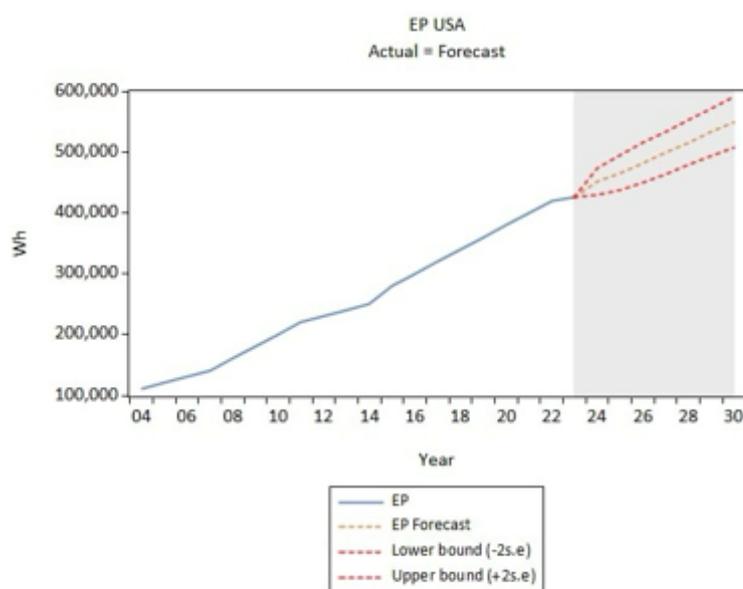


Figure 2 Forecasting electricity generation from wind energy: historical and future perspectives

The blue line in the graph illustrates a continuous increase in wind power generation from 2004 to 2023, reflecting growing investments and technological advancements that have strengthened wind energy's role in the national energy system. From 2023 onward, the forecast period is represented by the yellow line, which suggests that wind power generation is expected to continue its upward trend.

The uncertainty range is indicated by red dashed lines, showing possible upper and lower bounds for future growth. A trajectory along the upper bound may imply accelerated development due to factors such as improved turbine efficiency, supportive government policies, or increased infrastructure investment. Conversely, following the lower bound may indicate potential challenges.

6. Conclusions

Key factors influencing wind power generation in the U.S. include electricity consumption (EC), installed wind power capacity (IWPC), and government subsidies (SUB), consistent with previous studies on energy production and policy impacts.

Electricity consumption (EC) is positively correlated with wind power generation. As electricity demand increases, wind energy production also rises, consistent with the Energy Transformation Theory. Wisler & Bolinger (2023) found that higher electricity use in the U.S. drives wind energy development through increased investment.

Installed wind power capacity (IWPC) directly affects electricity generation. According to IRENA (2016), expanding and improving wind turbines enhances wind power output, especially in high-potential areas. Jacobson et al. (2021) also highlight that advanced turbine technology significantly boosts capacity and reduces long-term costs.

Government subsidies (SUB) are the most influential factor in promoting wind power. Financial support encourages investment and growth in the sector, aligning with the Renewable Energy Investment Theory. Lantz et al. (2022) emphasize that subsidies play a key role in expanding wind energy in the U.S.

7. Recommendations

1. Increase subsidies to stimulate wind energy production. The government should enhance financial support for producers. Evidence indicates that subsidies have the most significant positive impact on the volume of electricity generated from wind power.

2. Support installed wind power capacity expansion. The government should implement incentive measures such as tax reductions or special privileges for investors to encourage the expansion of wind power capacity.

3. Promote electricity consumption from wind energy. As electricity consumption from wind sources significantly correlates with increased wind power generation, the government should encourage industrial and household sectors to use more wind-generated electricity. This can be achieved through the development of clean energy infrastructure and related support mechanisms.

8. Acknowledgements

This study has been successfully completed, and I would like to express my heartfelt gratitude to Dr. Thanawit Bunsit, my advisor, for his valuable guidance, knowledge, and direction throughout the development of this research. I deeply appreciate his time and insightful suggestions, which greatly contributed to the completion of this work.

I would also like to thank the U.S. Energy Information Administration (EIA) for providing up-to-date reports and statistics on wind energy production and consumption, which have significantly supported this study. Finally, I hope this study will be beneficial to those interested in this field. I humbly welcome any suggestions or comments for improvement should there be any errors or shortcomings in this work.

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ECONOMY ON THE HORIZON OF POLLUTION: WHEN GREENHOUSE GASES SHAPE THE FUTURE OF GDP

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Abstract: This article examines the relationship

Abstract: This article examines the relationship between carbon dioxide emissions and Gross Domestic Product (GDP), with the objective of studying the factors that influence carbon dioxide emissions and testing the Environmental Kuznets Curve (EKC) theory. It analyzes the effect of GDP on carbon dioxide emissions to provide guidance for the development of environmental infrastructure and the use of data for sustainable economic development. Additionally, the study offers insights into policy development to help reduce pollution from production and energy consumption, aiming to create a balance between economic growth and long-term environmental sustainability. The research employs multiple regression analysis using cross-sectional data from the World Bank database for 2023, covering a sample of 30 countries globally. The results show that the top 10 countries with the highest carbon dioxide emissions are China, the United States, India, Japan, Indonesia, Mexico, Australia, Vietnam, Italy, and Poland. The study further identifies key factors influencing carbon dioxide emissions, including population size, population growth rate, population density, the Human Development Index, air quality, foreign direct investment, and export volume, all of which have a statistically significant effect at the 0.05 level. Furthermore, testing the Environmental Kuznets Curve (EKC) theory reveals that GDP has a statistically significant impact on carbon dioxide emissions at the 0.01 level.

Keywords: carbon dioxide emissions, Environmental Kuznets Curve, economic growth, sustainable economic development

1.Introduction: The study of the impact of economic growth on the environment and carbon dioxide emissions has gained significant attention in recent years. Carbon dioxide emissions are considered a key factor contributing to global climate change, and it is internationally recognized that urgent reductions in emissions are necessary to avoid the most severe consequences of climate change. However, the approach to sharing responsibility for this issue among regions, countries, and individuals remains a subject of ongoing debate in international discussions (Ritchie and Roser, 2024).

Among the countries with the highest carbon dioxide emissions each year, Asia stands out as the largest emitter, accounting for nearly half of global emissions. However, given that Asia is home to nearly 60% of the world's population, its per capita emissions are slightly lower than the global average. China is the largest emitter in both Asia and the world, responsible for more than a quarter of global emissions. Meanwhile, North America, with the United States as its primary contributor, ranks as the second-largest emitter by region, accounting for about one-quarter of global emissions, followed by Europe. In contrast, Africa and South America have very low emission shares, contributing only 3-4% of total global emissions (Ritchie and Roser, 2024).

Global greenhouse gas emissions since the mid-18th century reveal that emissions were extremely low before the Industrial Revolution. The growth of carbon dioxide emissions remained slow until the mid-20th century. In 1950, the world emitted six billion tons of CO₂, but by 1990, this figure had nearly quadrupled to more than 20 billion tons. Emissions have continued to rise rapidly, reaching over 35 billion tons per year today. Although the growth rate of emissions has slowed in recent years, it has not yet peaked (Ritchie and Roser, 2024).

Since the industrial era, fossil fuels have played a crucial role in economic development as the primary energy source for electricity generation, transportation, and industrial activities. As a result, economic growth has been closely linked to rising greenhouse gas emissions. In developed economies, GDP growth tends to be accompanied by increased CO₂ emissions. These economies collectively account for more than half of the world's GDP and more than one-third of global energy demand (Singh, 2024).

2. Research Objectives

- 1.To study the factors influencing carbon dioxide emissions.
- 2.To analyze the impact of carbon dioxide emissions on gross domestic product (GDP).
- 3.To test the Environmental Kuznets Curve (EKC) theory by examining the effect of GDP on carbon dioxide emissions

3. Materials and Methods

The data used in this study is cross-sectional data from the World Bank database for the year 2023, using a sample of 30 countries top carbon dioxide emissions from each continent. Regression analysis was employed to examine the factors influencing carbon dioxide emissions, we can analyze the relationship between CO₂ emissions and Gross Domestic Product (GDP) using a model to test the Environmental Kuznets Curve (EKC) theory.

This theory explains how economic growth affects the environment. The models used in this study are as follows:

Model 1: Factors influencing CO₂ emissions

$$CO_2_TE = \beta_1 POP + \beta_2 POPG + \beta_3 POPD + \beta_4 HDI + \beta_5 AQI + \beta_6 FA + \beta_7 AP + \beta_8 GINI + \beta_9 EX_V + \beta_{10} PCE_G + \beta_{11} FDI + \beta_{12} MT + e$$

Model 2: Factors influencing CO₂ emissions with the addition of GDP

$$CO_2_TE = \beta_1 POP + \beta_2 POPG + \beta_3 POPD + \beta_4 HDI + \beta_5 AQI + \beta_6 FA + \beta_7 AP + \beta_8 GINI + \beta_9 PCE_G + \beta_{10} MT + \beta_{11} GDP + e$$

Model 3: Factors influencing Gross Domestic Product (GDP)

$$GDP = \beta_1 CO_2_TE + \beta_2 POPG + \beta_3 HDI + \beta_4 AQI + \beta_5 FA + \beta_6 AP + \beta_7 GINI + \beta_8 EX_V + \beta_9 PCE_G + \beta_{10} FDI + \beta_{11} MT + e$$

Model 4: Testing the Environmental Kuznets Curve (EKC) theory with GDP and (GDP)²

$$CO_2_TE = \beta_1 GDP + \beta_2 (GDP)^2 + e$$

4. Results

The result from this study is shown in table 1 to 3.

Table 1 Results of the Analysis of Factors Affecting Carbon Dioxide Emissions

Variable	CO ₂ total emission		Variable	CO ₂ total emission	
	β (t)	Robust S.E.		β (t)	Robust S.E.
POP	1.70-06 *** (5.69)	2.99e-07	POP	1.82e-06 *** (9.39)	1.94e-07
POPG	219.1202 ** (2.43)	90.311131	POPG	70.18057 (1.23)	56.89223
POPD	1.420085 *** (12.31)	0.1153416	POPD	1.040132 *** (13.47)	0.0772435
HDI	-3488.938 ** (-2.29)	1524.456	HDI	-2085.181 ** (-2.21)	943.6431
AQI	-27.80386 *** (-3.93)	7.067902	AQI	-19.21476 *** (-4.01)	4.78606
FA	4.774004 (1.05)	4.555841	FA	2.071273 (0.69)	3.01642
AP	-0.0886001 (-0.93)	0.0950055	AP	-0.1298226 * (-2.07)	0.0628393
GINI	-2055.8 (-0.92)	2227.175	GINI	-35.20499 (-2.07)	1428.245
PCE_G	0.0009035 (0.10)	0.0090523	PCE_G	0.0037772 (0.66)	0.0056878
MT	1.7102 (0.91)	1.878878	MT	3.281274 ** (2.47)	1.327818
FDI	5.93e-09 *** (3.66)	1.62e-09	FDI	-	-
EX_V	8.67e-10 *** (4.16)	2.08e-10	EX_V	-	-
GDP	-	-	GDP	0.00011582 *** (13.79)	0.0000115
R ²	0.9913		R-squared	0.9955	
F	161.37		F	358.96	
Prob > F	0.0000		Prob > F	0.0000	
Obs	30		Obs	30	

Note: * Significant at the 0.1 level ** Significant at the 0.05 level *** Significant at the 0.01 level

The study found that there are factors that affect and do not affect the volume of carbon dioxide emissions. Among them, five variables positively influence carbon dioxide emissions. The population density variable has the greatest impact, with a value of 1.42 at a 0.01 significance level.

Conversely, two variables negatively influence carbon dioxide emissions, with air quality having the most significant impact, showing a value of 27.8 at a 0.01 significance level. An interesting variable is the Human Development Index, which has a value of 3,488.938 at a 0.05 significance level.

The study also analyzed the impact of factors and Gross Domestic Product (GDP) on carbon dioxide emissions. The GDP variable positively affects carbon dioxide emissions, with a value of 0.00012, meaning that a one-unit increase in GDP results in a 0.00012 million-ton increase in carbon dioxide emissions. Population density has the greatest impact, with a value of 1.04 at a 0.01 significance level. An interesting variable is trade in goods, which has a value of 3.28 at a 0.05 significance level.

On the other hand, three variables negatively influence carbon dioxide emissions, with air quality having the most significant impact, showing a value of 19.21 at a 0.01 significance level. An interesting variable is rainfall amount, which has a value of 0.13 at a 0.1 significance level.

Table 2 Regression analysis results of factors affecting Gross Domestic Product (GDP)

Variable	Gross Domestic Product (GDP)		
	β	t	Robust S.E.
CO2 TE	1131.194 ***	(6.17)	183.1948
POPG	622704.3 **	(2.37)	262626
HDI	295414.2	(0.06)	5175696
AQI	-11552.93	(-0.54)	21421.98
FA	1768.782	(0.13)	13589.04
AP	447.1457 *	(1.90)	235.8637
GINI	-7504249	(-1.34)	5607442
EX V	4.05e-06 ***	(4.83)	8.39e-07
PCE G	-26.23747	(-1.44)	18.25791
FDI	0.0000312 ***	(4.09)	7.60e-06
MT	-5380.273	(-0.83)	6477.696
R ²	0.9799		
F	158.30		
Prob > F	0.0000		
Obs	30		

Note: * Significant at the 0.1 level ** Significant at the 0.05 level *** Significant at the 0.01 level

The study found that, based on multiple regression analysis, there are five variables that influence Gross Domestic Product (GDP), all of which have a positive relationship with GDP. These variables include population growth rate, rainfall amount, export volume, and foreign direct investment.

These factors contribute to an increase in carbon dioxide emissions, with a value of 1,131.194 at a 0.01 significance level. It can be concluded that GDP growth heavily depends on the industrial sector, which significantly impacts carbon dioxide emissions

Table 3 The influence of Gross Domestic Product on carbon dioxide emissions

Variable	CO ₂ total emission Quadratic model	
	β (t)	Robust S.E.
GDP	7.66e-07 ** (5.00)	1.53e-07
GDP ²	-2.26e-14 ** (-3.80)	5.94e-15
R ²	0.6259	
F	22.59	
Prob > F	0.0000	
Obs	30	

Note: * Significant at the 0.1 level ** Significant at the 0.05 level *** Significant at the 0.01 level

The study found that, based on the analysis of the influence of Gross Domestic Product (GDP) on carbon dioxide emissions, the table shows that short-term GDP positively affects carbon dioxide emissions, with the regression coefficient as presented in the table.

However, as long-term GDP (GDP²) increases, carbon dioxide emissions decrease, with the regression coefficient also shown in the table at a 0.05 significance level.

Therefore, it can be concluded that when GDP reaches a certain level, carbon dioxide emissions begin to decline. This finding aligns with the Environmental Kuznets Curve (EKC) theory, which suggests that as economic growth reaches a certain point, carbon dioxide emissions decrease.

5. Discussion

From this study, the reasons behind the factors influencing carbon dioxide (CO₂) emissions and Gross Domestic Product (GDP) can be explained as follows:

1. Gross Domestic Product (GDP): In the short term, an increase in GDP leads to higher CO₂ emissions due to industrial expansion that relies on fossil fuels. However, in the long term, as per capita income rises, countries have more resources to invest in clean technologies and environmental policies, resulting in reduced CO₂ emissions. This concept aligns with the Kuznets theory and the study by Jira (2009), which suggests that efficient environmental management and resource utilization occur in the long run, particularly in high-income countries or those investing in clean technology. It also aligns with the research by Thanakarn, Arunee, and Supanee (2022).

2. Population Density: Population density influences CO₂ emissions in the same direction. A higher population density leads to increased industrial activities, higher energy consumption, and more transportation, all of which contribute to higher CO₂ emissions. This concept aligns with Thomas Malthus' theory and the studies by Wu (2023), Zou and Zhang (2020), and Osobajo et al. (2020), which found that rapid growth in some countries leads to greater fossil fuel consumption and higher pollution levels.

3. Human Development Index (HDI): HDI affects CO₂ emissions in the opposite direction. Improved policies and stringent environmental regulations, along with better education and awareness, lead to behavioral changes that reduce CO₂ emissions. This concept aligns with Kuznets' theory, which states that economic growth and human development enhance environmental management. However, it contradicts Malthus' theory, which argues that uncontrolled population growth depletes resources and worsens pollution. This also aligns with the research by Thanakarn, Arunee, and Supanee (2022), which found that economic growth improves environmental efficiency in the long run, especially in high-income countries investing in clean technology. However, it contradicts the findings of Wu (2023), Zou and Zhang (2020), and Osobajo et al. (2020), who found that rapid economic growth can lead to increased fossil fuel consumption and higher emissions.

4. Foreign Direct Investment (FDI): FDI influences CO₂ emissions in a positive direction. Developed countries may relocate factories to countries with less stringent environmental regulations, leading to increased pollution in host countries. In an effort to attract FDI, some countries may lower environmental standards, exacerbating air, water, and industrial waste pollution. This concept aligns with the Pollution Haven Hypothesis (PHH) and the research by Rigas and Kounetas (2023), which found that economic growth in high-income countries is associated with CO₂ emissions.

5. Rainfall Levels: Rainfall has a negative effect on CO₂ emissions. Higher rainfall can increase the use of renewable energy sources, such as hydropower, reducing fossil fuel consumption and CO₂ emissions. Additionally, increased rainfall promotes plant growth, which helps absorb more CO₂, mitigates drought, and prevents wildfires, leading to lower CO₂ emissions. The Climate Change Theory suggests that higher rainfall can reduce CO₂ emissions by supporting renewable energy use. This aligns with the study by Dissanayake et al. (2023), which found that renewable energy usage significantly reduces CO₂ emissions, particularly in rapidly growing economies.

6. CO₂ Emissions and GDP Growth: CO₂ emissions positively affect GDP. In economies that rely heavily on fossil fuels, CO₂ emissions increase alongside GDP growth. This aligns with Kuznets' theory, which suggests that in the early stages of economic development, CO₂ emissions rise with economic growth. It also aligns with the Pollution Haven Hypothesis (PHH), which explains that developed countries often relocate high-pollution industries to developing nations, increasing their GDP while also raising CO₂ emissions. The study by Aye et al. (2017) found that economic growth in developing countries may not necessarily benefit the environment, especially in economies that still rely heavily on fossil fuels.

6. Conclusions and recommendations

From this study, it is evident that different factors influence the dependent variable in both positive and negative directions. The factors that contribute to an increase in carbon dioxide (CO₂) emissions include population size, population growth rate, population density, foreign direct investment (FDI), export volume, and short-term GDP growth. Conversely, factors that reduce CO₂ emissions include the Human Development Index (HDI) and rainfall levels. These findings highlight that demographic and economic factors tend to drive higher CO₂ emissions, whereas development, quality of life, and environmental factors contribute to emission reductions. The results of this study can be useful for national development planning in the following ways:

1. **Renewable Energy Policy** The National Economic and Social Development Council should promote investment in clean energy infrastructure by offering tax incentives and financial support for renewable energy technology investments, such as tax deductions for solar panel installations.

2. **Sustainable Urban Development Policy** The Ministry of Social Development and Human Security should implement urban expansion strategies that promote balanced population distribution to prevent excessive density in major cities. Additionally, the Institute of Transportation and Urban Development should enhance public transportation networks in densely populated cities, incorporating CO₂-free transportation systems, such as clean energy public transit.

3. **Green Industry Investment Policy** The Board of Investment should encourage environmentally friendly industries, such as clean energy equipment manufacturing, waste recycling, and industries that utilize resources efficiently. This could be achieved through tax incentives or tax reductions.

4. **Rainwater Harvesting Promotion Policy** The Ministry of Natural Resources and Environment should implement rainwater harvesting systems in agricultural and urban areas by supporting the adoption of efficient rainwater filtration and storage technologies. These systems could be used for agricultural activities, household consumption, and urban landscaping. Additionally, public education and training should be promoted to improve community awareness of effective rainwater management, reducing reliance on other water sources and lowering CO₂ emissions from water production.

7. Data limitation

The use of cross-sectional data in this study is due to limitations in the dataset. Future research should incorporate time-series data to provide more comprehensive insights into complex relationships, enhancing the accuracy of analysis and improving the understanding of long-term trends in CO₂ emissions and economic factors. Additionally, including more countries, particularly those in ASEAN, would enhance the policy implications for future studies.

8. Acknowledgements

I would like to express my sincere gratitude to my professors and all individuals who have supported and assisted me in successfully completing this research. I extend my deepest appreciation to Dr. Thanawit Bunsit, my principal advisor, for his invaluable guidance, consultation, and support throughout this research process. His teachings and direction have significantly enhanced my understanding of research methodologies and inspired me to develop this study into a meaningful contribution to academia. I would also like to thank Mr. Atsadaporn Kaewsawat and Mr. Pattanun Chumsang for their assistance in data collection and research development. Their support in gathering data and exchanging ideas for result analysis has been immensely helpful. I truly appreciate their collaboration and encouragement throughout this journey. Lastly, I am deeply grateful to my family for their unwavering support and encouragement, which has been a crucial factor in the completion of this research. I sincerely thank everyone who has contributed to the success of this study and hope that this research will be beneficial to the academic community and society in the future.

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ANALYSIS OF FACTORS IN THE DEVELOPMENT OF HUMAN AND SOCIAL SKILLS (SOFT SKILLS) OF UNDERGRADUATE STUDENT WITH PREDICTIVE POWER TO PROMOTE SMALL BUSINESS ENTREPRENEURSHIP IN FOUR SOUTHERN PROVINCES OF THAILAND

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Abstract: This research aims to analyze the factors of developing human and social skills of undergraduate students to become small business entrepreneurs in Thailand and analysis of the factors of human and social skills development of undergraduate students has the power to predict the support towards becoming small business entrepreneurs in Thailand. It is a quantitative research. The sample group was personnel working at universities in group 2 in the lower southern region of Thailand. The sample size was 400 people, using simple random sampling. The research instrument was questionnaire with an overall reliability value of .95. Data were analyzed using ready-made programs. Statistic used for data analysis included mean, standard deviation, correlation coefficient, and stepwise multiple regression analysis. The results of data analysis found that factors in the development of human and social skills of undergraduate students towards becoming small business entrepreneurs consisted of 5 skills: thinking skills, working with others skills, leadership skills, asking and listening skills, and supervision skills. For the skills that have the power to predict the support towards becoming a small business entrepreneur in Thailand at the statistical significance level of .01, there are 4 skills: asking and listening skills, thinking skills, supervisory skills, and working with others skills.

Keywords: Soft Skills, Undergraduate Students, Small Business Entrepreneurs.

1. Introduction: In higher education or universities in the current country, there is a focus on developing fundamental skills commonly referred to as people and social skills (soft skills) which are important and necessary for applying them in creating new knowledge and adapting to working with others in all organizations. The important soft skills include numerical or mathematical skills, computer technology, leadership, language and communication skills, creative thinking, quick learning and awareness, and teamwork with others, among others. These skills are essential for undergraduate students in social sciences and humanities to support their engagement in all societies in a harmonious manner (Paopan, 2016) Importantly, learners also apply these alongside various tools that arise in the competitive landscape of the education and labor markets today, where learners need to continuously learn in order to acquire new knowledge and skills at all times that should be received for skill development towards the 21st century (Chumphet, Sakkawanich, ASatienchaiyakij & Chantakhad, 2022),

Both students and workers aspiring to become entrepreneurs today must continuously train and develop themselves in order to enter the rapidly changing business world. While initially, the focus is on core skills, namely hard skills, which may believe will lead to success, the current global situation emphasizes the importance of adapting to work and stakeholders, thus the need for new skills, namely people and social skills (soft skills), to be fully utilized. Being a modern entrepreneur, increasing relying on information technology and digital tools in business, further impacts the skills of workers and individuals who need to develop themselves to perform multiple roles. The pursuit of becoming an entrepreneur focused with challenges in work and the surrounding business context thus shifts focus to developing people within organizations as a priority over merely using hard skills. Relying solely on hard skills may not truly lead to success. Other fundamental skills, or what are called people and social skills (soft skills), inherent to individuals, along with those that must be sought or further developed, remain a topic of debate in higher education institutions and the labor market. Although many parties have stated the need to emphasize knowledge and use of information and digital technology skills in the 21st -century competition (Connell, Gough, McDonnell, & Burgess, 2014).

For the soft skills that have been continuously mentioned after the Covid 19 pandemic, many parties agree that in the fields of education and business, it is essential for personnel in every organization to apply them in their work, not just rely solely on technology and digital tools. Working and learning in the digital age requires facing numerous challenges. Therefore, business work must develop skills in communication, teamwork, motivation, problem-solving, enthusiasm, and relationship-building, among others. These skills impact individuals' trustworthiness and their ability to work well together (Dean & Julia, 2019). Soft skills are thus crucial for being applied in work and for achieving success in business operations (Dena, Hancock & Phillips, 2011). When selecting candidates for employment, the decision to choose and applicant must not be based solely on knowledge but must also involve other skills across various areas to enable them to cooperate with others effectively. The level of skills of applicants, whether high or low, will certainly affect the organization's operations later on (Velasco, 2012). The specific skills that clearly indicate someone's potential to be a small business entrepreneur remain a concern, and answers are sought on this matter to develop undergraduate students with those skills as quickly as possible.

The development of interpersonal and social skills (soft skills) is currently important, especially for individuals entering the job market and aiming to start a business. Although there is no clear data on which skills are needed to succeed in the digital age business world, Bailly & Lene (2013) suggest that individuals seeking to create change and success in business often rely on communication skills to work effectively in teams. However, this is not enough. Bailey (2014) proposes that other skills must also be developed in various areas to ensure that everyone can coexist. This is because the diverse skills of individuals within a group can complement one another. Those who exhibit a variety of soft skills will likely achieve greater success. However, there is still very little collected data related to soft skills that supports undergraduate students in southern Thailand in becoming entrepreneurs, which does not reflect the current reality that individuals need specific soft skills to transition into business. Moreover, to obtain an overall picture regarding the development of students from various universities in southern Thailand, it is essential to assess how much soft skills they have developed to advance toward becoming small business entrepreneurs.

From the importance mentioned above, it is a key reason that the researcher has an urgent necessity to conduct research on "Analysis of Factors in the Development of Human and Social Skills of Undergraduate Student with Predictive Power to Promote Small Business Entrepreneurship in 4 Southern Provinces of Thailand". The research findings are beneficial to university administrators and organizations related to the development of entrepreneurs, which can be used for policy purposes by establishing measures and regulations for the development of human and social skills of entrepreneurs. Furthermore, it is academically beneficial for improving curricula in various faculties to enable the development of soft skills for learners in educational institutions, preparing them to become small business entrepreneurs in Thailand in the future.

Objectives of the Research

1. To study the factors of developing human and social skills development of undergraduate students to become small business entrepreneurs in 4 Southern Provinces of Thailand.
2. To study the factors of human and social skills development of undergraduate students has the power to predict the support towards becoming small business entrepreneurs in 4 Southern Provinces of Thailand.

Literature Review

The skills of individuals that should be applied in organizational management can be said to be important as they lead the organization towards achieving success. Wiles (1995) stated that the essential skills to be utilized in organizational management include 1) leadership skills 2) interpersonal skills 3) group process skills 4) personnel management skills and 5) evaluation skills. Meanwhile, Dubrin (2012) proposed the idea that interpersonal relational skills are crucial for effective teamwork and can foster collaboration within the organization. Communication skills are a vital component of interpersonal communication skills since they are the principles of sending and receiving messages in the workplace. Furthermore, Namnu (2018), who synthesized the skills of educational leaders in the 21st century, identified the skills as communication skills, organizational management skills, analytical thinking and creative thinking skills, technology and digital skills, and interpersonal relationship skills.

By the concept of interpretive perspectives, which views the interpretation of human behavior in society in terms of motivations that lead to various actions, the interpretation or understanding can only explain the reasons for actions when it provides a clear and systematic meaning. Understanding in terms of cause and effect arises from having a shared emotional experience with the actor about why a particular action occurs in a certain time and circumstance. This helps understand what the actor is thinking when engaging in that action and what motivations lead them to think or feel that way, which then leads to using that understanding to seek the shared feelings of people in society. Therefore, this approach to interpretation is suitable for studying real-life situations to learn how those people think about actions in different circumstances (Krongbhumi, 2021: 30).

2. Methodology of Research

The research on this topic is designed as a quantitative study with the following details.

1) Population and Sample

1.1) Population refers to the personnel working at universities in the technology development and innovation promotion group in the southern region (group 2), consisting of 3 universities in the lower southern part. This includes a group of executive personnel at the faculty level, a group of academic staff (lecturers) who are engaged in teaching, and a group of academic support personnel. The exact number of the population for this research is unknown.

1.2) The sample group consists of personnel working at universities in the Southern Technology Development and Innovation Promotion Group (Group 2) with a total of 3 universities in the lower southern region.

It includes a group of deans, a group of academic staff (teachers) engaged in teaching, and a group of academic support personnel. The sampling method used was the Cochran (1977) formula for determining sample size in cases where the population is uncertain, allowing for a maximum acceptable error of 10 percent of the standard deviation. The formula for calculating sample size for proportional sampling and the formula for calculation sample size using continuous data resulted in a sample size of 384 samples (people). To ensure that the sample size was sufficiently large and to reduce the research errors, and additional 16 samples (people) were added, resulting in a total of 400 samples (people) (Srisatidnarkun, 2020: p.71). Simple random sampling was employed, which the researchers believe gives every individual in the sample group an equal chance of being selected, and simple random sampling can be used to analyze statistical values and test significance using reference statistics (Kaewjomnong & Phakdee, 2023: p.218).

2) Contents

In researching the content of small business entrepreneurship, the concepts of Frese (2000) are used, which present the characteristics of entrepreneurs such as autonomy orientation, innovativeness orientation, risk taking orientation, competitive aggressiveness orientation, stability and learning orientation, and focus on an achievement orientation. The concepts of the Office of the Higher Education Commission (2014) are also applied, based on the strategy for developing soft skills in students at higher education institution, which aims to enhance thinking skills, teamwork skills, questioning and listening skills, leadership skills, and supervisory skills.

3) Area

The researchers collected data from educational personnel working under higher education institutions, specifically from Group 2, which focuses on technology development and innovation promotion in the lower southern region, consisting of 3 locations: Narathiwat Rajanagarindra University, Thaksin University, and Rajamangala University of Technology Srivijaya Songkhla.

4) Research Instrument

4.1) Researcher used a questionnaire as a research instrument to collect data (Srisuk, 2009). The research team designed themselves. The design of the research instrument was related to enhancing undergraduate students enrolled in universities in the southern region of Thailand as small business entrepreneurs and their soft skills.

4.2) Quality Inspection of Research Instruments has been conducted using methods to find validity and reliability by revising the questions according to the suggestions of experts before developing them into a real questionnaire for data collection (Kaewjomnong, 2022: 216).

- For validity assessment involves sending the questionnaire to 3 experts who are recognized for their abilities research experience in related topics to examine and evaluate the quality of the research instruments by determining the Index of Item Objective Congruence (IOC) of the content validity of the questions. The results from the quality checks of each question in the validity measurement for this research indicate that the IOC value is greater than 0.5, suggesting that these are high-quality questions that can be used (Ritcharoon, 2008).

- For reliability assessment involved the researcher utilizing a questionnaire that had been modified based on the recommendations of experts to conduct a try-out with a population that had context similar to the sample group (Srisatidnarakun, 2007). Once the tests were returned, the reliability was calculated using Cronbach's alpha coefficients, finding that the questionnaire had a reliability value greater than 0.70. According to the concept proposed by Hair, Black, Babin & Anderson (2010). Overall, the reliability value of the questionnaire was .951, indicating that the questionnaire is highly reliable and can be used for data collection purposes (Wadeechareun, Leardnaisatt & Teekasap, 2007).

5) Data analysis

Researcher uses ready-made computer programs and employs descriptive statistics in the analysis of data, including Multiple Correlation Coefficient, and Stepwise Multiple Regression Analysis.

3. Results and Discussion

Data analysis is presented to meet the following objectives:

1) The analysis of the factors affecting the development of soft skills for undergraduate students towards becoming small business entrepreneurs in Southern Provinces of Thailand.

Table 1: Factors for developing soft skills of undergraduate students towards becoming small business entrepreneurs in southern provinces of Thailand

Factors for developing soft skills of undergraduate students towards becoming small business entrepreneurs in southern	B	SE _b	β	T	Sig.
Thinking skills (x1)	.206	.046	.222	4.508**	.000
Teamwork skills (x2)	.112	.037	.137	3.030**	.003
Leadership skills (x3)	.045	.046	.048	.978	.329
Questioning and listening skills (x4)	.312	.049	.338	6.341**	.000
Supervisory skills (x5)	.205	.051	.224	4.011**	.000
R = 0.899 R ² = 0.809 SE _{est} = 0.266 R ² _{Change} = 0.809					
R ² _{Adj} = 0.806 F = 299.839** a = 0.611					

** Statistically significant at the .01 level.

From table 1 The five factors of developing soft skills in undergraduate students majoring in economics and business administration towards becoming small business entrepreneurs in Thailand significantly support these students in their entrepreneurial efforts, with a multiple correlation coefficient (R) of 0.899. All factors can explain 80.9% of the variance in the development of soft skills for undergraduate students in economics and business administration aiming to become small business entrepreneurs in Thailand (R² = 0.809), with a standard error of prediction of 26.60% (Seest = 0.266). This indicated that the predictor variables positively affecting the development of soft skills for undergraduate students in economics and business administration towards small business entrepreneurship in Thailand are statistically at the .01 level, including thinking skills (X1), teamwork skills (X2), leadership skills (X3), questioning and listening skills (X4), and supervisory skills (X5).

2) The factors influencing the development of soft skills of undergraduate students has predictive power in supporting undergraduate students towards becoming small business entrepreneurs in the Southern Provinces of Thailand

Table 2 Analysis of factors influencing the development of soft skills for undergraduate students has predictive power in supporting undergraduate students towards becoming small business entrepreneurs in Southern Provinces of Thailand

Factors	B	SE _b	β	T	Sig.
Questioning and listening skills (x4)	.331	.045	.358	7.301**	.000
Thinking skills (x1)	.220	.044	.236	5.037**	.000
Supervisory skills (x5)	.201	.051	.220	3.948**	.000
Teamwork skills (x2)	.124	.035	.152	3.550**	.000
R = 0.899 R ² = 0.808 SE _{est} = 0.266 R ² _{Change} = 0.007					
R ² _{Adj} = 0.806 F = 374.604** a = 0.633					

** Statistically significant at the .01 level.

From table 2, it is found that the multiple correlation coefficient (R) is 0.633, indicating a predictive power of 80.80% (R²=0.808) and a standard deviation of prediction of 26.60% (SEest = 0.266). The overall predictive power stands at 80.60% (R²_{Adj}= 0.806), showing that the predictive variables positively influence the supportive factors for undergraduate students in the field of economics and business administration towards becoming small business entrepreneurs in Thailand with statistical significance at the .01 level.

There are 4 predictive variables: questioning and listening skills (X4), thinking skills (X1), supervisory skills (X5), and teamwork skills (X2), which are formulated into predictive equations in the form of raw scores and standard scores as follows.

Predictive equation in the form of raw scores

$$Y/ = 0.633 + 0.331(X4) + 0.220(X1) + 0.201(X5) + 0.124(X2)$$

Predictive equation in the form of standard scores

$$Z/ = 0.358 (Z4) + 0.236 (Z1) + 0.220 (Z5) + 0.152 (Z2)$$

Discussion

1) The analysis of the development of soft skills of undergraduate students towards becoming small business entrepreneurs in the border provinces of southern Thailand identifies leadership skills, thinking skills, and supervisory skills, consistent with the research of Penratanahiran & Thongkham (2021), which found that the soft skills that are highly necessary in 21st century workplaces include leadership, teamwork, problem-solving, work ethics, and time management

2) From the analysis of data showing that the factors contributing to the development of people and social skills (soft skills) of undergraduate students have a predictive power towards becoming small business entrepreneurs in the border provinces of Southern Thailand, there are 4 skills. This aligns with the research of Proyrungroi & Chansom (2021), it was found that soft skills such as adaptability, teamwork, creativity, and persuasion have an impact on work performance.

4. Conclusions

1) The five factors of developing soft skills in undergraduate students majoring in economics and business administration towards becoming small business entrepreneurs in Thailand significantly support these students in their entrepreneurial efforts, with a multiple correlation coefficient (R) of 0.899. This indicated that the predictor variables positively affecting the development of soft skills for undergraduate students in economics and business administration towards small business entrepreneurship in Thailand are statistically at the .01 level, including thinking skills, teamwork skills, leadership skills, questioning and listening skills, and supervisory skills, respectively.

2) There are 4 predictive variables: questioning and listening skills, thinking skills, supervisory skills, and teamwork skills.

Suggestions

1.1) Suggestions for utilizing the data analysis results: Researchers recommend utilizing the findings from research item 1 for policy purposed by incorporating them into the student development plan and the academic plan to collaboratively focus on enhancing students' soft skills in all aspects through various learning activities or projects both in and out of the classroom.

1.2) Recommendation for future research: Researcher suggests conducting research on the development of soft skills of undergraduate students toward becoming entrepreneurs in area of Southern of Thailand or study the analysis of the components of soft skills development necessary for undergraduate students to enhance themselves into becoming entrepreneurs in area of Southern of Thailand.

5. Acknowledgements

Thank you to the Faculty of Economics and Business Administration, Thaksin University, for supporting the research grant for the fiscal year 2023, and thanks to everyone who was involved in this research project. This made the research successful, and thus it is considered a collaborative effort in academic work.

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HOW CARBON FOOTPRINT FOR ORGANIZATION CONTRIBUTES TO SUSTAINABLE CLIMATE CHANGE MITIGATION

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Abstract: Carbon Footprint for Organization is a critical tool for evaluating the greenhouse gases emission generated by operational activities. The calculation includes seven types of GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆), and nitrogen trifluoride (NF₃). These gases contribute significantly to global warming, making it imperative to identify strategies to reduce emissions. Carbon Footprint for Organizational assessments encompass three scopes: Scope 1, direct emissions from an organization's operations, Scope 2, indirect emissions from energy consumption, and Scope 3, other indirect emissions. The results are reported in tons of carbon dioxide equivalent (CO₂eq), with variations in emission levels depending on each organization's activities. The assessment identifies the greenhouse gas emission from various activities, allowing organizations to develop accurate and targeted measures to reduce greenhouse gas emissions. It is therefore essential for all organizations to understand and prepare for the carbon footprint assessment process and identify mitigation measures for high-emitting activities. Mitigation strategies require collaboration from governments in promoting and enforcing the law, businesses in assessing and reducing greenhouse gas emissions at source, and the general public in choosing environmentally friendly products, as all sectors play crucial roles in achieving sustainable greenhouse gas reductions.

Keywords: Carbon Footprint for Organization, Greenhouse gases, Global warming

1.Introduction: Carbon The Sustainable Development Goals (SDGs) are a set of global development objectives adopted by 193 member states of the United Nations on September 25, 2015. These goals, designed to be achieved within a 15-year timeframe, have guided global development efforts since 2016 and will continue through 2030. Among these, Goal 13: Take urgent action to combat climate change and its impacts [1] stands out as a critical priority. Recognizing the pressing need to address climate challenges, member states have collectively committed to achieving carbon neutrality by 2050.

This goal underscores the importance of immediate and coordinated action to mitigate climate change and its wider impacts, positioning it as a cornerstone for achieving sustainable development around the world.

During the COP26 conference, Thailand's Prime Minister, General Prayut Chan-o-cha, announced the nation's ambitious targets: achieving carbon neutral by 2050 and net-zero greenhouse gas emissions by 2065. These goals highlight Thailand's commitment to addressing climate change and align with global efforts toward sustainable development. To achieve carbon neutral, Thailand must address carbon dioxide emissions across multiple sectors, including energy consumption, transportation, industry, and agriculture. Alongside reducing emissions, efforts must focus on carbon sequestration. The forestry sector plays a crucial role in this process by increasing green areas through tree planting and mangrove reforestation. Currently, Thailand's carbon sequestration capacity stands at 90 million tons of CO₂ eq annually. The country aims to enhance this capacity to at least 120 million tons of CO₂ eq in the future. Achieving this target will allow Thailand to offset an equal amount of emissions, effectively reaching carbon neutral by 2050 [2].

To achieve Thailand's carbon neutral and net-zero targets, understanding the current state of greenhouse gases (GHGs) emissions is crucial. The unchecked release of GHGs has led to significant global challenges, including a projected increase in global temperatures ranging from 1.1°C to 6.4°C [3]. Without proactive measures, the frequency and duration of heatwaves will intensify, rainfall patterns will become more erratic and severe, and the global average sea level will rise. These impacts threaten economies, ecosystems, biodiversity, and human health, including the emergence and spread of new diseases.

2. Literature Review

Haoyang Liu and Jiangtao Zhai (2025) [4.] Study Carbon Emission Modeling for High-Performance Computing Based AI in New Power Systems with Large-Scale Renewable Energy Integration. This study introduces a newly developed carbon emission model (CEM) that accounts for both embodied and operational emissions in HPC systems. The CEM integrates parameters such as energy intensity coefficients, workload distribution patterns, and renewable deficiency rates, providing a lifecycle perspective of emissions in HPC-based AI applications for power systems. Results reveal that operational emissions dominate, constituting 87% of the total lifecycle footprint. Different regions exhibit varying carbon emissions, and on average, increasing the renewable energy share from 20% to 50% reduces total emissions by 43%, while a full transition to renewable energy achieves a 92% reduction. Circular economic practices, including hardware recycling and sustainable design, are also highlighted to mitigate embodied emissions. This study offers quantitative evidence and actionable insights for power industry stakeholders, enabling the balance between high-performance AI computations and ambitious carbon neutrality goals in renewable-integrated systems.

Dinara et al. (2025) [5.] Study Environmental Sustainability and Carbon Footprint of Tourism: A Study of a Natural Park in Northeastern Kazakhstan. This study aims to assess the environmental sustainability and carbon footprint of tourism in Bayanaul State National Park (Kazakhstan) using the GSTC criteria and the Protocol on Greenhouse Gas Emissions. As part of the work, surveys and interviews were conducted with representatives of the tourism industry, administration officials and environmental organizations to analyze awareness of the principles of sustainable tourism, existing barriers and opportunities to increase sustainability. The results showed that the main contribution to the carbon footprint (530 tons of CO₂eq.) is made by indirect emissions (57%) related to procurement and logistics as well as coal heating (20.5%). Based on the expert assessment method, key factors were identified, such as increased energy efficiency, the introduction of renewable energy sources, separate waste collection and recycling, the transparency of financial management and educational programs for tourists and employees. Based on these factors, a model of sustainable tourism management has been developed, adapted to regional peculiarities. This model provides for the active involvement of the state, business and the local community, and introduces mechanisms to reduce the carbon footprint and increase environmental sustainability. The theoretical contribution of the study is the adaptation of GSTC standards to the conditions of Kazakhstan and the development of a sustainable tourism management model that takes into account local characteristics. The results obtained provide a practical basis for reducing the negative impact of tourism on the environment, improving environmental sustainability and creating conditions for further research and the introduction of sustainable practices.

3. Materials and Methods

Greenhouse gases include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆), and nitrogen trifluoride (NF₃). These emissions arise from various human activities such as energy consumption, industrial expansion, agriculture, deforestation, and the exploitation of natural resources. These activities contribute significantly to global warming, and the severity of their impacts continues to escalate.

for Organization (CFO) or Corporate Carbon Footprint (CCF). This assessment quantifies the GHG emissions from an organization's operations, providing a foundation for designing targeted strategies to reduce emissions.

The CFO serves as a critical metric for understanding and managing GHG emissions at various levels, ranging from individual agencies, companies, and factories to national operations. By adopting CFO methodologies, organizations can develop efficient measures to mitigate emissions, contributing to both their operational sustainability and the broader global effort to combat climate change [6].

In 2019, Thailand's total greenhouse gas emissions, excluding those from Land Use, Land-Use Change, and Forestry (LULUCF), were 372,716.86 GgCO₂eq, primarily driven by the energy sector, which accounted for 260,772.69 GgCO₂eq or 70% of total emissions. The agriculture sector contributed 56,766.32 GgCO₂eq or 15%, followed by the industrial sector with 38,301.21 GgCO₂eq or 10%, and the waste sector with 16,876.64 GgCO₂eq or 5% [7]. These figures highlight the energy sector as the dominant source of emissions in Thailand, necessitating targeted mitigation strategies, while also emphasizing the need for comprehensive approaches to address emissions from agriculture, industry, and waste to achieve national and global climate goals.

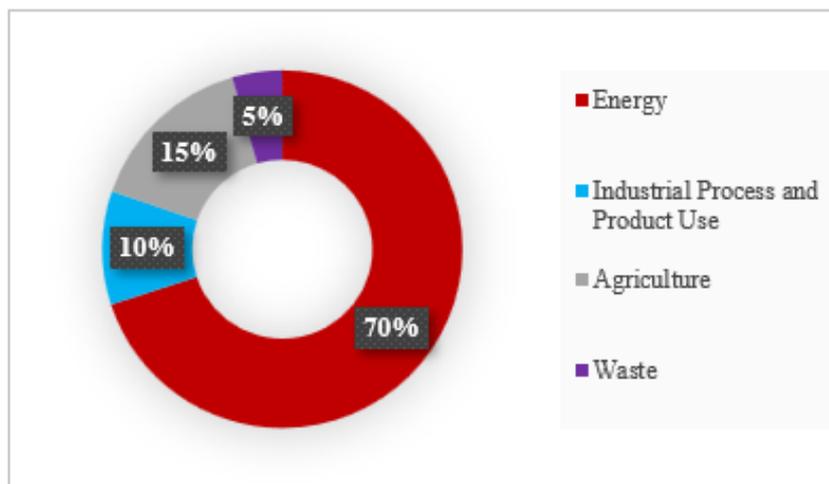


Figure 1. Total GHG emissions by sector (excluding LULUCF), 2019

The Carbon Footprint for Organizations (CFO) is a tool that enables entities to apply principles and guidelines for greenhouse gas (GHG) accounting, measurement, and reporting. It quantifies the GHG emissions resulting from various organizational activities, such as fuel combustion, refrigerant leakage, wastewater treatment, electricity use, waste management, employee commuting, raw material acquisition, and transportation, expressed in tons of CO₂ equivalent. These emissions are categorized into three scopes [8].

1. Direct Emissions: GHG emissions directly from organizational activities, including stationary and mobile combustion, production processes, chemical usage for wastewater treatment, leakage, and emissions from biomass such as soil and forestry.
2. Indirect Emissions from Energy Use: GHG emissions from imported energy consumed by the organization, such as electricity, steam, heating, cooling, and compressed air.
3. Other Indirect Emissions: GHG emissions from activities not covered under Scopes 1 and 2, including emissions from purchased raw materials, waste generated by the organization, transportation of raw materials by suppliers, business-related travel, customer and visitor transportation, product transportation and distribution, and employee commuting.

This comprehensive approach to categorizing emissions allows organizations to identify, measure, and report GHG emissions systematically, paving the way for effective mitigation strategies. For the evaluation of an organization's carbon footprint, Scope 3 emissions are further divided into 15 subcategories [9].

1. Purchased Goods and Services: Emissions from the procurement of raw materials and services.

2. Capital Goods: Emissions from the production of capital goods.
3. Fuel-and Energy-Related Activities: Emissions associated with fuel and energy not covered under Scope 1 and Scope 2.
4. Upstream Transportation and Distribution: Emissions from transporting and distributing goods before they reach the organization.
5. Waste Generated in Operations: Emissions from waste management activities resulting from the organization's operations.
6. Business Travel: Emissions from business-related travel by employees.
7. Employee Commuting: Emissions from employees traveling to and from the workplace.
8. Upstream Leased Assets: Emissions from leased assets not included in Scope 1 or Scope 2.
9. Downstream Transportation and Distribution: Emissions from transporting and distributing goods after they leave the organization.
10. Processing of Sold Products: Emissions from third-party processing of products sold by the organization
11. Use of Sold Products: Emissions from the use of products sold by the organization during their lifetime.
12. End-of-Life Treatment of Sold Products: Emissions from the disposal and treatment of products after their end-of-life.
13. Downstream Leased Assets: Emissions from assets leased to others.
14. Franchises: Emissions from franchise operations.
15. Investments: Emissions related to investments made by the organization.

This detailed categorization allows organizations to systematically identify and account for all relevant Scope 3 emissions, ensuring accurate reporting and effective GHG management across the entire value chain.

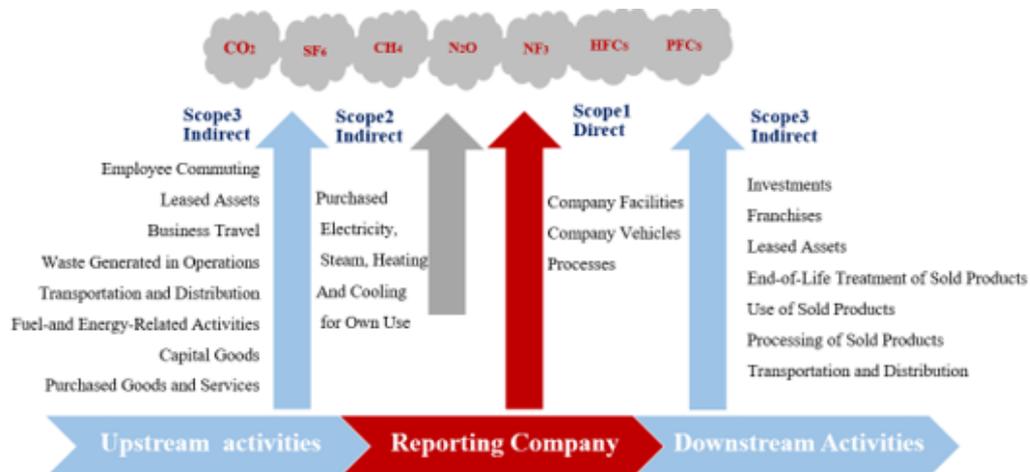


Figure 2. Scope of GHG emissions

4. Results and Discussion

The evaluation of an organization's carbon footprint consists of five key steps, as outlined by the Climate Change Institute. [10]

1. Defining Organizational and Operational Boundaries. This step is critical for identifying the scope within which the carbon footprint will be assessed, including all activities involved in the organization's operations. Due to the complex structure of many organizations, which may encompass multiple business units or factories, it is essential to clearly define appropriate boundaries that account for all relevant emission and absorption sources.
2. Identifying GHG Emission Sources. Organizations must specify the operational boundaries by identifying the sources of GHG emissions and absorptions within their defined operational scope. These are categorized into three types: Scope 1, Scope 2, and Scope 3 emissions.
3. Data Collection and Selection of Emission Factors. Once emission and absorption sources are identified and categorized, the next step is data collection for calculation purposes. Organizations must collect systematic and verifiable data for at least the past 12 months. This data should be well-organized and supported by documentation for transparency and accuracy.

Table 1. Example of Greenhouse Gas Emission and Absorption Accounting

Type	Activity	Unit	Usage Amount												Data Source
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	Diesel Fuel Usage (Trucks)	L	95	88	98	75	80	95	85	66	87	92	93	99	Fuel Withdrawal Slip
	Firewood Usage (Boiler)	Kg	95	98	97	82	85	93	98	96	89	95	91	93	Firewood Withdrawal Slip
2	Electricity Usage	kWh	55	45	65	70	58	68	56	65	78	77	68	65	Electricity Bills
3	Acquisition of electricity	kWh	55	45	65	70	58	68	56	65	78	77	68	65	Electricity Bills
	Garbage Disposal	kg	5	4	6	7	5	4	6	7	8	6	4	5	Bills

4. Calculating Greenhouse Gas Emissions and Reporting. Greenhouse gas emissions can be calculated by

4. Calculating Greenhouse Gas Emissions and Reporting. Greenhouse gas emissions can be calculated by multiplying activity data with greenhouse gas emission factors. Reporting and assessing carbon footprint for organization must follow the standards and guidelines set by the Thailand Greenhouse Gas Management Organization (Public Organization). If an organization wishes to obtain certification for the use of the carbon footprint for organization label, it must adhere to the specified standards and prepare a report that includes relevant content as outlined in the format. The results from the assessment can be used as baseline data for the organization's greenhouse gas emissions. If previous carbon footprint assessments exist, they must include a comparison with the baseline year in the report.

5. Identifying Strategies for Reducing Greenhouse Gas Emissions. After completing the carbon footprint for organization assessment, the results can be analyzed to determine the causes of greenhouse gas emissions from organizational activities. This allows for planning and identifying solutions to reduce emissions. Alternatively, the organization can purchase carbon credits to offset its greenhouse gas emissions (Carbon Reduction or Carbon Offset).

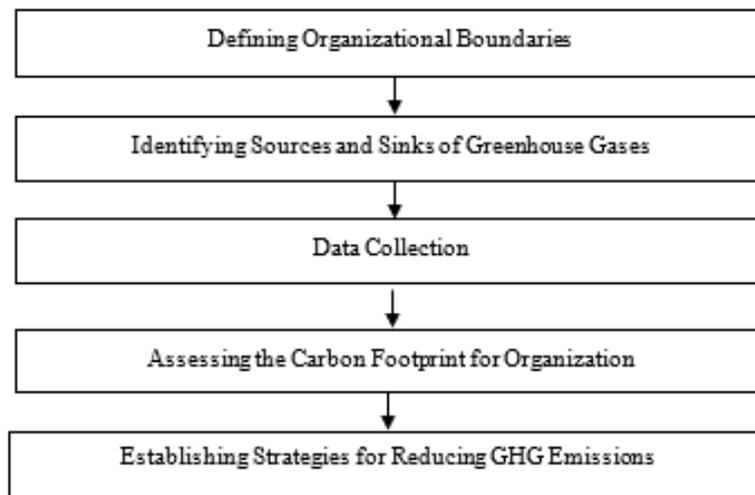


Figure 3. Steps for Assessing the Carbon Footprint for Organization

5. Conclusions

Conducting the carbon footprint for organization assessment must be performed by individuals with expertise in this field. In the initial stages, many organizations typically engage consultants who are registered with the Thailand Greenhouse Gas Management Organization (Public Organization). As of December 23, 2024, there are 174 consultants available to provide guidance on preparing the carbon footprint for organization, and 16 accredited verification entities.[11] The assessment requires a comprehensive analysis of all three types of greenhouse gas sources and sinks. It is essential to select the correct emission factors for accurate calculations. Furthermore, successful implementation relies on collaboration from all departments within the organization, as the data used for assessment must come from actual activity records across all units, not merely financial figures used for cost calculation.

The carbon footprint for organization assessment is a tool used to determine the amount of greenhouse gas emissions generated and identify the activities contributing to these emissions. This information can be analyzed to establish strategies for reducing emissions, particularly from high-emission activities, and translate these strategies into actionable plans. To achieve this, it is essential to hold discussions with stakeholders and personnel involved in the activities to collaboratively design measures for reducing greenhouse gas emissions.

Examples of activities that can serve as guidelines for reducing greenhouse gas emissions include:

1. Improving energy efficiency or upgrading energy equipment.
2. Using energy more efficiently.
3. Increasing the use of renewable energy sources for heat production, such as bioenergy and waste.
4. Enhancing technologies and production processes.
5. Managing empty transport trips.
6. Switching fuel types.
7. Reducing waste.
8. Using alternative fuels and raw materials.
9. Managing refrigerators effectively.
10. Implementing CCS/CCUS (Carbon Capture and Storage/Utilization) technologies in industrial processes.

Achieving greenhouse gas reduction goals requires the collaboration of all sectors, including the government, businesses, and the public: Government: Clear policies, law enforcement, and support in knowledge dissemination, funding, data accessibility, and reporting on progress and policy revisions are essential. Policies and targets for reducing greenhouse gas emissions must remain up to date. Businesses: Companies must prioritize greenhouse gas assessments to set accurate and targeted reduction goals. Efforts should focus on reducing emissions from their operations rather than relying on carbon credits for compensation. Reductions should be genuine and not solely for publicity. Public: Citizens should increase their knowledge, awareness, and commitment by choosing products with carbon labels to encourage businesses to prioritize sustainable practices. Additionally, individuals should adapt their lifestyles to help reduce greenhouse gas emissions.

Collaboration and dedicated action from all sectors are critical for achieving continuous and sustainable reductions in greenhouse gas emissions.

6. Acknowledgements

This research was supported by data and budget from Pacific Fish Processing Co.,Ltd. (PFP)

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SUSTAINABLE FOOD TOURISM PROMOTION GUIDELINES IN PHUKET, THAILAND

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Abstract: This study aims to explore the potential and propose guidelines for promoting sustainable food tourism in Phuket, Thailand. A qualitative research approach was employed, with the sample consisting of 8 food tourism business operators and 4 experts in Phuket. In-depth interviews were conducted. Data were analyzed using qualitative content analysis. The findings indicate that Phuket has the potential to develop a sustainable food tourism industry. Experts suggested promoting the preservation of local food recipes, utilizing local ingredients, and improving infrastructure for easier access to tourist attractions. Additionally, online marketing strategies and food festivals should be used to promote local cuisine. Based on the findings, the researcher proposes three main strategies for promoting sustainable food tourism in Phuket: (1) Growth of the tourism industry, focusing on developing tourist destinations and activities related to local food; (2) Environmental preservation through sustainable use of natural resources, such as local ingredients and renewable energy; (3) Enhancement of local community livelihoods through training and skill development in service and local food preparation to strengthen the economy sustainably.

Keywords: Sustainable food tourism, Phuket, Local cuisine, Community involvement

1.Introduction: Food tourism is an increasingly popular form of travel, particularly in Thailand, which is celebrated worldwide for its rich and diverse culinary heritage. Thai cuisine is widely regarded as a key attraction that draws both domestic and international visitors. In Phuket Province, this appeal is especially strong, as the region is renowned not only for its scenic beaches but also for its vibrant local culture and distinctive regional dishes (Figure 1).



Figure 1: Tourism map of Phuket (Poolvillaproperty, 2021)

Phuket's signature dishes—such as Hokkien fried noodles, Moo Hong, Owtaw, Loba, Fried Dumplings, O-Aew, Paw Lang, and Koi Talarm—are beloved by locals and tourists alike. These dishes reflect the island's cultural fusion and culinary diversity, underscoring its unique identity. Despite this rich potential, food tourism in Phuket remains underdeveloped, possibly due to the absence of clear strategies for promotion and long-term growth. Without well-defined planning, the sector risks losing its sustainability and economic viability.

To ensure long-term success, sustainable food tourism must prioritize natural resource conservation, support for local food producers, and the empowerment of environmentally and socially responsible businesses. Promoting this model in Phuket can boost the local economy while improving residents' quality of life. This research seeks to assess the potential of food tourism in Phuket and propose strategic, sustainable guidelines that balance tourism growth, environmental stewardship, and community development—positioning Phuket as a lasting and valuable destination for global travelers.

2. Literature Review

2.1 Gastronomy Tourism

Food is a key tool for telling the story of a community's lifestyle, beliefs, and history through its flavors and ingredients. It plays an essential role in attracting tourists who seek to experience something profound and valuable. Food serves as a symbol of local identity and culture, offering a way to share the story of a community through travel experiences, such as tasting local dishes that reflect the environment and the way of life of people in each area.

Gastronomy Tourism refers to traveling to experience food that reflects the local culture. It is not just about tasting food but also includes learning about the food preparation process, production, and cultivation that reflect the uniqueness of each region (Yalin, 2021). Food tourism also reflects the way of life of local communities, making it a crucial tool for promoting the local economy, particularly in supporting the preservation of cultural practices and local wisdom related to food production (APTA, 2016). In addition, food tourism stimulates economic growth by promoting local businesses such as restaurants, markets, and food-related activities, which benefits the community through the influx of tourists. Food tourism not only creates taste experiences but also deepens understanding of the landscape, agriculture, and the relationship between humans and nature, all of which contribute to the authenticity of the food and tourism experience (Sorcaru, 2019).

Food tourism also plays a significant role in supporting the conservation of natural resources and promoting the sustainable use of local resources. Learning about sustainable food production and culinary traditions can help raise awareness about environmental conservation and the preservation of local lifestyles (National Geographic Thailand, 2019). Additionally, food tourism has the potential to create local jobs and preserve traditions by stimulating local economic development and promoting social and environmental responsibility. Therefore, food tourism blends diverse travel experiences that enhance cultural and lifestyle understanding and can be a tool for promoting sustainable local economic development. It is essential for preserving both cultural and environmental aspects, ensuring a sustainable future for communities and the global society.

While gastronomy tourism clearly contributes to cultural preservation and sustainable economic growth, the literature focuses largely on general concepts and benefits. However, there is limited exploration of how these concepts are practically implemented in specific local contexts like Phuket, where culinary culture is both rich and regionally distinct. This gap underscores the need for place-specific strategies that align gastronomic tourism with sustainability principles in Phuket.

2.2 Gastronomy Tourists

Sorokina (2016) classified Gastronomy Tourists into four main categories, each with distinct characteristics and purposes for travel, as follows: (1) Food-focused tourists: This group of tourists typically travels to experience food directly. They are primarily interested in the taste and quality of food, such as tasting unique local dishes, visiting food production factories, or participating in cooking activities. They often seek food that reflects the culture and uniqueness of the local area, which they can take back as a memorable experience. (2) Culturally-interested tourists: These tourists travel to study and learn about the culinary culture and local eating habits. They are interested in the history and stories behind food, as well as traditional food preparation methods passed down through generations. They enjoy learning about the use of local ingredients and cooking techniques that reflect the cultural background of the community. (3) Mixed-tourists: This group typically has interests in multiple types of activities during their travels, such as cultural tourism, sightseeing natural attractions, or visiting historical sites, in addition to experiencing food.

They do not limit themselves to food tasting but seek destinations that offer a combination of cultural learning and full culinary experiences. (4) Educational tourists: These tourists are primarily interested in learning and developing food-related skills. They often participate in cooking courses or food-related educational activities, such as learning traditional cooking techniques or studying the impact of food on society and culture. This group does not only wish to taste food but seeks deep knowledge about the food preparation process and the cultural background associated with it.

Sorokina's (2016) classification of Gastronomy Tourists illustrates the diversity of tourists interested in food, whether it is through food tasting experiences, learning about culinary traditions, or developing food skills. Each group has different needs and experiences. Understanding the characteristics and interests of these tourist groups can help in the development and promotion of food tourism that effectively meets the needs of tourists and promotes sustainable local economic growth.

The classification of gastronomy tourists provides a useful framework for understanding visitor motivations and needs. Yet, existing studies lack local demographic analysis on which type of gastronomy tourists visit Phuket and how tourism experiences can be tailored accordingly. Addressing this gap can help develop targeted strategies that match tourist types with sustainable food tourism initiatives.

2.3 Sustainable Tourism

Sustainable Tourism is a tourism approach that aims to achieve a balance between economic development, environmental conservation, and the preservation of the social and cultural values of local communities. This form of tourism not only creates positive experiences for tourists but also enhances the quality of life for local communities without depleting natural resources or eroding local cultures. Sustainable tourism, therefore, focuses on the efficient use of local resources and promotes environmental conservation to ensure long-term development and growth (Stojanovska-Stefanova & Atanasoski, 2018).

Sustainable tourism emphasizes the creation of a balance between the demands of tourists and the effective management of local resources, promoting tourism that does not harm the environment or local culture. This type of tourism also considers the economic development of the local community alongside the preservation of natural and cultural diversity. Sustainable tourism is not just about protecting natural resources but also ensuring the well-being of the local community. At the same time, it seeks to reduce the negative impacts of tourism on both the environment and society by encouraging responsible tourism activities that do not place a heavy burden on natural resources or local communities. Sustainable tourism management requires clear planning and management to ensure that tourist destinations can accommodate visitors over the long term without damaging resources or losing their ability to regenerate (Gössling et al., 2019).

The implementation of sustainable tourism policies requires the participation of all sectors: government, private sector, and local communities. This is crucial for achieving balanced and fair development, especially in developing infrastructure and services that can accommodate tourists comfortably and safely, while also considering the conservation of natural resources and local culture. This ensures that tourist destinations can grow and generate long-term income without harming the environment or the cultural identity of the area (Chomphpanya et al., 2024).

Although sustainable tourism principles are well established, they are often discussed in broad, theoretical terms. The literature does not sufficiently address the intersection between sustainability goals and food tourism practices in specific tourist destinations like Phuket. Further research is needed to examine how sustainable tourism principles can be effectively applied in the development of Phuket's culinary tourism sector.

2.4 Sustainable food tourism

Bertella (2020) suggested that gastronomic tourism should not only focus on attracting tourists but should also aim to create experiences that support sustainable development in local communities. This can be achieved through collaboration between the government, private sector, and local communities in designing tourism programs that are appropriate and environmentally friendly.

Several dimensions should be considered, including: (1) Conservation and responsible resource use – gastronomic tourism should promote the use of local ingredients and sustainable food production by supporting local farmers and producers, while minimizing the environmental impact of transporting food over long distances; (2) Supporting the local economy – the development and promotion of local cuisine help add value to the local economy. For example, organizing local food events or festivals not only creates experiences for tourists but also generates income for the community; (3) Promoting culture and food diversity – gastronomic tourism should promote the preservation and dissemination of unique culinary traditions in each area, such as preserving traditional cooking methods and sharing them with tourists; (4) Sustainable development – the development and promotion of gastronomic tourism must consider long-term sustainability in terms of economic, social, and environmental factors. The development of this form of tourism must balance economic benefits with the protection of natural resources. Furthermore, policies should be developed to support this approach, and awareness of sustainable gastronomic tourism should be raised among tourists.

Furthermore, Sakolnakorn et al. (2013) studied sustainable tourism development and management in Phuket province, Thailand, and found that the development of sustainable gastronomic tourism in Phuket should focus on the following actions: (1) Promoting the use of local resources – emphasizing the importance of using local resources in the development of the tourism industry, including the use of local ingredients in food preparation. Utilizing products made in Phuket will help support the local economy and reduce the environmental impact caused by the transportation of goods; (2) Developing and promoting local cuisine – the development of local cuisine in Phuket plays a crucial role in creating a unique identity and attracting tourists. This can be achieved by promoting traditional dishes that use local ingredients and by transferring knowledge of local cooking techniques to tourists, thereby creating valuable and environmentally friendly experiences; (3) Managing sustainable tourism – the development and management of tourism in Phuket should aim to maintain a balance between attracting tourists and preserving natural resources. Developing environmentally friendly and socially and economically sustainable tourist attractions is a key factor in supporting sustainable gastronomic tourism in Phuket; (4) Strategic development and collaboration – the development of gastronomic tourism in Phuket should focus on collaboration among government agencies, the private sector, and local communities. The development and promotion of gastronomic tourism must consider the economic and environmental impacts, as well as the sustainable development of food production.

Research highlights key principles and stakeholder roles in sustainable gastronomic tourism. However, there is limited empirical analysis of how these principles are being applied in Phuket, especially in terms of collaboration models between communities, government, and the private sector. This points to the need for a framework that connects sustainable food practices to tourism planning in the Phuket context, addressing both opportunities and practical limitations.

2.5 Situation of Culinary Tourism in Phuket

Phuket is internationally recognized as one of the leading tourist destinations, known for its rich cultural heritage and diverse cuisine, which reflect the fusion of local history and traditions, particularly those rooted in Chinese and Malay cultures. The situation of culinary tourism in Phuket can be summarized as follows:

2.5.1 Cultural and Local Cuisine: Phuket was honored as a member of the UNESCO Creative Cities of Gastronomy Network on December 11, 2015, based on five distinctive characteristics: (1) Cultural diversity, particularly in food, shaped by a multicultural society; (2) Food plays a central role in every festival, ceremony, belief, and family life; (3) Several local Phuket dishes possess unique identities not found elsewhere; (4) Strong collaboration among various sectors leading to the creation of innovations based on food science; and (5) The people of Phuket are hospitable, welcoming visitors to a city with beautiful landscapes and a warm atmosphere, under the philosophy of "Good Food, Good Health, Good Spirit...in Phuket" (Patchanee, 2020). Additionally, the Creative Cities Network website highlights that Phuket's culinary culture has greatly benefited from cultural exchange and diverse knowledge. Cooking plays an essential role in the lives of the local people through the preservation and transmission of culinary traditions passed down through generations. The commitment to preserving these culinary traditions is reinforced and promoted through annual events that revive ancient food knowledge, handicrafts, folk art, and visual arts, with a focus on sustainable, environmentally friendly production and the long-term sustainability of local food resources. Phuket's cuisine is deeply connected to local traditions, festivals, and rituals, with several dishes that have been passed down through generations, such as Hokkien fried noodles (large yellow noodles similar to Japanese soba), Moo Hong (stewed pork belly with soy sauce), Oh Tao (a type of oyster omelette), Lobah (pork cooked with spices and soy sauce, then fried crispy), fried dumplings (Phuket-style sausage made from minced pork and other fillings like shrimp or crab wrapped in tofu skin, then steamed and deep-fried), and O-Aew (a local dessert made from agar-like jelly mixed with red beans, grass jelly, syrup, and shaved ice).

There are also special festival dishes like Angoo (turtle-shaped pastry), which are offered during rituals honoring ancestors or at Peranakan wedding ceremonies in Phuket. These unique food traditions contribute to Phuket's cultural appeal, creating a distinct "Phuket brand" that continues to attract attention today (Patra Patchanee, 2020).

Additionally, a review of the literature reveals that Cultural and Local Cuisine significantly contributes to the sustainable development of culinary tourism in Phuket. Promoting local food and unique cultural traditions not only helps preserve cultural heritage but also makes culinary tourism in Phuket distinctive and appealing. Tourists can experience something new that cannot be found elsewhere. Furthermore, encouraging the use of local ingredients and sustainable cooking practices can help preserve natural resources, reduce dependence on external goods, and contribute to local development and long-term income generation.

Phuket's unique food heritage is well documented and officially recognized by UNESCO. Still, much of the literature focuses on cultural value without deeply evaluating how local cuisine can be strategically integrated into sustainable tourism plans. There is a need to assess how cultural preservation can be balanced with modern tourism demands to ensure long-term viability.

2.5.2 Community Involvement: Singkala and Jansuri (2022) studied the management of culinary tourism in the old town area of Phuket and found that culinary tourism has strengths and opportunities in terms of community involvement, as follows: (1) There is a wide variety of food establishments distributed across the area. (2) Activities related to cultural beliefs are organized on significant dates in the annual calendar to preserve customs and good practices. (3) There has been an increase in the development of modernized food products and local souvenirs. (4) The strong community tourism network in the old town of Phuket warmly welcomes tourists and organizes creative culinary tours, offering them opportunities for knowledge exchange and active participation in the tourism experience. (5) Local guides from the community are available to lead group tours, reducing the risk of misinformation. (6) Government agencies and relevant sectors consistently support the organization of food festivals, food-related activities, and local Phuket food stalls. (7) Food establishments in the old town of Phuket present innovative dishes and adapt to modern trends, such as fusion restaurants and café-style eateries.

However, certain limitations and obstacles were also identified in culinary tourism, including: (1) Inefficiency and inadequacy in the collaboration between stakeholders for researching and gathering data on Phuket's local cuisine. (2) The old town area has relatively few narratives or stories about the origins of local dishes. (3) Operators often misunderstand the difference between traditional Phuket food and food aimed at tourists, leading to offerings that deviate from authentic flavors. (4) Older generations with knowledge of traditional Phuket food tend to guard recipes, while younger generations place less emphasis on cultural capital. (5) There is a lack of standardized evaluation of the skills and capabilities of food service staff, as many employees are hired on a daily basis, and staffing is frequently changed without consistent recruitment criteria. (6) There is insufficient guidance on the ingredients used in food preparation, which is essential for service quality, especially for dishes with specific ingredients tied to religious beliefs, food allergies, or personal preferences. (7) There is limited collection of tourist feedback on services or the overall tourism experience, which could provide valuable data for self-improvement and effective management planning. (8) Limited communication channels with the community for organizing tourism activities. (9) A shortage of personnel to integrate modern technology into tourism management.

Additionally, a literature review highlights that community involvement significantly influences the sustainable development of culinary tourism in Phuket. When the community actively participates in developing and promoting culinary tourism, it fosters a sense of ownership and a stronger commitment to preserving local food. Tourists can experience the unique cultural identity of the community and the authenticity of the services provided. Moreover, community involvement supports sustainable economic development, allowing local communities to benefit from tourism without relying on external income sources or environmentally destructive tourism practices.

Community participation is identified as both a strength and a challenge in developing culinary tourism in Phuket. While there is strong local engagement, barriers such as lack of knowledge-sharing and intergenerational disconnect threaten long-term sustainability. Thus, a deeper understanding of how to strengthen inclusive and knowledge-driven community participation is essential for sustainable food tourism development.

2.5.3 Infrastructure and Development: Singkala and Jansuri (2022) conducted a study on the current situation of food tourism management in the Old Town area of Phuket. The study found strengths and opportunities regarding infrastructure development as follows: government agencies and relevant sectors have prioritized the landscape of Phuket's Old Town by undergrounding power lines to enhance the potential and identity of the area, thereby stimulating tourism in line with the policy of transforming Phuket into a smart city. In addition, the Phuket Provincial Authority has assigned staff to monitor and ensure the safety of tourists. However, there are still challenges related to transportation and urban congestion, which lead to high travel costs to access the Old Town area. There is also a lack of parking space, which is limited and narrow. Furthermore, the frequency of the Airport Bus (Smart Bus) service is relatively low, making it inconvenient for tourists to access the area.

Moreover, from a review of the literature, it was found that infrastructure and development play a significant role in the sustainable development of food tourism in Phuket. Good infrastructure, such as convenient transportation, the development of tourist attractions, and amenities, facilitates tourists' access to food tourism sites and enhances their overall convenience. Additionally, the development of sustainable infrastructure, such as an efficient transportation system and the use of environmentally friendly technologies, will help mitigate the environmental impact of tourism while ensuring long-term comfort and convenience for tourists.

Although there are infrastructure improvements aligned with smart city goals, practical limitations such as transportation inefficiencies and accessibility issues persist, potentially undermining sustainable food tourism. This suggests the need to evaluate how infrastructure development can be better aligned with culinary tourism planning, ensuring both tourist satisfaction and reduced environmental impact.

2.5.4 Marketing and Promotion: Singkala and Jansuri (2022) studied the current state of food tourism management in the Old Town area of Phuket and found that Phuket is a province that actively promotes and supports the integration of local cuisine with tourism. This is evident through the continuous organization of food festivals aimed at raising awareness and establishing the city's image as a world-class creative city of gastronomy. Several events and activities are regularly held, such as the Phuket Festival & Seafood Gastronomy, Roi Rim Lay, New Year celebrations, the Phuket Pride Festival, the Phuket Red Cross Fair, the Phuket Local Food Festival, and the Delicious Phuket Food Festival. Among the key strengths and opportunities identified is the promotion of the Sunday Market, which plays a crucial role in increasing awareness and sharing the local food culture of Phuket with tourists. Related agencies have conducted publicity through both online and offline media, including travel promotional videos, short films, product and service reviews by tourists, social media influencers, and media platforms that influence tourism. Additionally, promotional activities have been developed to align with the smart city context, such as promoting Phuket as a model community for tourism, festivals, and annual traditions. There are also activities aimed at encouraging tourists to experience Michelin-starred restaurants and expanding the market to include specialized tourist groups amidst the growing trend of food tourism, both domestically and internationally. Furthermore, efforts to link information to international markets have increased, and marketing strategies are integrated with tourism activities, resulting in travel agencies and airlines offering travel packages that include flight tickets and tourism programs in the area. However, there are still weaknesses and challenges related to tourism promotion, such as limited connections between tourism routes and communities, the need to develop marketing skills, budget constraints of food establishments, and limitations in the development of useful tourism data systems. Additionally, the high transportation fees charged to tourists and the lack of a collaborative marketing and promotional strategy through integrated mechanisms are challenges that need to be addressed, along with building trust in Thailand as a tourist destination in the eyes of international travelers.

Furthermore, a review of the literature indicates that effective marketing and promotion play a significant role in the sustainable development of food tourism in Phuket. By promoting food tourism through efficient marketing, the province can attract both domestic and international tourists. Promoting the diversity of local food through various channels, such as social media, websites, or tourism events, can enhance visibility. Moreover, marketing strategies focused on sustainable tourism, such as promoting restaurants that use local ingredients and environmentally friendly travel, help create a positive image and attract tourists interested in long-term sustainable travel experiences.

Marketing initiatives have successfully raised Phuket's gastronomic profile, yet challenges remain in achieving integrated, community-linked strategies. There's limited evidence on how current promotions translate into sustained engagement with local food culture and responsible consumption. Addressing this gap requires developing coordinated marketing approaches that align with sustainability and local economic empowerment.

3. Research Objectives

1. To explore the potential of food tourism in Phuket Province.
2. To propose guidelines for promoting sustainable food tourism in Phuket Province.

4. Research framework

The research framework depicted in Figure 2 illustrates the conceptual model for this study on sustainable food tourism in Phuket.

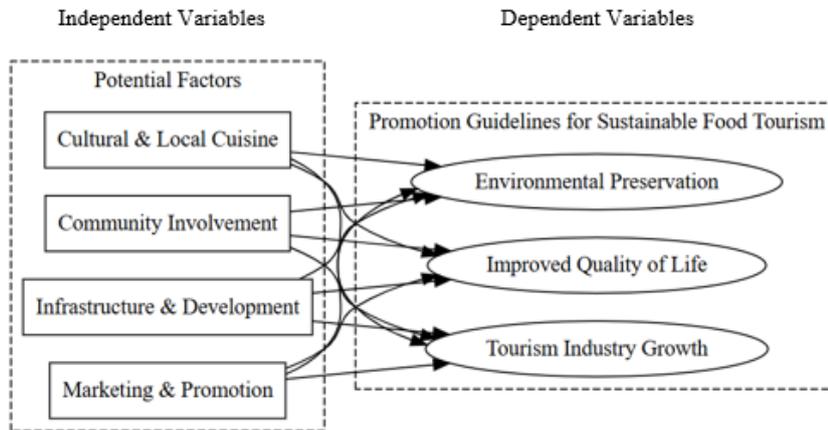


Figure 2: Research framework

5. Materials and Methods

This study employs a qualitative research approach to explore the characteristics and potential of food tourism in Phuket, as well as to propose strategies for promoting sustainable food tourism. The qualitative research method is chosen to gather in-depth data that allows for comprehensive answers to the research questions, and to offer recommendations that can be effectively implemented for the development of sustainable food tourism in Phuket. The research methodology is outlined as follows:

5.1 Study of the Characteristics and Potential of Food Tourism in Phuket

5.1.1 Sample Group

The sample group in this study consists of 8 individuals selected through purposive sampling. These include:

- (1) Local food business operators, comprising owners of local restaurants, seafood restaurants, local food markets, and producers of famous traditional food.
- (2) Representatives from local organizations involved in promoting tourism, as well as individuals with experience and knowledge in the field of food tourism.

5.1.2 Data Collection Tools

This study employs in-depth interviews with the sample group to obtain detailed information and to gain insights into the characteristics and potential of food tourism in Phuket. The interview questions focus on topics such as: the characteristics of local foods that are popular and attractive to tourists, the demands and behaviors of tourists who choose food tourism, opinions on the promotion of food tourism in Phuket, and factors that contribute to the sustainable development of food tourism.

5.1.3 Data Analysis

The data obtained from the in-depth interviews will be analyzed using content analysis to identify and summarize trends related to food tourism in Phuket.

5.2 Proposal for Sustainable Food Tourism Promotion Strategies in Phuket

5.2.1 Review of Related Literature and Research

The study begins with a review of relevant literature on sustainable food tourism in other regions, as well as an examination of policies and strategies employed to promote food tourism both in Thailand and abroad. The goal is to identify strategies that can be adapted and applied in Phuket.

5.2.2 Data Collection through Expert Interviews

Data will be collected through interviews with 4 experts in related fields, including local chefs, food business operators, representatives from the public sector, and marketers.

5.2.3 Data Analysis

The interpretation of the data obtained from the expert interviews will utilize content analysis to propose strategies that are practical and align with economic and environmental sustainability.

6. Results and Discussion

6.1 Potential for Food Tourism in Phuket

The analysis of data from in-depth interviews revealed that food tourism in Phuket has the potential to be developed sustainably, with strengths in four key areas as follows:

6.1.1 Cultural and Local Cuisine

Phuket is culturally diverse, particularly in terms of its food, including Chinese-Hokkien cuisine, Malay food, and famous seafood. These local dishes feature unique flavors and cooking methods that can attract tourists interested in learning about and experiencing culture through food. However, there is potential to further develop local cuisine into valuable and unique products that can compete in the global market, such as promoting local food through food festivals or training restaurant owners to preserve traditional recipes.

6.1.2 Community Involvement

The community in Phuket is strong and willing to participate in the development of food tourism, which is essential for preserving and disseminating local culture. Examples include learning to cook local dishes from residents and collaborating with local farmers to source fresh ingredients. However, enhancing the community's knowledge and skills in serving tourists, such as through training local food guides or organizing community cooking activities, will contribute to generating income and strengthening the local economy.

6.1.3 Infrastructure and Development

Phuket has well-developed infrastructure, including an international airport connecting the island to both domestic and international destinations, a convenient transportation system, and diverse tourist attractions, which are well-suited to support food tourism. However, further development of infrastructure is needed, such as improving access to food tourism destinations in remote areas or creating easily accessible food tourism hubs, such as local markets or food centers in all regions, to increase the potential for food tourism in Phuket.

6.1.4 Marketing and Promotion

Phuket has the potential to promote food tourism through various channels such as social media, websites, and tourism campaigns, linking food tourism with cultural and ecotourism. However, enhancing marketing activities that focus on building awareness and attracting tourists is essential. For example, organizing Phuket food festivals or tourism campaigns related to local food, or creating online platforms to promote local restaurants and food tourism activities, will help attract both international and domestic tourists.

6.2 Expert Interviews on Promoting Sustainable Food Tourism in Phuket

The results of the expert interviews can be summarized as follows:

6.2.1 Promotion of Local Cuisine

Promoting Phuket's local food must start with preserving traditional recipes and cooking methods that reflect the island's culture. This includes using local ingredients and traditional cooking techniques passed down through generations. Establishing training courses for restaurants or communities in preparing local dishes is crucial, as it helps preserve valuable food heritage and provides knowledge to both locals and tourists. Activities such as 'Food Tours' can also be effective in attracting tourists to experience and learn about local cuisine.

6.2.2 Community Involvement

The community plays a key role in the development and promotion of food tourism, particularly in creating authentic experiences for tourists. Providing opportunities for local communities to participate in food-related activities, such as cooking workshops or food festivals, will enable them to benefit from tourism while preserving their cultural identity. A significant step forward would be to support local restaurants or kitchens in connecting authentically with the community, fostering sustainable development.

6.2.3 Infrastructure Development

The development of infrastructure to support food tourism in Phuket is essential, especially in making food tourism destinations easily accessible. Improvements in transportation systems, such as creating food tourism routes that connect various food-related attractions across Phuket, will make it more convenient for tourists to visit these areas. Additionally, the establishment of facilities connected to local food, such as markets or venues showcasing local products, will enhance the overall tourist experience.

6.2.4 Marketing and Promotion

Promoting food tourism in Phuket requires strategies that focus on raising awareness of the uniqueness of local cuisine through various channels. This includes using social media to promote local restaurants and organizing activities that highlight local food as a defining feature of Phuket. Campaigns like 'Food Tours' that link food tourism with cultural and ecotourism activities will attract tourists interested in both food and local culture. Collaboration with the media and influencers can further extend the reach to international tourists, increasing the likelihood of attracting more visitors to Phuket.

Table 1 summarizes these expert suggestions, which can guide the successful promotion and development of food tourism in Phuket.

Table 1 Expert recommendations for promoting sustainable food tourism in Phuket

Domain	Key Recommendations
1. Promotion of Local Cuisine	- Preserve traditional recipes and cooking techniques- Use local ingredients- Conduct training for locals and restaurants- Organize food tours
2. Community Involvement	- Involve locals in food-related activities (e.g., cooking workshops, festivals)- Support local restaurants' authentic engagement- Foster cultural identity
3. Infrastructure Development	- Improve transport systems for easier access- Develop food tourism routes across Phuket- Create food-related facilities (e.g., markets, food venues)
4. Marketing and Promotion	- Use social media to promote local cuisine- Highlight Phuket food through events- Link food with culture/ecotourism- Collaborate with media/influencers

The results of this study are consistent with the research of Hwaenjin & Aswawichairoj (2024) on factors influencing tourist satisfaction in Phuket, which found that factors such as the quality of local food, community participation, and the development of appropriate infrastructure and services significantly impact tourist satisfaction. Furthermore, the study aligns with the research by Chaiyasain (2018) on guidelines for competitive advantage and service innovation in the restaurant business 4.0, which proposed sustainable food tourism development strategies for Phuket, such as promoting local food with distinctive qualities to compete in the global market, improving service standards, integrating with cultural tourism, and fostering collaboration between public and private sectors. These efforts would elevate Phuket as a creative gastronomic city and ensure the long-term sustainability and growth of food tourism in the region.

7. Conclusions

Phuket has significant potential for sustainable development in various areas, including the conservation of local culture, community involvement, infrastructure development, and the implementation of appropriate marketing strategies to attract tourists and ensure the sustainability of food tourism. Therefore, promoting food tourism in Phuket should focus on preserving local cuisine, fostering community participation, developing infrastructure that supports tourism, and employing effective marketing strategies.

This study contributes uniquely to the existing body of literature by providing a comprehensive framework that not only addresses the challenges and opportunities of food tourism in Phuket but also offers actionable recommendations for local stakeholders. By integrating expert insights and focusing on sustainable practices, it bridges the gap between theory and practice in promoting food tourism as a key driver of sustainable economic growth in the region.

8. Recommendations

Promoting sustainable food tourism in Phuket should focus on developing approaches that balance the growth of the tourism industry, environmental preservation, and the improvement of the quality of life for local communities. Based on the research findings, we propose the main strategies for promoting sustainable food tourism in Phuket as follows:

8.1 Tourism Industry Growth

The development of the food tourism industry should promote growth that not only attracts tourists but also considers the preservation of cultural diversity and the creation of value for local food. Developing food-related attractions and activities, such as organizing food festivals or promoting experiential tourism (Food tours), can enhance the value of the industry and raise global awareness of Phuket's unique culinary offerings.

8.2 Environmental Preservation

Promoting food tourism should focus on environmental preservation by using natural resources responsibly. This includes sourcing local ingredients that are sustainably grown and produced, as well as minimizing the use of resources that have negative environmental impacts. Supporting organic farming and utilizing renewable energy sources in tourism-related businesses are ways to achieve this goal.

8.3 Improving the Quality of Life for Local Communities

Sustainable food tourism should prioritize improving the quality of life for local communities by providing training and developing skills for community members, such as in food service, local cooking, or becoming local food tour guides. Enhancing the ability to serve tourists will increase the income of the community and strengthen the local economy, contributing to long-term sustainability.

8.4 Suggestions for Future Research

1. Comparative Study of Food Tourism in Phuket and Other Areas: A comparative study of food tourism in Phuket and other regions could be conducted to compare strategies for development, management practices, and the impacts resulting from food tourism. This would provide valuable insights into effective approaches and potential areas for improvement.

2. Assessment of Long-Term Impacts of Food Tourism: Evaluating the long-term impacts of food tourism would help to gain a comprehensive understanding of its outcomes and allow for the refinement of strategies to promote tourism in ways that are more sustainable and aligned with broader sustainable development goals.

3. Development of Innovations in Food Tourism: Research focused on developing innovations in food tourism could help attract tourists from around the world, adding greater value to the food tourism industry. This could include exploring new trends, technologies, or experiences that would enhance the appeal of food tourism and contribute to the growth and sustainability of the sector. For instance, leveraging digital technologies such as augmented reality (AR) for immersive culinary experiences, mobile apps for food tours, or online platforms for booking culinary experiences can expand the reach of food tourism, attract tech-savvy tourists, and provide more engaging, personalized experiences, ensuring the sector's long-term growth and relevance.

9. Acknowledgements

I would like to express my sincere gratitude to the International College of Thaksin University for their generous support in facilitating my travel to present my work.

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IMPLEMENTING CIRCULAR ECONOMY CONCEPT IN TOURISM: A CASE STUDY OF PHUKET, THAILAND

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Abstract: This research explores strategies for applying the Circular Economy (CE) concept in tourism sector using Phuket province in Thailand as a case study. It applied 7R framework (Reduce, Reuse, Recycle, Refurbish/Repair/Remanufacture, Redesign, Replace, Rethink) and a Delphi technique involving 33 experts in data collection. The study identifies seven approaches with high implementation potential in Phuket tourism sector. These approaches are (1) digital technology to monitor waste, (2) minimising food and beverage waste, (3) creating new products from recycled materials, (4) installing water-recycling systems, (5) promoting eco-friendly packaging, (6) deploying electric buses, and (7) adopting electric trams. These measures highlight strategic actions for transitioning Phuket's tourism into a circular tourism destination which aims at utilizing digital solutions to reduce resource consumption, waste and greenhouse gas. The research reveals key enabling factors of implementing CE in Phuket tourism as the understanding of the concept, high public environmental awareness, supportive policies and budget, improvement in public transport and recycling infrastructure and a strong institution for mobilizing and monitoring CE initiatives. Strong collaboration among government agencies, private sector, and local communities is seen as a vital foundation for mobilizing CE at the operational level.

Keywords: Circular economy, sustainable tourism, Phuket, 7R, environmental management

1. Introduction

1.1 Tourism and Sustainability

Tourism is a major global industry driving economic growth. According to the World Tourism Organization (UNWTO), prior to the COVID-19 pandemic, tourism contributed up to 10% of global GDP and provided more than 300 million jobs worldwide [1]. Nonetheless, rapid tourism expansion, if insufficiently managed, can create serious negative impacts on the environment and society such as excessive waste generation, ecosystem degradation, overuse of water and energy, and greenhouse gas emissions [2]. Given these challenges, "Sustainable Tourism" has emerged as an urgent priority for many countries, including Thailand. Phuket is one of Thailand's top tourism destination with over 14 million international arrivals annually that is facing significant challenges from overtourism including overflowed waste, untreated wastewater, traffic congestion, as well as high water and energy usage. This prompts Phuket tourism stakeholders to adopt sustainable tourism principles in the attempt to conserve its natural resources and environment which are essential for its economic success. Integrating Circular Economy (CE) into tourism context remains a gap in research that this study aims to address. The study aims to resolve two research questions which are (1) Which CE principles can be applied to Phuket tourism? and (2) what are the enabling factors and barriers for implementing CE in Phuket tourism? Addressing these questions will help scholars and decision makers understand the way in which CE can be implemented at operation level in a real-world context.

1.2 Circular Economy and Tourism

The CE model is an alternative to the traditional linear economy which exemplifies 'take-make-dispose' paradigm leading to resource overconsumption and extensive waste generation. By contrast, CE promotes the closed-loop production and consumption systems that extend resource life cycles, minimise waste, and reuse or recycle materials. CE core pillars include: (1) maximising resource-use efficiency, (2) regenerating and reusing materials, and (3) minimising environmental impacts across all processes [3]. In the tourism sector, CE can be integrated at multiple levels ranging from individual accommodation providers such as reducing waste and improving energy efficiency in hotels, to broader policies that promote the use of renewable energy or electric vehicles in public transport. Examples of CE in tourism include comprehensive waste-sorting mechanisms at tourist sites, extension of the material usage, carbon emission reduction and creating value from leftover resources [4]. Multiple studies suggest that CE can be adapted effectively to service-based industries like tourism by applying the 7Rs [5]:

1. Reduce: Lessen the use of materials and resources (e.g., reducing food waste in hotels and restaurants or cutting electricity consumption).
2. Reuse: Encourage repeated use of items, such as reusing towels, linens, or packaging materials.
3. Recycle: Sort and reprocess waste into new products or convert it into energy.
4. Refurbish/Repair/Remanufacture: Extend the lifespan of equipment (e.g., furniture, beds) through repairs rather than discarding items prematurely.
5. Redesign: Develop products, packaging, or processes in a more environmentally friendly manner—for instance, utilising biodegradable materials or modifying hotel building designs to improve energy efficiency.
6. Replace: Transition to alternative materials and renewable energy sources, such as replacing fossil fuels with green energy or switching from conventional light bulbs to LED systems.
7. Rethink: Re-evaluate the entire service system; reconfigure business models so that sustainability is integrated across the whole supply chain.

Several international tourist destinations in Europe, China, and Japan have been shown to adopt CE practices such as wastewater recycling for resort gardening, using digital platforms to monitor hotel carbon footprints, and creating hotel networks that share or recirculate underused equipment [4]. A study by Rodríguez-Antón et al. (2019) [5] and Cornejo-Ortega and Chávez Dagostino (2020) [6] noted that leading hotel chains have embraced 7R frameworks to enhance their sustainability credentials in order to meet eco-conscious travellers' expectations, and reduce operational costs over time.

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The exploration of how CE can be incorporated in Phuket tourism will provide insights into application of the concepts and potential obstacles that need to be addressed. As a host for 2026 GSTC (Global Sustainable Tourism Council) [7] while grappling with over 1,000 tonnes of solid waste per day, Phuket is in desperate need for effective resource management and innovative environmental solutions.

. Materials and Methods

2.1 Study Area and Scope

This research was conducted in Phuket Province of Thailand to showcase a tourism destination facing mass tourism and several environmental problems. The study used a Delphi method with two rounds of data gathering from governmental agencies, tourism associations, and academics specialising in development planning, environmental and tourism. Data was collected during May–October 2023 and January–March 2024. The inclusion criteria for participants were knowledge about CE and having at least five years of experience working with Phuket tourism, development or environmental stakeholders.

2.2 Delphi Method and Data Collection

According to Oliko and Pawlowski (2004)[8], Delphi method can be used to gain insights from experts on specific topics based on multiple rounds of discussions until a census is reached. In this study, 50 experts were asked to participate with 49 responded to a survey which was developed from literature review and evaluated by three scholars. After assessing CE-related knowledge and work experience, answers from 33 respondents qualified to be analyzed further. The survey asked about the respondents' background, familiarity with CE, evaluation (using 5-point scale rating) of tourism sector's adoption of CE and 29 measures based on relevant literature as well as their knowledge and comments about enabling and hindering factors of CE implementation in Phuket tourism.. In the first round of survey, participants were asked to rate the feasibility of various CE-oriented measures and identified enabling or constraining factors. The result from the first round of survey were used to identify participants whose answers significantly differed from the majority and asked in the second round whether they wanted to confirm or adjust their rating on the areas that were radically different from the others. In the second round, 9 participants were invited with 6 responded back.

2.3 Data Analysis

Average scores were calculated for each quantifiable item such as age, years of work experience and rating on the CE application potential. The study placed particular emphasis on dispersion metrics specifically, the interquartile range (IR) which signified consensus where $IR \leq 1.50$ indicated a high level of agreement, and the difference between the median and mode that was ≤ 1.00 suggested a high degree of consistency. Together, these criteria were used to interpret whether there was a genuine expert consensus on each CE measure. Qualitative data from the comments on enabling factors and barriers to CE implementation in Phuket tourism were analyzed contextually with frequency counts of topics and related themes.

3. Results and Discussion

Table 1. provides a summary of the expert evaluation on possible CE measures for sustainable tourism in Phuket after the two rounds of survey. In some cases, relatively high mean scores did not correlate with expert consensus on its feasibility, as indicated by high IR or a large difference between median and mode. Where both mean scores and consensus metrics were in alignment ($IR \leq 1.50$, median–mode difference ≤ 1.00), the CE measure was deemed highly feasible according to the participating experts.

Table 1. Evaluation of CE measures for Phuket tourism sector

No.	Measure	Mean	Median	Mode	Range	Feasibility	IR	Median-Mode Difference	Consensus
1	Promote the use of electric buses in public transportation	4.206	5.00	5.00	2	Highly feasible / mostly already in practice	1	0.00	Consistent
2	Integrate digital technology for tourism services	4.059	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
3	Promote the use of eco-friendly packaging	4.059	4.00	4.00	2	Highly feasible / partially in practice	1	0.00	Consistent
4	Encourage waste separation and recycling in tourism establishments	4.029	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
5	Promote the use of electric vehicles in the tourism sector	4.029	4.00	4.00	4	Highly feasible / partially in practice	3	0.00	Not consistent
6	Encourage electric vehicles for car rentals and private transport	3.971	4.00	5.00	4	Highly feasible / partially in practice	3	-1.00	Not consistent
7	Develop eco-friendly accommodations	3.912	4.00	5.00	3	Highly feasible / partially in practice	2	-1.00	Not consistent
8	Promote tourism activities that integrate the CE concept	3.765	4.00	4.00	3	Highly feasible / partially in practice	3	0.00	Not consistent
9	Introducing measures and mechanisms to reduce plastic usage in the tourism sector	3.706	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
10	Employ digital technology to measure, monitor, and optimize electricity and water	3.706	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent

No.	Measure	Mean	Median	Mode	Range	Feasibility	IR	Median-Mode Difference	Consensus
	usage in tourism establishments								
11	Implement carbon footprint reduction measures in tourism activities	3.706	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
12	Establish a network to collect discontinued items or equipment and forward them for reuse	3.676	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
13	Install solar farms (Solar Farm) to generate electricity for the tourism sector	3.676	4.00	4.00	4	Highly feasible / partially in practice	2	0.00	Not consistent
14	Minimize food and beverage waste	3.647	4.00	4.00	3	Highly feasible / partially in practice	1	0.00	Consistent
15	Establish a tourism supply-chain network to manage environmentally friendly operations	3.647	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
16	Create a secondhand marketplace for items from the tourism industry	3.618	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
17	Promote the use of electric trams for tourist services	3.618	4.00	4.00	3	Highly feasible / partially in practice	1	0.00	Consistent
18	Use digital technology to measure and monitor waste management in tourism establishments	3.588	4.00	5.00	3	Highly feasible / partially in practice	1	-1.00	Consistent
19	Develop new products using recycled waste	3.588	4.00	4.00	3	Highly feasible / partially in practice	1	0.00	Consistent
20	Form an agri-food supply chain for environmentally friendly raw materials in the tourism sector	3.588	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
21	Foster collaboration between tourism businesses and repair centers for damaged equipment	3.500	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent

No.	Measure	Mean	Median	Mode	Range	Feasibility	IR	Median-Mode Difference	Consensus
22	Install water-recycling systems in tourism establishments	3.471	4.00	4.00	3	Highly feasible / partially in practice	1.5	0.00	Consistent
23	Transition to circular-friendly business models, e.g., leasing appliances instead of purchasing	3.471	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
24	Design suitable, efficient public transport routes	3.441	4.00	4.00	3	Highly feasible / partially in practice	2	0.00	Not consistent
25	Promote the use of electric boats in the tourism sector	3.441	4.00	5.00	4	Highly feasible / partially in practice	2	-1.00	Not consistent
26	Generating electricity from hydropower for the tourism sector	3.118	4.00	4.00	4	Highly feasible / partially in practice	2.75	0.00	Not consistent
27	Install wind turbines (Wind Energy) to produce electricity for the tourism sector	3.088	3.00	4.00	4	Feasible / concept stage, not yet implemented	2	-1.00	Not consistent
28	Build a waste-to-energy power plant for direct supply to nearby tourist establishments	3.029	3.00	3.00	4	Feasible / concept stage, not yet implemented	2.75	0.00	Not consistent
29	Build a biomass power plant for direct supply to nearby tourism establishments	2.824	3.00	3.00	4	Feasible / concept stage, not yet implemented	2	0.00	Not consistent

Notes:

- IR = Interquartile Range (lower values indicate higher agreement)
- Median–Mode Difference ≤ 1.00 suggests close alignment of central tendencies
- Consensus indicates whether experts' opinions converged ("Consistent") or diverged ("Not consistent").

3.1 Interpreting Consensus on CE Strategies

Data from both Delphi method survey rounds confirmed that a high mean score alone does not represent the consensus on the practical feasibility of the CE measures. When IR exceeded 1.50 or the median–mode difference was greater than 1.00, notable divergence in the opinions was highlighted. Evaluating mean scores in conjunction with IR and the median–mode gap therefore offered more insights into implementation likelihood of each CE measure.

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3.2 High Potential CE Strategies

According to the expert consensus, seven CE strategies were highlighted with both high average scores and strong expert consensus namely (1) Utilising digital technology to track and manage waste; (2) Minimising food and beverage waste; (3) Creating products from recycled materials; (4) Installing water-recycling systems in tourism establishments; (5) Promoting eco-friendly packaging; (6) Implementing electric buses for public transport; and (7) Using electric trams for tourism services.

These measures are consistent with the findings in earlier studies about 7R: Reduction [3,5,9,10,11,12,13,14], Refurbish/Remanufacture [9,15,14], Reuse/Redistribute [5,9,11], Recycle [3,5,9,12,14], Redesign [3,9,13,14,15],

Rethink [3,9,11,14,15], and Replace [5,9,12,13] that underscore the importance of waste reduction, the use of renewable energy, and recycling in the service sector. Many international projects have already demonstrated the successful adoption of these approaches [5,16].

Key success factors and barriers for CE implementation in Phuket tourism frequently identified by the experts included (1) Knowledge and understanding about CE; (2) Awareness about environmental problems; (3) Policy and budgetary support; (4) Multi-sectoral collaboration; (5) Infrastructure; and (6) Responsible agencies for effective management of CE related initiatives. The study results align with the study of Cornejo-Ortega & Dagostino (2020) [6] which highlighted the importance of community and stakeholder knowledge and support for CE transition.

3.3 Feasibility of CE Adoption by Tourism Sub-sectors

Expert consensus indicates that different segments of the tourism industry in Phuket possess different levels of readiness and capacity for CE implementation. The evaluation of each tourism sub-sector readiness and enabling or barrier to CE adoption are summarized in Table 2.

Table 2. Evaluation of Phuket tourism sub-sector on CE adoption

Tourism sub-sector	CE Potential	Enabling factors	Barriers
Accommodations (Hotels, Resorts, Guesthouses)	High	Many large hotel chains already implement waste reduction and energy-saving measures	High initial costs of technology upgrades and renovating existing buildings
Food and Beverage Services	High	Many restaurants already cut back on plastic usage and procure local ingredients.	Lack regulatory incentives and penalties for waste generation
Creative Tourism and Tourist Attractions	Fair	Operators frequently promote environmental stewardship and local culture.	Certain sites may lack robust infrastructure for waste sorting or green mobility.
Support Services (tour operators, luggage transport, repair shops)	Moderate	Some knowledge transfer among operators already happen	Lack economic incentives especially for SMEs
Transportation	Unclear	Some operators have already used EVs	Substantial investment required for EVs and associated infrastructure
Recreational Activities	Unclear	Global market trends for environmental friendly services and products	Cost-sharing and product change can be challenging for established operators.

These results highlight the stakeholders in Phuket tourism with high capacity and readiness to adopt CE measures namely accommodation and food and beverage services. Many of them have already put in place waste reduction and recycling practices in their operations. For creative tourism attractions and supportive services, the potential for CE adoption is moderate and could be further promoted through infrastructure support and economic incentive especially for small businesses. Experts in the study showed mixed opinions about the CE potential for transport and recreational activity providers as they require high investment in infrastructure and substantial change in their business model and products.

3.4 CE Strategies with Strong Potential but Diverging Opinions

Certain CE measures, particularly those requiring large-scale infrastructure and substantial investment such as waste-to-energy plants, renewable energy projects received moderate to high mean scores but showed considerable disagreement among experts. While some regarded such initiatives as potentially yielding for environmental benefits, others were concerned about funding, management complications and community impacts. Such divergence implies high sensitivity and the need for careful planning with communicative participatory process before committing to full-scale implementation of these measures. Some projects are highly controversial and may face negative responses if consultation with local stakeholders is insufficiently.

4. Conclusions

To address research question one on which CE principles can be applied to Phuket tourism, seven measures emerged from expert consensus as follow:

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4. Conclusions

To address research question one on which CE principles can be applied to Phuket tourism, seven measures emerged from expert consensus as follow:

1. Digital Tools for Waste Management: This highlights the use of applications or digital platforms to monitor and reduce waste in an individual establishment as well as feeding into a database for policy planning at provincial level.
2. Food and Beverage Waste Reduction: The strategy encourages locally sourced, seasonal ingredients to reduce logistics and promoting biodegradable packaging as well as incentives and penalties to curb excessive food waste.
3. Upcycled or Recycled Products: This measure focuses on improving logistics for collecting recyclables and transforming them into marketable goods such as fabrics from recycled plastic bottles or compost from organic waste.
4. Onsite Water-Recycling Systems: This strategy promotes greywater recycling in hotels and resorts for gardening, landscaping or cleaning so that freshwater use can be reduced.
5. Eco-Friendly Packaging: This concept emphasizes on the use of biodegradable or recyclable packaging, for example, banana leaves or paper in order to reduce plastic pollution.

7. Electric Trams for Tourist Services: This initiative highlights the demand for light rail systems in Phuket to reduce road congestion and greenhouse gas emissions.

Although there were other CE strategies with high average score, they presented high variance among the experts which represent disagreement in their potential to be implemented in a reality. The reasons for the diverging viewpoint could be due to the need for further examination of the concept on technical and economic prerequisites. Projects involving large-scale infrastructure with high environmental and social impacts such as power plants from waste or renewable energy were deemed controversial and received mixed responses.

1. For research question two on the key enabling factors and barriers for implementing CE in Phuket tourism, 6 factors were identified as follow: CE Knowledge: A thorough understanding of CE principles by key stakeholders especially the policy makers and influential businesses is fundamental to the shift in the development direction and economic models that will allow for transition towards environmental sustainability.

2. Awareness on environmental crisis: Caring for nature and understanding the implications of the environmental problems on the economy and life-supporting systems is essential for stakeholders to commit to impactful measures.

3. Policy and Funding: Economic incentives such as tax reductions or subsidies and infrastructure investment by the government are central to promote CE adoption. This is especially important for SMEs with limited financial capital to invest in environmental solutions and innovation.

4. Multi-Stakeholder Collaboration: Collective vision and direction toward CE among local government, private businesses, and community groups are foundation for effective mobilization of activities to achieve clear objectives and ensure regular monitoring.

5. Infrastructure: Providing facilities for public transports will require investment from the government and effective landuse planning and zoning.

6. Responsible agencies: Having an agency to mobilize and monitor progress in CE implementation will help provide guidelines and directions for other stakeholders. This include the collection of data such as waste volumes, wastewater composition, and carbon emissions against the initiatives to provide evidence-based targets and improve the CE strategies to address pressing problems.

In conclusion, Phuket has a potential to become a 'circular tourism destination'. Many accommodation and tourism providers have already implemented environmentally-friendly practices and actively participating in sustainable tourism movement. Effective implementation of CE in Phuket tourism should focus on waste minimisation, reducing carbon emissions, and improving resource efficiency as these are the pressing problems in the area that need urgent actions.

This study is limited to the CE implementation in Phuket tourism from the evaluation of the experts in governmental agencies, business association and academics. Future study can investigate the perception and understanding of CE from the communities and business operators to provide comparison. A case study of businesses or operators which have adopted CE practices should also be considered to provide further insights into the detailed steps of CE transitioning at operation level.

5. Acknowledgements

The author expresses sincere gratitude to the Faculty of Technology and Environment at Prince of Songkla University Phuket Campus for the administrative support and the experts from governmental agencies, academia, the private sector, and civil society in Phuket who participated in the research.

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BRIDGING SDGS AND DIGITAL EDUCATION: A STUDY ON VALIDATED PEER ASSESSMENT MODELS IN HIGHER EDUCATION

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Abstract: This study investigates the effectiveness of participatory peer assessment in enhancing digital literacy skills among university students. The research employed a mixed-methods design involving 67 students from Physical Education and General Science programs over 15 weeks. Participants completed nine digitally-mediated collaborative tasks (e.g., Google Sites, Canva infographics) with integrated peer evaluations. The assessment instruments were validated by experts from three fields (Information Technology, Educational Measurement, and Curriculum & Instruction), yielding high reliability (mean = 4.39 on a 5-point scale). Quantitative analysis using complex number modeling ($a+bi$) demonstrated strong learning outcomes ($a = 0.89-0.98$) and positive engagement ($b = 0.11-0.42$). Qualitative sentiment analysis of open-ended feedback revealed enhanced critical thinking and collaborative skills. The findings support SDGs 4 (Quality Education) and 8 (Decent Work), highlighting how technology-enhanced peer assessment can promote sustainable learning. While results show promise, discipline-specific variations suggest need for further adaptation across academic domains.

Keywords: digital literacy, peer assessment, expert validation, sustainable learning, technology-enhanced education

1.Introduction: In today's digital era, technology integration in education has made digital skill development essential. This research addresses this need by creating interactive learning models that align with higher education's requirement to develop digital literacy and collaborative skills, supporting both SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure). This Research Framework aligns with SDG. The research implements an interactive learning model where students develop digital skills through collaborative activities using tools like Canva, Google Sites, Google Forms and Google Drive. This approach evaluates the effectiveness of digital assessment forms while contributing to SDG 4's goal of inclusive, quality education. Weekly group activities foster teamwork and peer assessment opportunities, creating a participatory learning environment.

The peer assessment process creates a collaborative atmosphere where students receive peer feedback for continuous improvement. This connects directly to analyzing the relationship between assessment methods and SDGs, as collaborative work and creative assessment align with SDG 9's focus on innovation and capacity development.

This innovative approach develops both technological and workplace skills—collaboration, communication, and constructive assessment—providing insights for participatory assessment guidelines in the ASEAN context. The model demonstrates how institutions can implement sustainable practices that prepare students for the digital economy while promoting inclusive education across the region.

1.1. Digital Literacy and Peer Assessment in Higher Education

The integration of digital literacy skills in higher education is essential for preparing students for the demands of the digital workforce. As digital technologies become increasingly prevalent in both academic and professional settings, equipping students with the necessary skills to navigate these tools is critical. This integration not only enhances student engagement but also fosters critical thinking and collaborative learning, ultimately improving academic performance and employability [1-2]. Recent studies emphasize that participatory peer assessment not only enhances technical competencies but also fosters critical thinking and collaborative skills [3-4]. The current study builds on this foundation by implementing a structured peer assessment model using digital tools (Google Docs, Canva, AI platforms), aligning with Panadero et al.'s [5] findings that discuss various factors that influence peer assessment, which can indirectly relate to metacognitive processes. However, discipline-specific variations in digital literacy adoption remain understudied, particularly between physical education and science students - a gap this research addresses.

1.2 Technology-Enhanced Assessment and Sustainable Learning

The integration of educational technology and sustainable pedagogy has gained increasing importance through frameworks linking digital tools to SDG 4 (Quality Education) and SDG 9 (Industry, Innovation). Technologies such as dynamic geometry software and adaptive learning platforms significantly improve student engagement and critical thinking skills in mathematics education [6]. Dash & Panigrahi [7] emphasize promoting educational resilience through Technology Enhanced Learning (TEL) in higher education, aligning with SDG 4 for quality education, while highlighting the need for skilled workforce development and integrating digital tools to enhance educational quality and innovation in India. Adaptive e-learning systems can customize learning experiences according to individual learner needs, preferences, and performance data [8], with these systems capable of utilizing complex number modeling to represent performance (real part) and satisfaction (imaginary part), providing a comprehensive view of learner engagement. Research indicates that learner satisfaction significantly impacts the efficacy of adaptive learning systems [9], and factors such as self-efficacy, clarity of materials, and mentor support are critical in influencing both performance and satisfaction [10]. The application of complex number modeling helps educators visualize and analyze how these factors interact, leading to improved learning outcomes. Our methodology apply complex number modeling. This approach provides new insights into how digital assessment tools can be optimized for different academic disciplines while supporting sustainable education goals.

2.1 Research Design

This research employs a Mixed Methods approach, integrating quantitative and qualitative analyses to evaluate nine digital assessment tools. The quantitative component utilizes Complex Number Analysis ($a+bi$), where a represents assessment efficiency derived from scores, while the qualitative component applies Sentiment Analysis to interpret open-ended feedback. This dual approach ensures a comprehensive assessment of both numerical performance and emotional tone in student responses.

Phase Angle (θ) is a metric used in complex number analysis to quantify the relationship between two orthogonal components (real and imaginary parts) of a complex number. In this research, it measures the balance between quantitative performance (a) and qualitative sentiment (b) in digital learning assessments.

Formula for Phase Angle Calculation for a complex number is $z=a+bi$, where a is normalized performance score (real part) and b is average sentiment score (imaginary part).

The phase angle (θ) is calculated as

$$\theta = \tan^{-1} \left(\frac{b}{a} \right) \text{ in radians) or } \theta = \arctan \left(\frac{b}{a} \right) \text{ . degrees)$$

2.2 Sample Group

The sample group consists of 45 Physical Education majors and 22 General Science majors, with data collected over 15 weeks using nine digital assessment forms. These forms were systematically developed, validated by experts, and tested to ensure reliability. The extended data collection period allows for robust analysis of learning patterns and tool effectiveness across different disciplines.

2.3 Research Tools

The research methodology incorporates nine digital assessment instruments (Forms 1-9) and a Python-based analytical framework that integrates Sentiment Analysis (VADER) with Complex Number Analysis. Additionally, the study employs a comprehensive evaluation protocol wherein assessment forms are validated by experts from three disciplinary domains: Information Technology, Educational Measurement, and Curriculum & Instruction.

2.4 Data Analysis

Data analysis combines Complex Number Analysis and Sentiment Analysis to map assessment efficiency (a) and feedback sentiment (b) as $z = a + bi$. This approach enables phase angle analysis to measure qualitative-quantitative balance. Results are visualized on the complex plane.

3. Research Results

From data analysis using Complex Number Analysis ($a+bi$) and Sentiment Analysis from 9 forms, the following interesting results were found: The mathematical interpretation shows an average real part (a) of 0.95 ± 0.03 (reflecting operational efficiency according to evaluation criteria) and an average imaginary part (b) of 0.22 ± 0.09 (reflecting positive attitudes from feedback). The spatial pattern (Complex Plane) is shown in Figure 1.

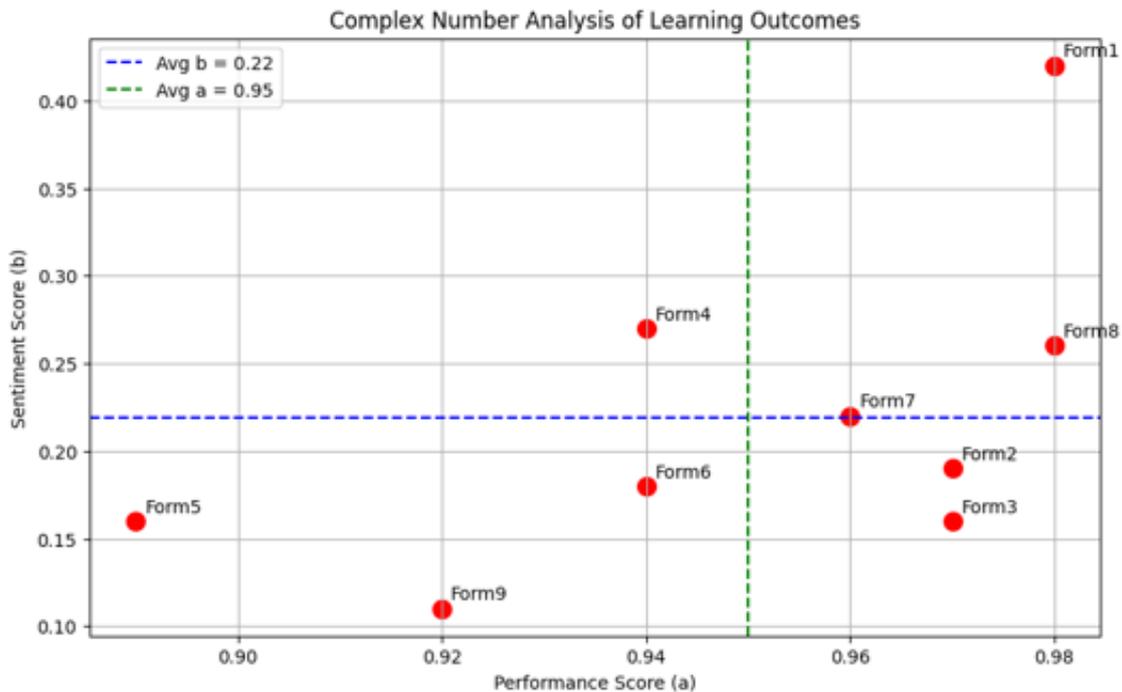


Figure 1 Complex Number Analysis of Learning Outcomes from 9 forms

Table 1 The analysis of performance versus satisfaction trends

Form	Assessment Focus	a (Performance)	b (Sentiment)	Phase Angle (θ)	Key Findings
1	Basic Digital Tools (Google Docs)	0.98	0.42	23.2°	Highest performance and satisfaction
2	Digital Literacy Fundamentals	0.97	0.19	11.1°	High performance but moderate engagement
3	Digital Citizenship	0.97	0.16	9.4°	Strong performance, lower satisfaction
4	Online Communication	0.94	0.27	16.0°	Balanced results
5	Graphic Design (Canva)	0.89	0.16	10.1°	Technical challenges evident
6	Collaborative Tools	0.94	0.18	10.8°	Steady performance
7	Website Development	0.96	0.22	12.9°	Good overall results
8	Video Production	0.98	0.26	14.9°	High achievement
9	Advanced Digital Tools	0.92	0.11	6.8°	Significant satisfaction gap

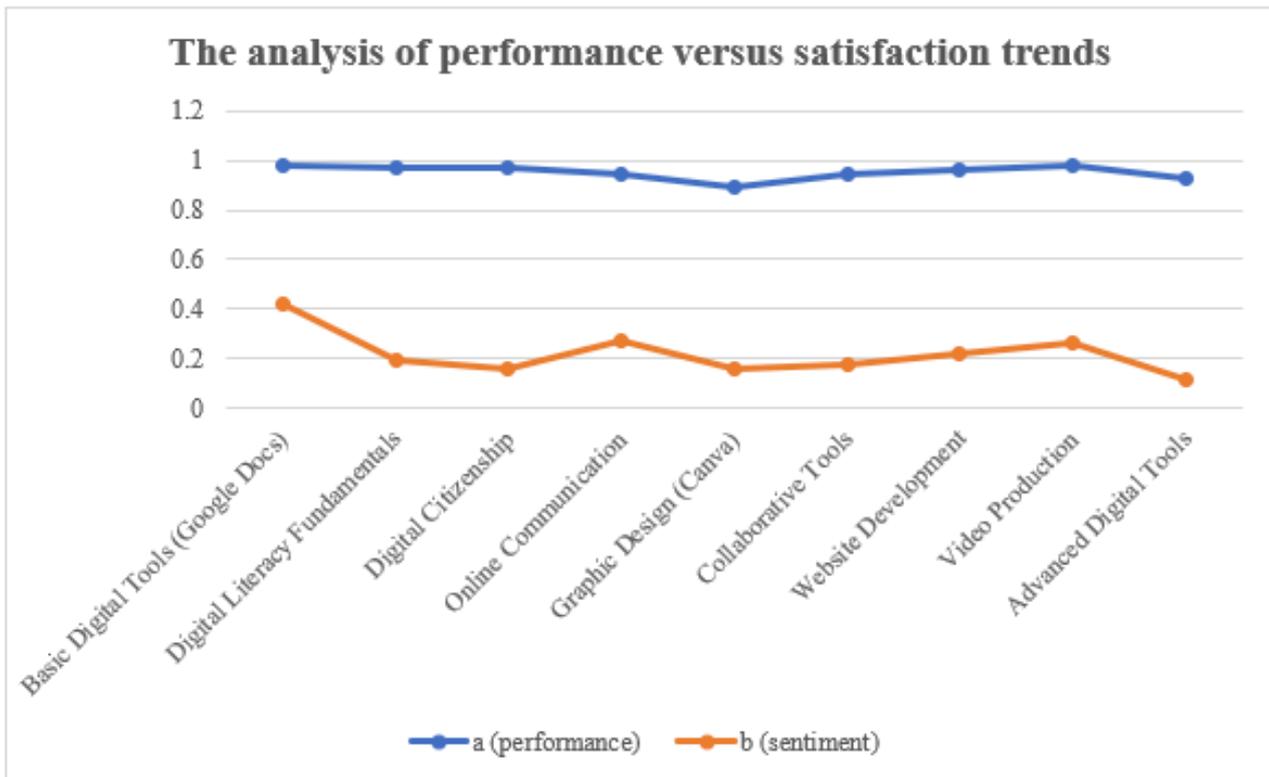


Figure 2 The analysis of performance versus satisfaction trends

Table 1 and Figure 2 show the analysis of performance versus satisfaction trends which reveals two distinct patterns: Forms 1, 7, and 8 demonstrate the best balance between high performance ($a > 0.95$) and strong satisfaction ($b > 0.22$), as evidenced by their favorable phase angles ranging from 12.9° to 23.2°, while Forms 5 and 9 present a concerning disparity where maintained high performance ($a > 0.89$) contrasts sharply with significantly lower satisfaction levels ($b < 0.16$), resulting in notably reduced phase angles of just 6.8° to 10.1°, suggesting that while students could complete advanced tasks successfully, they experienced substantial dissatisfaction with these more complex digital tools.

The tool-specific analysis reveals clear differences between basic and advanced digital tools: basic tools (Forms 1-4) showed consistently high performance (0.94-0.98) with moderate-to-high satisfaction (0.16-0.42), demonstrated by well-aligned phase angles (9.4°-23.2°), while advanced tools (Forms 5, 9) exhibited a noticeable satisfaction drop (particularly with AI tools and Google Sites, where Form 9 showed $b = 0.11$) despite maintained high performance, indicating that while students could competently complete advanced tasks, they experienced significantly lower satisfaction levels with these more complex digital tools.

The cluster analysis identified three distinct learner groups: High Achievers (35%) demonstrated excellent performance ($a = 0.95 \pm 0.02$) and satisfaction ($b = 0.38 \pm 0.05$), excelling in all tasks while showing particular comfort with basic digital tools; Moderate Performers (50%) maintained respectable performance ($a = 0.88 \pm 0.03$) but showed limited satisfaction ($b = 0.12 \pm 0.07$), struggling especially with advanced features and requiring additional support for AI integration; while Low Achievers (15%) displayed both low performance ($a = 0.72 \pm 0.05$) and negative satisfaction ($b = -0.08 \pm 0.04$), needing fundamental digital literacy support and exhibiting frustration across all tool types, highlighting significant challenges in their digital learning experience

The study highlights three crucial findings regarding tool complexity, pedagogical implications, and research contributions: basic digital tools like Google Docs demonstrated optimal performance-satisfaction balance ($\theta = 23.2^\circ$), while advanced tools such as AI and Google Sites revealed significant satisfaction gaps ($\theta = 6.8^\circ$) despite maintained performance, underscoring that foundational skills must be solidified before introducing complex tools and that advanced tools require additional instructional scaffolding - the phase angle metric proves particularly valuable for identifying at-risk learning activities. These results make important research contributions by demonstrating how complex analysis uncovers hidden digital learning challenges, providing a quantifiable evaluation method through phase angles, and offering actionable curriculum design insights that emphasize progressive skill development and targeted support for advanced tool integration.

This analysis provides a comprehensive understanding of the experimental results while offering practical recommendations for improving digital literacy instruction. The phase angle metric proves particularly valuable for identifying where pedagogical interventions are most needed.

4. Conclusions

This study successfully developed a data-driven assessment model integrating complex function analysis and machine learning to evaluate digital competencies in interactive learning environments. By analyzing data from multiple cohorts using nine digital assessment forms, our approach effectively measured key competencies including responsibility, engagement, organization, and digital literacy. The complex number framework allowed for simultaneous evaluation of quantitative performance and qualitative sentiment, providing a comprehensive view of student learning experiences across various digital tools.

The findings revealed distinctive patterns in student engagement across different technological platforms, with foundational tools generating higher participation rates while advanced applications highlighted areas requiring additional instructional support. This multi-dimensional assessment approach bridges educational theory with computational analytics, offering valuable insights for curriculum development and pedagogical practice.

Our model demonstrates clear alignment with Sustainable Development Goals, particularly in advancing quality education and technological innovation. Future research should expand the sample to include diverse academic disciplines to enhance reliability, while the development of an automated platform for real-time assessment represents a promising direction for practical implementation in educational settings.

This framework ultimately provides educators with a more nuanced understanding of digital learning assessment, supporting evidence-based decision making that can enhance educational outcomes while promoting sustainability principles in educational innovation.

5. Acknowledgements

Thank you to the Academic Affairs and Learning Division, Office of Thaksin University, for supporting the project to develop teaching innovations for the fiscal year 2025 (round 1) under the project on "Innovation in Interactive Learning: Digital Skill Development through Group Assessment". Thank you to the course managers for giving the researcher the opportunity to participate in teaching the Digital Way and Learning course to both groups of learners. And thank you to the two pilot groups of learners for helping the researcher try out the innovations to see the initial results of use this time.

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THE DEVELOPMENT OF LEARNING OUTCOMES IN RESEARCH METHODOLOGY AND RESEARCH DESIGN SKILLS OF THIRD-YEAR STUDENTS USING RESEARCH-BASED LEARNING

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Abstract: This research aims to study the learning outcomes of research methodology and research project design skills through research-based learning for third-year students in the Modern Trade and Service Innovation program at the Faculty of Economics and Business Administration, Thaksin University. The study involved 10 regular third-year students enrolled in the Research Methodology and Business Research Practice courses under the Asst. Prof. Dr. Wilawan Jansri in the second semester of the 2023 academic year. The research tools included: 1) a lesson plan for research-based learning activities (4 hours over 16 weeks); 2) an assessment of learning outcomes; and 3) an evaluation of research design skills. The statistical analysis used the mean and standard deviation. Results showed that students' learning outcomes in research methodology were excellent, with an average percentage of 83.31%. Specifically, 60% of students achieved an excellent score, and 40% achieved a good score. Regarding research design skills, the overall skills of the students were rated highly, with a mean score of 4.44 and a standard deviation of 0.55. Most students exhibited high skills in research methodology design.

Keywords: Research-Based Learning, Learning Outcomes, Research Methodology, Research Design Skills

1.Introduction: Research methodology courses in higher education, especially in business research, emphasize assessing student achievement through the integration of knowledge in research methodology and research courses. These courses require students to develop a comprehensive research proposal, particularly focusing on the background and significance of the research problem. Researchers must demonstrate the necessity and importance of the research, answering why the study is essential and outlining the approach for investigation. This is typically structured within the introduction, including the background, objectives, research hypotheses, and definitions of key terms [8].

However, teaching these courses has faced challenges in recent years. Traditional lecture-based instruction and the heavy use of programs and textbook readings have led to disengagement among students. The course, which integrates various theories and principles, demands substantial reading, research, and writing skills. As a result, students often lose interest, leading to higher dropout rates, especially since they struggle to complete their research proposals.

Students tend to have difficulty selecting appropriate research topics and writing coherent proposals, often failing to define research objectives aligned with the identified problem. Literature reviews are also commonly incorrect, and research frameworks fail to match the research questions. Furthermore, students often rely on irrelevant research studies for their conclusions, highlighting a gap in their understanding of the research process. This issue has resulted in the need for frequent revisions in their proposals.

To address these challenges, enhancing students' research skills through Research-Based Learning (RBL) has been proposed. RBL focuses on involving students directly in research processes, helping them understand the research framework through practical experience. RBL fosters critical thinking, problem-solving, and independent learning, essential skills for the 21st century [12]. It aligns with the student-centered learning approach and enhances learners' abilities to apply knowledge to real-world problems, preparing them for future challenges.

Thus, Research-Based Learning is seen as an effective method for developing research skills, creating opportunities for students to learn through research projects, and supporting innovation and creativity. Implementing RBL can significantly improve students' engagement and academic performance in research courses, especially in fields like business research.

1.1 Research Objectives

This study aims to:

1. Investigate the impact of Research-Based Learning on students' learning outcomes in research methodology.
2. Assess the improvement of students' research design skills after implementing Research-Based Learning.
3. Evaluate the effectiveness of RBL in fostering students' analytical and problem-solving abilities in research.
4. Identify key challenges and best practices in applying RBL in higher education research courses.

1.2 Research Hypotheses

This study is based on the following hypotheses:

- H1: The learning outcomes of third-year students in research methodology will significantly improve after using Research-Based Learning.
- H2: The research design skills of third-year students will be significantly enhanced through the implementation of Research-Based Learning.

1.3 Research Scope

The target group consists of 10 regular third-year students in the Modern Trade and Service Innovation program, Faculty of Economics and Business Administration, Thaksin University, who are enrolled in the Research Methodology and Business Research Practice course under Asst. Prof. Dr. Wilawan Jansri in the second semester of the 2024 academic year.

Eligibility Criteria for Sample Selection

1. Both male and female participants.
2. Enrollment in the Research Methodology and Business Research Practice course under Asst. Prof. Dr. Wilawan Jansri in the second semester of the 2024 academic year.
3. Ability to read, listen, and write in Thai.
4. Willingness to participate in the research.

Exclusion Criteria

Participants may withdraw from the study once the researcher has explained the purpose and scope of the research. If participants are unable to participate in the activities during the designated period, they are free to decline or withdraw from the research at any time without any consequences or loss of benefits.

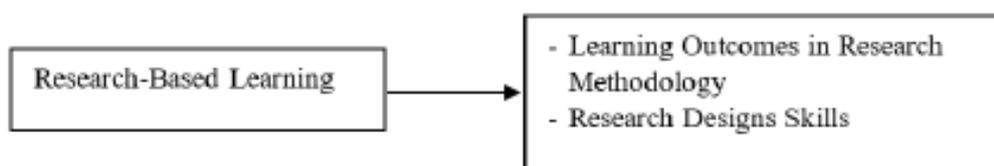
- **Study Period:** The research was conducted over one academic semester.
- **Research Variables:**
 - Independent Variable: Research-Based Learning (RBL).
 - Dependent Variables: Learning outcomes in research methodology and research design skills.

1.4 Expected Benefits

The findings of this study are expected to contribute in several ways:

- **For Students:**
 - Enhance critical thinking and research problem-solving abilities.
 - Improve understanding and application of research methodologies.
- **For Educators:**
 - Provide insights into effective teaching strategies for research courses.
 - Support the development of engaging research-based curricula.
- **For Institutions:**
 - Serve as a model for implementing RBL in similar programs.
 - Foster a culture of research and inquiry among students.

1.6 Theoretical Framework of the Research



2. Literature Review

2.1 Learning Outcomes

[2] defined academic achievement as the results of teaching, learning, training, or experiences in various environments, including school and home. These outcomes encompass knowledge, skills, abilities, values, and ethics, which can be measured through tasks, test scores, grades, or observations. Effective assessments should be valid, reliable, fair, and specific, with the ability to discriminate and measure different levels of achievement.

[14] also described academic achievement as the knowledge, skills, and abilities gained through both teacher-led and self-directed learning, which can be assessed using psychological tools or academic tests. Panja Chuchuay (2008) emphasized that academic achievement results from personal effort and

2.2 Research Skills

Research skills, as defined by [19], are the expertise in acquiring knowledge and truth through scientific methods and thinking, while selecting the appropriate research methods. [17] described research skills as activities focused on investigating knowledge and truth, solving problems, and answering questions. This includes forming hypotheses, reviewing related theories, collecting data, and synthesizing findings to generate new knowledge.

These skills encompass systematic thinking, analytical thinking, data analysis, and problem-solving, all aimed at generating new knowledge. Teachers today must possess research skills to improve teaching methods and enhance student learning. According to [3,6,16,5], nine essential research skills include: defining research problems, studying relevant theories and literature, establishing research frameworks and hypotheses, designing research, defining populations and samples, creating and assessing research tools, collecting data, analyzing data, and interpreting research findings. In summary, research skills enable the ability to explore knowledge and address teaching-related problems by using scientific methods from problem definition to the generation of new insights [11].

2.3 Research-Based Learning

This study adopted the concept of Research-Based Learning (RBL). RBL is a teaching technique that promotes self-generated knowledge creation, crucial for 21st-century education. It encourages student-centered learning and supports research as part of the learning process. It helps students gain real-world experience, develop thinking skills, management skills, and problem-solving abilities, ultimately preparing them for a knowledge-based society. Research-based learning also provides lifelong learning tools, especially through direct research experience, which leads to deep and meaningful learning [1].

[11,7] proposed four RBL models: 1) Using the research process in teaching, 2) Involving students in research projects, 3) Teaching by reviewing research studies, and 4) Using research findings to teach content. This approach supports critical thinking, problem-solving, and knowledge acquisition. It aligns with the idea that teaching methods should enable students to conduct research, solve problems, and think analytically, thus fostering self-directed learning.

[4] communication research, specifically on the literature review. The results indicated that students in the third year of the Bachelor of Communication Arts program at Nakhon Ratchasima Rajabhat University had significantly higher academic achievement after using research-based learning (RBL) compared to before, with statistical significance at the 0.05 level.

[12] studied the impact of research-based learning on promoting 21st-century learning skills and innovation among graduate students in teacher training programs. The findings revealed that the overall level of students' 21st-century learning skills and innovation was high ($\bar{x}= 4.24$, S.D. = .46), in line with the hypothesis. The highest average score was found in critical thinking and problem-solving skills ($\bar{x}= 4.41$, S.D. = .49), followed by communication and collaboration skills ($\bar{x}= 4.20$, S.D. = .47). The lowest average score was found in creativity and innovation skills ($\bar{x}= 4.15$, S.D. = .57).

[4] studied research-based learning and its effect on academic achievement and learning behavior in the course of mass communication research, specifically on the literature review. The results indicated that students in the third year of the Bachelor of Communication Arts program at Nakhon Ratchasima Rajabhat University had significantly higher academic achievement after using research-based learning (RBL) compared to before, with statistical significance at the 0.05 level.

2.5 Research-based Learning and Research Design Skills

The study by [10] revealed that research-based learning enhanced the research competencies of students in the Graduate Diploma in Teaching Program. Most students demonstrated excellent research skills, and the quality of their research work was also rated highly. This approach helped students develop systematic thinking and plan every step of their research, leading to improved research skills and higher-quality research outcomes.

According to the study by [18] project-based learning facilitated students in the industrial vocational education program to improve their research capabilities. The students exhibited a high level of competence in research, and their learning outcomes in the research methodology course were significantly higher after the course. They also expressed a high level of satisfaction with the learning activities.

The research by [9] demonstrated that research-based teaching activities improved the research abilities of graduate students. The study found that students achieved satisfactory to excellent results in research learning, research skills, and the quality of their research work. The students also had positive feedback on the research-based learning activities and developed systematic thinking, analytical skills, and collaborative work, which ultimately enhanced their ability to create and share research findings.

3. Materials and Methods

3.1 Research Design

This study adopted a quasi-experimental research design to examine the development of research design skills among third-year undergraduate students through a research-based learning (RBL) approach. The intervention was implemented in the "Research Methodology and Business Research Workshop" course during the second semester of the 2024 academic year at the Faculty of Economics and Business Administration, Thaksin University. The participants were ten students enrolled in the Modern Trade and Service Innovation Program.

3.2 Instruments and Development

Three main instruments were used:

1. Instructional Plan: Designed using RBL principles, the 16-week instructional plan (4 hours/week) aimed to promote systematic thinking and active participation. It was validated by experts for content accuracy and appropriateness using the Index of Item-Objective Congruence (IOC), followed by revisions based on expert feedback.

2. Research Design Skill Assessment: This rubric-based instrument evaluated students' ability to develop a complete research proposal, covering key components such as research title, objectives, scope, theoretical framework, methodology, and references.

3. Learning Outcome Assessment: A learning achievement test and an analytic rubric were used to measure students' understanding of research methodology and the quality of their research proposals. A total score of 30 points was converted to 100%, with a minimum passing grade set at C.

Instrument validation followed these steps: literature review, expert validation ($IOC \geq 0.50$), pilot testing with a different group ($n = 30$), and calculation of reliability using Cronbach's alpha ($\alpha \geq 0.70$).

3.3 Data Collection Procedures

The instructional process followed the PAOR (Plan–Act–Observe–Reflect) action research cycle:

- Plan: The researcher developed a semester-long instructional design grounded in RBL theory.
- Act: Weekly sessions (4 hours each) were conducted over 16 weeks. Students engaged in hands-on research activities under guided instruction.
- Observe: Data were collected through performance assessments, focusing on students' progress in research proposal development using pre-designed rubrics.
- Reflect: Weekly reflective discussions allowed students to present their work, receive peer feedback, and engage in shared learning. Insights gained were used to revise instructional strategies.

3.4 Data Analysis

The data were analyzed using both qualitative and quantitative methods:

- Instrument Quality: Content validity (IOC \geq 0.50) and internal consistency (Cronbach's alpha \geq 0.70) were calculated to ensure the reliability of the tools.
- Descriptive Statistics: Mean scores and standard deviations were used to summarize students' performance in research skills and learning outcomes, based on analytic rubric evaluations.

Table 1: Interpretation of Learning Outcome Scores Compared to Course Grades

Grade Symbol	Description	Score Range (%)
A	Excellent	80–100
B+	Very Good	75–79
B	Good	70–74
C+	Fairly Good	65–69
C	Fair	55–64
D+	Poor	50–54
D	Very Poor	40–49
E / F	Fail	0–49

Table 2: Interpretation of Average Scores for Research Design Skills

(Adapted from Boonchom Srisaard, 2023)

Average Score Range	Level of Research Design Skill
4.51 – 5.00	Highest
3.51 – 4.50	High
2.51 – 3.50	Moderate
1.51 – 2.50	Low
1.00 – 1.50	Lowest
Below 1.00	Not Applicable / No Skill Indicated

4. Results and Discussion

Results

This table summarizes the general demographic information of the research participants, all of whom are female, third-year students in the Modern Commerce and Service Innovation program, with a total sample size of 10 students. 4o mini

Table 3: Demographic Information of Research Participants

Demographic Information	Number (n)	Percentage (%)
Gender	Female	10
Field of Study	Modern Commerce and Service Innovation	10
Year of Study	3 rd Year	10
Total		10

Table 4: Learning outcomes of Research Methodology using research-based learning for 3rd year students, with the interpretation criteria based on percentage scores: 80% and above is considered Excellent, and 70% to 79% is considered Good.

Student No.	Total Score (30)	Percentage	Interpretation
1	22	73.33%	Good
2	24	80.00%	Excellent
3	22	73.33%	Good
4	22	73.33%	Good
5	28	93.33%	Excellent
6	28	93.33%	Excellent
7	28	93.33%	Excellent
8	28	93.33%	Excellent
9	22	73.33%	Good
10	26	86.67%	Excellent
Total	244	83.31%	Excellent

From Table 4, it can be observed that the learning outcomes for the Research Methodology course using research-based learning for 3rd year students are generally at an **Excellent** level, with an average percentage of 83.31%.

Table 5 : presents the study of research project design skills using research-based learning management among third-year students in the Modern Trade and Service Innovation program, Faculty of Economics and Business Administration, Thaksin University. The interpretation criteria for average scores are as follows: a mean score of 4.51 and above indicates the highest skill level, while a mean score between 3.51 and 4.50 indicates a high skill level.

Skill Item	Mean Score	Standard Deviation	Interpretation
Title	4.60	0.49	Highest Skill Level
Research Significance	4.20	0.75	High Skill Level
Objectives	4.40	0.49	High Skill Level
Definition of Terms	4.40	0.49	High Skill Level
Research Framework	4.40	0.80	High Skill Level
Research Scope	4.60	0.49	Highest Skill Level
Expected Benefits	4.20	0.40	High Skill Level
Related Theories and Research	4.60	0.49	Highest Skill Level
Research Methodology	4.80	0.40	Highest Skill Level
Bibliography	4.20	0.75	High Skill Level
Overall	4.44	0.55	High Skill Level

The overall results show that the students possess research project design skills at a high level, with an average score of 4.44 and a standard deviation of 0.55. The majority of students demonstrated the highest skills in designing research methodology, with an average score of 4.80. The next highest skills were observed in the areas of title selection, research scope, and related theories and research, each with an average score of 4.60. Skills in writing objectives, definitions of terms, and research framework had an average score of 4.40. Finally, skills in research significance, expected benefits, and bibliography had an average score of 4.20.

5. Discussion

Research Findings on Teaching Research Methodology and Developing Research Proposals Using a Research-Based Learning Approach

The previous teaching approach divided research proposal components among five lecturers, each responsible for specific topics. After theoretical lectures, students developed their proposals and sought feedback from chosen advisors. However, the course faced a high withdrawal rate, averaging 37%, mainly because students struggled to complete their proposals. This challenge stemmed from the course's complexity and students' varying levels of foundational research skills.

To address this, the researchers redesigned the course into a four-week module with weekly lectures and in-class assignments on proposal development. The instructor provided individual consultations and feedback both during class and through online channels (e.g., email and LINE). This approach aimed to better support students and improve completion rates by addressing diverse learning needs.

Details of Lectures and Assigned Tasks:

1. Lecture on Business Research Overview:

This lecture focuses on the significance of conducting research in business management. It introduces interesting and reliable information sources for data collection. Students will summarize their research findings in a table designed by the instructor, identify research topics of interest, and present them to peers in class. They will also submit the research tables to the instructor for topic approval, which will guide the next steps of their work.

2. Writing the Introduction (Problem Background, Objectives, Benefits, Research Scope, and Definitions), and Citation of References and Bibliography:

Once the research topics of interest have been approved by the instructor, the next lecture will focus on writing the introduction. This is a key area where many students struggle, particularly in defining the research problem and aligning the research objectives. Inadequate objectives often lead to failure in the course.

After the lecture and writing techniques, students will write the introduction in class, based on information gathered in the first week. They will submit their drafts on time for the instructor's review, feedback, and revisions until the drafts meet the required standards.

3. Literature Review and Theoretical Framework:

After submitting the introduction and receiving feedback, the instructor will give a lecture on reviewing literature and identifying relevant theories to establish a research framework. The lecture will cover the importance of literature reviews, sources of information, research ethics, plagiarism, citation practices, and bibliography writing. Afterward, students will conduct in-class exercises and continue developing their work outside of class. They will have individual consultation sessions with the instructor, arranged through email or group messaging (LINE), for further guidance.

Once the lectures and assignments are completed, each student will have a three-chapter research proposal. However, further revisions will be needed to ensure accuracy and completeness. During this period, students will continue to develop their work with continuous support from the instructor. After all students have submitted their work, a group session will be held where students present their proposals, exchange feedback, and prepare for the final presentations.

Throughout the 16-week course, students were highly engaged and motivated, actively scheduling meetings with the instructor to refine their work. All groups submitted their work on time and successfully passed the research methodology course with a 100% success rate.

The research findings will present a discussion in two key areas: Learning outcomes in research methodology and research design skills from research-based learning for third-year students in the Modern Trade and Service Innovation program. The details are as follows:

1. Learning Outcomes in Research Methodology using Research-Based Learning for Third-Year Students: The overall learning outcomes in research methodology through research-based learning for third-year students showed an excellent level, with a percentage of 83.31%. This can be attributed to the fact that research-based learning enables students to engage in hands-on research, following the planned steps of the research process each week. The training enables students to develop critical thinking skills, guided by the instructor, which leads to problem-solving through logical reasoning. This aligns with [15] study on factors influencing learning and innovation skills for 21st-century students at Dusit Thani College, which found that overall learning and innovation skills were at a high level. This is consistent with the findings of [12], who studied the impact of research-based learning on learning skills and 21st-century innovation skills for graduate students in the teacher certification program. Their research indicated that research-based learning significantly enhanced learning skills and innovation, aligning with the findings of [4], who investigated research-based learning in communication studies. Their study found significant improvements in students' achievement in media research courses, as measured by pre- and post-test scores.

2. Research Design Skills using Research-Based Learning for Third-Year Students: The study of research design skills through research-based learning for third-year students in the Modern Trade and Service Innovation program at Thaksin University found that, overall, students exhibited a high level of research design skills, with a percentage of 4.44. The students demonstrated the strongest skills in designing research methodology (4.80), followed by skills in titling, defining research scope, theories, and related research (4.60). Skills in writing objectives, definitions, and research frameworks had an average percentage of 4.40, while skills related to the significance, expected benefits, and bibliography had an average of 4.20. This research-based learning process, planned over four weeks, enabled students to apply their skills in practice with continuous guidance and feedback from the instructor. As a result, all ten students exhibited strong to excellent research design skills and successfully completed their research proposals on time. This finding aligns with the study by [10], who investigated research-based learning for enhancing research competencies among students in the teacher certification program at Lampang Rajabhat University. Their study found that students' research competencies were rated highly, especially in research execution skills, with most students producing high-quality research work. Similarly, [18] studied project-based learning to enhance research capabilities in industrial engineering students and found significant improvements in their research competencies, as well as high satisfaction with the overall learning activities.

6. Conclusions

The research-based learning method for the research methodology course for third-year students in the Modern Commerce and Service Innovation Program was implemented.

The learning outcomes of the students, based on the research-based learning approach in the field of research methodology, were compared to the standard criteria from the study's results. The learning outcomes were assessed using two main components: a learning achievement assessment test (30%) and a research project design skills assessment (50%). The results are as follows:

The learning outcomes in research methodology for the third-year students, using the research-based learning method, showed that the overall learning outcomes were at an excellent level, with a percentage score of 83.31%.

The study on research p

roject design skills using the research-based learning method for third-year students in the Modern Commerce and Service Innovation Program at the Faculty of Economics and Business, Thaksin University, found that the overall students' research project design skills were at a high level, with a mean score of 4.44. The majority of students demonstrated the highest skills in designing research methodology, with an average score of 4.80. The next highest skills were observed in the areas of title selection, research scope, and related theories and research, each with an average score of 4.60. Skills in writing objectives, definitions of terms, and research framework had an average score of 4.40. Lastly, skills in research significance, expected benefits, and bibliography had an average score of 4.20.

7. Acknowledgements

The authors would like to express their sincere gratitude to the Faculty of Economics and Business Administration at Thaksin University for the support and opportunity to conduct this research. Special thanks are also extended to all third-year students in the Modern Trade and Service Innovation Program who participated in this study. Their cooperation and engagement made this research possible.

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STUDY OF SKILLS IN USING THE EXPRESS ACCOUNTING SOFTWARE AND LEARNING BEHAVIOR BASED ON SIMULATED SITUATIONS IN THE ACCOUNTING SOFTWARE COURSE FOR THIRD-YEAR UNDERGRADUATES

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Abstract: This research aims to study the skills in using the Express accounting software through simulation scenarios, comparing the teaching before and after using the simulation scenarios with the skills in using the Express accounting software and the learning behavior in the Express accounting software course. The sample group consists of third-year undergraduates majoring in Accounting, Faculty of Economics and Business Administration, Thaksin University, Semester 2, Academic Year 2024, totaling 75 students, selected by purposive sampling. The statistics used include arithmetic mean, standard deviation, and sample t-test, with a statistical significance level of 0.05. The research findings indicate that 1. Students had a high level of skill in using the Express accounting software before the simulation, and after the simulation, their overall skills increased. 2. Students exhibited excellent learning behavior before using the simulation-based learning and maintained good learning behavior after using the simulation. 3. Students who were taught using simulation scenarios showed no significant difference in their skills in using the Express accounting software before and after the instruction. 4. Learners who studied through simulations showed no significant difference in learning behavior before and after using the simulations, indicating an improvement in teaching with more realistic simulations. Develop content and learning activities to be more realistic by using case studies that closely resemble real-life situations in practice to enhance direct experiences for learners. This approach includes incorporating interactive learning, using techniques such as Problem-Based Learning (PBL) or Case-Based Learning (CBL) alongside simulations.

Keywords: simulation-based methods, accounting software, learning behavior, and the Express accounting program.

1.Introduction: In an era where technology and business operations are changing rapidly, the use of accounting software has become an essential skill for modern accountants. To achieve proficiency, these skills require not only theoretical learning but also practical experience. Using simulations in classroom teaching is a method that can effectively fill this gap. Simulation is an effective tool for teaching and learning, focusing on creating realistic scenarios that help students practice skills and knowledge in contexts that closely resemble reality. The use of simulations in teaching can help students have a more intense and engaging learning experience. Additionally, it allows students to develop problem-solving skills, decision-making abilities, and the application of knowledge in situations similar to real life effectively. The use of simulations in teaching has become widely popular across various fields such as medicine, engineering, business administration, and education. In the field of medicine, simulations help medical students practice patient care skills in a safe environment before engaging in real-world practice (Kneebone, 2005). In the field of engineering, simulations allow students to experiment and analyze complex engineering systems without incurring high costs (Alessi & Trollip, 2001). Additionally, simulations are used in business administration education to help students practice decision-making skills in environments of risk and uncertainty (Faria & Wellington, 2004).

The benefits of using simulations in teaching allow students to fully engage in the learning process, which enhances understanding and memory. They practice problem-solving in a safe environment and can apply the skills acquired to real-life situations. They can develop skills and test new ideas without worrying about the risks that may arise in real situations. Studies on the use of simulations in teaching have also demonstrated several benefits, such as enhancing content understanding, developing analytical thinking skills, and promoting collaborative learning among students (Gredler, 1996). However, using simulations in teaching still presents challenges, such as designing realistic simulations, assessing learning outcomes from simulations, and using appropriate technology. For this reason, research and development of the use of simulations in teaching are important to ensure they can be effectively applied in various educational and training contexts.

In a rapidly changing business environment, the ability to use accounting software is considered an essential skill for modern accountants. Having theoretical knowledge alone is not sufficient. Accountants need practical experience and hands-on training to develop expertise in using accounting software effectively. Scenario-Based Learning (SBL) has been adopted as an effective teaching method to fill this gap in accounting education. SBL involves creating realistic, interactive scenarios that mimic real-life situations. In the context of teaching accounting software, SBL allows students to interact with simulated business scenarios and practice using accounting software in a safe and controlled environment. This method provides students with a diverse learning experience, allowing them to apply theoretical knowledge, develop practical skills, and build confidence in using accounting software through carefully designed simulations. Students will encounter various accounting entries, financial reporting requirements, and diverse business challenges. They will be able to practice data entry, create reports, analyze financial data, and learn to navigate the complexities of accounting software, just as they would in a real work environment. Such virtual experiences not only enhance technical skills but also help develop analytical thinking, problem-solving, and decision-making abilities.

From the organization of the course 0702335 Accounting Software, which aims to enable students to prepare financial reports and present useful information to users, it was taught in the second semester of the 2023 academic year using the Express software manual along with case studies in the manual as part of the teaching materials and exercises for learners to practice. In the third semester of 2023, the same group of students interned at a business establishment that uses the Express accounting software in real work. Interviews with students, business owners, and internship supervisors provided consistent information regarding the use of the Express accounting software for recording accounting transactions. Students still face difficulties in analyzing transactions from real documents used in the establishment, determining the type of each document, and deciding which menu to use for recording transactions. This session differs from the exercises used in the previous semester's teaching, as the exercises provided were already analyzed and included menu usage instructions prepared by the software vendor.

From past research on the problems and obstacles of using accounting software, the issue is the lack of practical experience with the software. For example, Sudinpreeda (2020, pp. 2802) suggested that students should develop professional skills in accounting software that align with the current practical use in workplaces. To aim for future innovative accountants, it is recommended to incorporate real documents in case studies so that students can practice accounting entries as if they were real transactions. According to Srisawangwong (2018, pp. 59) The learning outcomes from activities aimed at developing digital technology skills for managing learning, using a set of practice exercises with accounting software before and after learning, can stimulate students to think critically and express their opinions. Additionally, they can solve various problems that arise in scenarios set by the instructor accurately and appropriately. Students begin to engage more in the teaching and learning process, which results in significantly higher test scores and academic achievements after learning compared to before, at a significance level of 0.05.

Therefore, the researcher has the idea of modifying the teaching process by using simulation-based scenarios to develop accounting software skills in the classroom. This approach emphasizes the potential to transform how students learn and apply these essential skills in the real world. It involves using actual documents from businesses as exercises in teaching instead of using exercises from company manuals. This practice not only helps students achieve better academic results and prepares them for the job market but also enhances the necessary expertise for accountants in the digital age, developing problem-solving and decision-making skills.

2. Materials and Methods

This study is a quantitative research. The researcher has conducted the research according to the following format.

2.1.1. Literature review

The use of simulations in teaching is a concept that has been continuously studied and developed across various disciplines. This concept is rooted in Kolb's (1984) Experiential Learning, which emphasizes learning from experience and reflecting on that learning. This principle is particularly important in contexts where practicing skills in a safe and controlled environment is essential. Simulation is defined as the creation of a virtual environment that mimics real-life situations or processes, allowing students to practice and develop necessary skills without facing real risks. (Gaba, 2004). Simulation in teaching can be divided into several types, including physical simulations, computer simulations, and social simulations (Bradley, 2006).

The method of teaching through simulation is a process where the instructor helps learners achieve the specified learning objectives by having them engage in a role-playing scenario with roles, information, and rules that reflect reality. Learners interact with various elements within that scenario using data that closely resembles real-life information to make decisions and solve problems. These decisions will affect the players in the same way as they would in a real situation. Teaching through simulation has several: 1) It is a teaching method that helps learners understand complex relationships. 2) This teaching method greatly engages learners in the learning process. Students learn in a fun and enjoyable way. 3) It is a teaching method that provides learners with the opportunity to practice various processes, such as interpersonal interaction, communication, decision-making, problem-solving, and thinking processes, among others. (Kaemmani, 2019).

Simulation-Based Learning (SBL) has gained significant popularity in accounting education as an innovative method to enhance student engagement and understanding of complex accounting principles. SBL integrates real-world scenarios into the learning environment, providing students with practical experience and promoting critical thinking skills. The integration of scenario-based learning (SBL) in accounting software education is considered a significant advancement in teaching strategies, aimed at enhancing students' practical skills and understanding of complex software tools. Despite its many advantages, the implementation of SBL in accounting education also presents several challenges. According to Albrecht and Sack (2000), one of the main obstacles is the high cost of developing and maintaining simulation software. Institutions must invest in technology and training to ensure effective implementation, which can be a significant financial burden. Additionally, Greenstein and McKee (2004) point out that integrating SBL into traditional accounting curricula requires significant changes in teaching methods and assessment strategies. Instructors need to be adequately trained to facilitate SBL activities and accurately assess students' learning outcomes.

In previous research studies, it has been found that using virtual simulation in teaching and learning is an effective strategy for developing students' skills in various fields. For example, Thammakitphairoj et al. (2023) found that using virtual simulation can effectively enhance critical thinking among nursing students. Meanwhile, Chaiyathongsri (2020) studied the development of listening and speaking skills in English among 9th-grade students and found that using simulations significantly improved communication skills. Additionally, Nakorn (2019) indicated that organizing learning activities using simulations along with multimedia helps learners effectively learn English for daily use. Therefore, the researchers have the idea of modifying the teaching and learning process by using simulations as a basis for organizing learning in the course on using accounting software to reflect the development of skills in using accounting software and learning behaviors. The study aims to lead to the development of teaching methods appropriate to the course content, as well as suitable teaching development approaches.

2.1.2. Research framework

This research is a quantitative study. Research and collect data from various documents and studies, including theories, concepts, and research related to the study of skills in using the Express accounting software and learning behaviors based on simulations in the accounting software course for third-year undergraduates, to improve the research framework as follows.

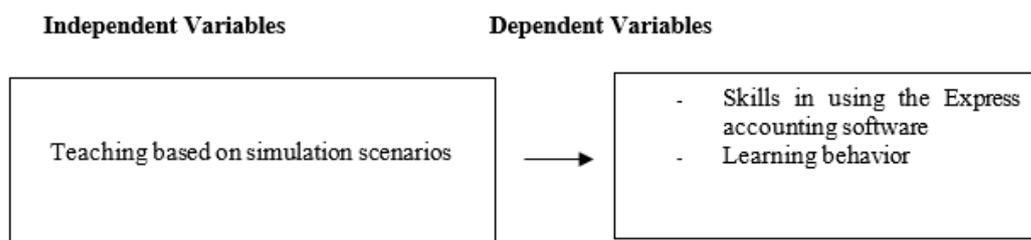


Figure 1. Research Framework

2.1.3. Research hypothesis

1. Teach both before and after using simulations. Have different skills in using the Express accounting software.
2. Teaching before and after using simulations There are different learning behaviors in the Express Accounting Software course.

2.1.4. Population and sample

The population and sample used in this study consisted of 75 third-year undergraduates majoring in Accounting from the Faculty of Economics and Business Administration, Thaksin University, Songkhla Campus, for the second semester of the 2024 academic year, collected through purposive sampling.

2.1.5. The research tools

The research tools consist of a questionnaire developed based on the research framework, theories, and related studies. The questionnaire comprises three distinct parts. Part 1: Regarding the skills in using the Express accounting software Part 2: Regarding learning behavior in the accounting software course Section 3: Comments and Suggestions

The assessment of proficiency in using the Express accounting software adheres to the following Likert Scale criteria.

Skill level usage	Score weight
Excellent	4
Good	3
Moderate	2
It Should be improved	1

By interpreting the meaning of the average, the criteria are as follows (Srisawat, 2003, pp. 162).

Average score range	Meaning
3.26 - 4.00 points	Excellent proficiency level
2.51 - 3.25 points	Good proficiency level
1.76 - 2.50 points	Adequate proficiency level
1.00- 1.75 points	Ability level needs improvement

Measuring behavior levels in the accounting program course uses the Likert Scale evaluation criteria as follows.

Behavioral level	Score weight
Excellent	4
Good	3
Moderate	2
Should be improved	1

By interpreting the meaning of the average, the criteria are as follows (Srisawat, 2003, pp. 162).

Average score range	Meaning
3.26 - 4.00 points	Excellent behavior level
2.51 - 3.25 points	Good behavior level
1.76 - 2.50 points	Moderate behavior level
1.00- 1.75 points	Behavior level needs improvement

2.1.6. Quality inspection of the questionnaire

The researcher developed and improved the questionnaire by having three academics and accounting experts review its content validity. The criterion was that the Item-Objective Congruence (IOC) value should be between 0.50 and 1.00, indicating acceptable validity. The IOC values for each item in the questionnaire ranged from 0.67 to 1.00, which are greater than or equal to 0.50, indicating they are acceptable. Then, the revised questionnaire, based on the experts' recommendations, was tested on a non-sample group of 30 participants to determine the reliability of the questionnaire using the Cronbach Alpha Coefficient. The skill in using the Express accounting software had a reliability value of 0.885, the level of learning behavior in the accounting software course had a reliability value of 0.872, and the overall reliability value was 0.902, with an acceptable value being 0.7 or higher. (Tabers, 2018)

2.1.7. Data collection

This research was conducted using a questionnaire in the form of a Google Form, with students answering the questionnaire twice, with each round consisting of 75 copies.

1. Have the students complete the questionnaire after practicing with the exercises in the program manual from the vendor.
2. Have the students complete a questionnaire after practicing with the actual document-based exercises provided for their studies.
3. Conduct a verification of the accuracy and completeness of the questionnaire for processing.

2.1.8. Data and statistical analysis used

The researcher analyzed the received data using statistical software, employing descriptive statistics such as the mean and standard deviation. Analyze the skills in using the Express accounting software and the learning behaviors in the course on Express accounting software. The comparative statistics used inferential statistics, including the sample t-test for comparative analysis and hypothesis testing of the skills in using the Express accounting software before and after using the simulation, as well as the learning behavior in the Express accounting software course before and after using the simulation.

3. Results and discussion

3.1 Results

Table 1. Shows the skill levels in using the Express accounting software.

Ability to use the Express program	Before using the situation (N=75)			After using the situation. (N=75)		
	\bar{X}	S.D.	meaning	\bar{X}	S.D.	meaning
Input accuracy	3.19	0.65	good	3.23	0.56	good
Data Analysis	2.96	0.67	good	3.13	0.55	good
Speed of action	2.96	0.76	good	3.08	0.73	good
Understanding of programming functions	2.99	0.69	good	3.12	0.64	good
Overall	3.02	0.60	good	3.14	0.51	good

From Table 1, it was found that students had skills in using the Express accounting software before the simulation, overall at a good level, with an average ($= 3.02$, S.D.= 0.60). When considering each aspect, it was found that the accuracy in data entry had the highest average, at a good level ($= 3.19$, S.D.= 0.65). Next is the aspect of understanding the program's functions, which is at a good level ($= 2.99$, S.D.= 0.69). The aspect of data analysis is at a good level ($= 2.96$, S.D.= 0.67), and the aspect of operational speed is at a good level ($= 2.96$, S.D.= 0.76), respectively.

After the implementation of the situation, it was found that the students' overall skills in using the Express accounting software were at a good level ($= 3.14$, S.D.= 0.51). When considering the various aspects, it was found that the accuracy of data entry had the highest average, at a good level ($= 3.23$, S.D.= 0.56). Next is the aspect of data analysis, which is at a good level ($= 3.13$, S.D.= 0.55). Next is the aspect of understanding program functions, which is at a good level ($= 3.12$, S.D.= 0.51), and the aspect of speed in execution, which is also at a good level ($= 3.08$, S.D.= 0.73), respectively.

Table 2. Shows the levels of learning behavior in the accounting program

Course Behavior	Before using the situation (N=75)			After using the situation. (N=75)		
	\bar{X}	S.D.	meaning	\bar{X}	S.D.	meaning
Participation in class	3.45	0.64	Excellent	3.44	0.60	Excellent
Collaboration with others	3.43	0.60	Excellent	3.40	0.62	Excellent
Attention to learning	3.37	0.59	Excellent	3.39	0.59	Excellent
Ability to solve problems	3.13	0.62	Good	3.13	0.70	Good
Answering Questions	3.13	0.64	Good	3.01	0.67	Good
Overall	3.30	0.50	Excellent	3.27	0.53	Excellent

From Table 2, it was found that the learning behavior in the accounting program before the use of the situation was, overall, at an excellent level ($= 3.30$, S.D.= 0.50). When considering each aspect, it was found that the aspect of class participation had the highest average, at an excellent level ($= 3.45$, S.D.= 0.64). Next is the aspect of working with others, which is at an excellent level ($= 3.43$, S.D.= 0.60), and the aspect of attentiveness to learning, which is also at an excellent level ($= 3.37$, S.D.= 0.59). In terms of answering questions, the level is good ($= 3.13$, S.D.= 0.62), and in terms of problem-solving ability, the level is also good, which is ($= 3.13$, S.D.= 0.62), respectively.

After the implementation of the situation, it was found that overall, the students' learning behavior was at a good level ($= 3.27$, S.D.= 0.53). When considering each aspect, it was found that the aspect of class participation had the highest average, at an excellent level ($= 3.44$, S.D.= 0.60). Next is the aspect of working with others, which is at an excellent level ($= 3.40$, S.D.= 0.62). The aspect of attentiveness to learning is at an excellent level ($= 3.39$, S.D.= 0.59). In terms of problem-solving ability, it is at a good level ($= 3.13$, S.D.= 0.70). And in the area of answering questions, the average score is the lowest but still at a good level ($= 3.01$, S.D.= 0.67).

Table 3. compares the skills in using the Express accounting software before and after using the simulation.

Skills in Using	N	\bar{X}	S.D.	df	t	P
Before use	75	3.02	0.60	74	1.527	.131
After use	75	3.14	0.51	74	1.527	.131

$P < 0.05$

From Table 3, the analysis results show that students who learn through simulations have skills in using the Express software for accounting that are no different before and after use.

Table 4. Compares the learning behavior in the Express Accounting Program course before and after the use of simulations.

Learning Behavior	N	\bar{X}	S.D.	df	t	P
Before use	75	3.30	0.50	74	-0.412	.682
After use	75	3.27	0.53	74	-0.412	.682

$P < 0.05$

From Table 4, the analysis results show that students who learned using simulations exhibited no difference in their learning behavior in the Express Accounting Software course before and after use.

Hypothesis test results

1. Teach both before and after using simulations. Students do not exhibit different skills when using the express accounting software.

2. Teaching before and after using simulations There are no different learning behaviors in the express accounting software course.

3.2 Discussion

1. The study results indicate that the students have skills in using the Express accounting software. The use of simulations was at a good level ($= 3.02$, $S.D.= 0.60$) and after using the simulations, overall skills increased to ($= 3.14$, $S.D.= 0.51$), reflecting a positive trend in simulation-based learning (SBL) in accounting education. Kolb's (1984) Experiential Learning Theory (ELT) can explain simulation-based learning. ELT focuses on direct experience (Concrete Experience) and learning through reflective observation (Reflective Observation) before coming up with abstract ideas (Abstract Conceptualization) and testing them in real-life situations (Active Experimentation). The research findings align with this concept, as learners who underwent simulation training were able to strengthen their skills in using accounting software, particularly in data entry accuracy, which was at a good level with minor errors that were easily corrected, and data analysis, which was also at a good level with some data omissions. The results of this research align with the aforementioned concept, as students who underwent simulation training were able to strengthen their skills in using accounting software, particularly in terms of data entry accuracy, which was at a good level with minor errors that were easily correctable, and data analysis, which was also at a good level, although some data might have been overlooked. Consistent with the findings of Gammie and Joyce (2014), the use of SBL in accounting education helps students develop practical skills and theoretical knowledge more effectively, particularly decision-making and problem-solving skills. This aligns with the study by Apostolou et al. (2013), which found that learning through simulations enhances students' ability to use accounting software, resulting in increased confidence and work efficiency. Similarly, Thammakitphairoj et al. (2023) found that the use of virtual simulations improves critical thinking among nursing students, supporting the idea that SBL stimulates analytical thinking and problem-solving in realistic environments. This conclusion is consistent with the findings of this study, where learners were able to develop data analysis skills using the Express accounting program. Additionally, Chaiyathongsri (2020) and Nakorn (2019) found that the use of simulations can effectively develop communication skills and content understanding. The study demonstrates that learning through simulations can be applied in various contexts, including the development of professional accounting skills. It is evident that the use of simulations helps improve learners' skills in accounting software. Therefore, educational institutions should consider incorporating SBL into accounting curricula to better prepare students for real-world work. This approach includes designing activities that promote experiential learning and providing opportunities for students to practice using accounting software through case studies and simulations that closely resemble real work environments.

2. The study found that students exhibited excellent learning behavior ($= 3.30$, $S.D. = 0.50$) before the use of scenario-based learning and having good learning behavior ($= 3.27$, $S.D. = 0.53$) After using the simulation, particularly in terms of class participation and teamwork, which had the highest average, there was consistent engagement and involvement in learning. The students showed special interest and enthusiasm, indicating the effectiveness of teaching that promotes interactive learning. While they answered questions correctly, some responses lacked detail. Additionally, their problem-solving skills were mostly self-sufficient, but some problems required guidance, resulting in a lower average. Such an outcome indicates certain limitations of the simulation-based learning that need further improvement. The study found that students participated and were able to work well in teams. However, the low average scores in problem-solving and answering questions indicate that students may not have yet developed reflective thinking and conceptualization skills, which are essential components of applying theoretical knowledge to new situations. In line with Kolb's (1984) concept Simulation-Based Learning (SBL) is based on the Experiential Learning Theory, which consists of four stages: Concrete Experience, Reflective Observation, Abstract Conceptualization and Active Experimentation in line with the study by Thammakitphairoj et al. (2023), it was found that the use of virtual simulations significantly enhances students' critical thinking skills. Our research findings support this idea, as students scored high in classroom participation and teamwork. However, our study found that questioning and problem-solving skills still need further development, which may reflect the differences in the types of skills that simulations can develop. This conclusion is consistent with the studies by Chaiyathongsri (2020) and Nakorn (2019), which examined the use of simulations in developing language skills. They found that learning through simulations significantly improved academic achievement, aligning with our study's findings that simulations can stimulate student engagement. However, the differences in academic disciplines may affect the learning styles. In the context of accounting, analytical thinking and problem-solving skills are more important than mere memorization or language use. This assertion is inconsistent with the study by Pengsuk (2022), which examined the use of simulations in developing problem-solving skills in teacher education students and found that simulations significantly enhanced problem-solving skills. According to the study's results, which found that students' problem-solving skills are still at a moderate level, it is possible that the structural factors of the simulations and the nature of the problems used in the teaching of the accounting program have not yet been designed to sufficiently stimulate deep analytical thinking. The study results indicate that learning through simulations can effectively promote student engagement and teamwork. However, the moderate average scores in problem-solving and answering questions indicate the need for additional teaching strategies to develop analytical thinking and decision-making skills. Promote deep thinking processes by integrating Problem-Based Learning (PBL) or Case-Based Learning (CBL).

3. The study found that learners taught using simulation scenarios showed no significant difference in their skills in using the Express accounting software before and after the instruction. This aligns with Kolb's (1984) concept of experiential learning, which states that effective learning must consist of multiple components, not just simulation scenarios, but also reflection and the application of concepts in different environments. This conclusion is inconsistent with the findings of Thammakitphairoj et al. (2023), which found that the use of virtual simulation scenarios could develop nursing students' critical thinking abilities. This discrepancy may be due to the different nature of the learning content, as nursing education may require more analytical thinking compared to accounting software learning, which primarily focuses on operational skills. It is also inconsistent with the findings of Gammie and Joyce (2014), which found that simulation-based learning helps develop practical skills and enhances understanding of accounting theory. This study may indicate that the use of simulation scenarios alone is insufficient; additional components, such as feedback from instructors or extra practice outside the classroom, are necessary to stimulate and support learners' learning. This highlights the importance of designing simulation scenarios to be more realistic and connected to actual work situations, as well as integrating other learning techniques, such as assigning tasks based on real situations, to enhance the necessary skills. This study may indicate that the use of simulations alone is insufficient. Additional components are necessary, such as feedback from instructors or extra practice outside the classroom, to stimulate and support learners' education. The result highlights the importance of designing simulations to be more realistic and connected to actual work situations, as well as integrating other learning techniques, such as assigning tasks based on real scenarios, to enhance the required skills.

4. The study found that learners who engaged in simulation-based learning showed no significant difference in their learning behaviors before and after using simulations. This conclusion is inconsistent with the findings of Chaiyathongsri (2020) and Nakorn (2019), who found that simulation-based learning significantly improved English communication skills. Language learning might require more interaction and continuous practice than learning accounting software, which may explain why accounting students' learning behaviors were not affected by simulations. This conclusion is also inconsistent with the findings of Pengsuk (2022), who found that simulation-based learning significantly improved problem-solving skills among teacher education students.

The difference in results may be due to the fact that teacher education requires practical training that emphasizes systemic thinking and direct problem-solving, making simulations more impactful in this context than in accounting software courses. Additionally, this is not in line with the findings of Apostolou et al. (2013), who found that simulation-based learning increased student engagement and supported active learning, particularly in developing accounting technology skills. This finding highlights the importance of developing teaching techniques that can stimulate learner engagement, such as using interactive case studies.

4. Research recommendations

1. Improve teaching with more realistic simulations. According to the study results, it was found that using simulations helps improve skills in using the Express accounting program in some areas, but it has not yet significantly affected learning behavior. It is advisable to consider developing content and learning activities to be more realistic by using case studies that closely resemble real-life situations in practice to enhance direct experience for learners.

2. Enhancing interactive learning: Since students' question-answering and problem-solving behaviors are still at a moderate level, it is advisable to incorporate learning activities that encourage more interaction among students. For example, using Problem-Based Learning (PBL) or Case-Based Learning (CBL) techniques along with simulations can help students practice analytical thinking and problem-solving in more complex contexts.

3. Develop teaching methods appropriate to the nature of accounting content. The study found that learning through simulation did not significantly enhance skills in using accounting software, which may reflect the need for different teaching methods compared to other fields, such as language or teacher training. Therefore, the teaching and learning process should be designed to emphasize repetitive practice and personalized feedback, allowing learners to continuously develop their skills.

4. The integration of technology to enhance learning should involve the development of supplementary platforms such as e-learning or virtual labs, which allow learners to practice using the Express accounting program independently outside the classroom and receive guidance or feedback through automated systems. Such an approach will help increase opportunities for learning and skill development.

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FOSTERING PEACE AND STRONG INSTITUTIONS THROUGH HAPPINESS ENGINEERING AND MEDITATION: A CASE STUDY OF THAKSIN UNIVERSITY'S SUSTAINABLE EDUCATION MODEL

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Abstract: This case study explores how Thaksin University's courses Happiness Engineering and Meditation for Life Development align with SDG 16 (Peace and Strong Institutions) by cultivating mindfulness and leadership skills. Launched in 2023, these courses emphasize self-development, social awareness, and ethical responsibility, reflected in their learning outcomes. Initial enrollment reached 290 and 280 students respectively, but participation declined when volunteer mentors became scarce, highlighting institutional sustainability challenges. Using a qualitative approach (student feedback, course evaluations, and participatory observation), the study reveals: 1. Peace building: Students reported enhanced emotional regulation and interpersonal skills through mindfulness practices. 2. Institutional Gaps: Dependence on volunteer mentors exposed vulnerabilities in long-term course delivery. 3. Contextual Barriers: Lower enrollment at Phatthalung Campus (10% of initial numbers) suggested regional adaptation needs. The study proposes two collaborative solutions: 1. Structural Support: Replacing volunteers with trained instructors and digital tools (e.g., Mind Power Bank). 2. Curriculum Integration: Embedding happiness and meditation modules across disciplines to institutionalize peace education. Findings underscore the need for adaptive educational models that balance individual well-being and institutional resilience to achieve sustainable development goals.

Keywords: sustainable education, peace pedagogy, institutional adaptation, mindfulness training, participatory learning

1.Introduction: Achieving the Sustainable Development Goals (SDGs), especially SDG 16 which focuses on peace and strong institutions, requires educational approaches that promote intelligence, social awareness, and ethical responsibility [1]. In this context, universities worldwide have begun integrating mindfulness and leadership development curricula into education systems to foster skills essential for creating peaceful societies [2]. Multiple studies indicate that mindfulness practice can help reduce stress, enhance emotional regulation, and develop conflict resolution skills, all of which are crucial components of peacebuilding [3].

Thaksin University designed the "Happiness Engineering" and "Meditation for Life Development" courses in 2023 to promote four core competencies: Knowledge, Skills, Ethics, and Characteristics in response to SDG 16, focusing on self-development and creating public consciousness. The learning outcomes reference conceptual frameworks aligned with Goleman's [4] emotional intelligence, Kabat-Zinn's [3] mindfulness and life development, and Lederach's [5] peacebuilding through education. However, the curriculum implementation faced sustainability challenges due to over-reliance on volunteer mentors, resulting in a noticeable decrease in student participation (from initial enrollments of 290 and 280 students, dropping to 288 and 273 students respectively in the first two weeks). Additionally, contextual adaptation remains a critical issue, as the Phatthalung campus had only 10% of the initial enrollment to compare with Songkhla campus, reflecting the need to design curricula that align with regional needs.

This study employs qualitative research methods, analyzing student feedback, curriculum evaluations, and participatory observations to address three main questions: (1) How does the curriculum promote peacebuilding through emotional and social skills development? (2) What institutional gaps affect curriculum sustainability? and (3) What contextual barriers need to be addressed? The findings highlight the necessity of adapting educational models to be more flexible and reliant on institutional resources, such as replacing volunteer mentors with trained instructors and utilizing digital tools (like the Mind Power Bank platform), as well as integrating happiness and mindfulness content into various disciplinary curricula to create sustainable peace education [6].

2. Materials and Methods

The objective of this research paper is to study the effects of the courses "Happiness Engineering" (HEG) and "Meditation for Life Development" (MLD) on developing inner peace and collaborative skills, and to propose an educational management model that strengthens educational institutions through community participation (volunteers);

The courses "Happiness Engineering" and "Meditation for Life Development" are elective subjects at Thaksin University within the B.Ed. in Science and Technology curriculum, Computer Science and Computational Science major, under the Faculty of Education which produces graduates in collaboration with the Faculty of Science and Digital Innovation. These courses aim to develop 21st century skills, particularly Leadership Skills such as Flexibility, Adaptability, and Social Responsibility, which are essential components of peacebuilding according to Lederach's (2005) approach, through practical activities divided into 3 learning levels. These are

1. Individual Level (consistent with Module Learning Outcome MLO1-2): Practicing mindfulness through walking meditation and sitting meditation to develop physical and mental health

2. Social Level (consistent with Module Learning Outcome MLO3): Transferring skills to communities through social service projects

3. Institutional Level (consistent with Course Learning Outcomes CLOs): Designing happiness and meditation programs that align with local contexts

This paper proposes conceptual framework, integrates Participatory Learning and Holistic Development Foundational Theories include 1. Sustainable Happiness and Participatory Learning; and 2. Institutional Resilience through volunteer mentoring systems. Indicators include Peace to reduced stress, conflict management skills; and Strong Institutions, volunteer participation rates, curriculum sustainability. However, the implementation faces three key challenges. These are

1. System Sustainability due to over-reliance on volunteer mentors (as there is no compensation, relying on retired volunteer mentors with public consciousness to supervise students' classroom activities)

2. Spatial Inequality, especially at the Phatthalung campus where enrollment is only 10% compared to the initial number of enrolled students at the Songkhla campus (thus focusing on teaching primarily at the Songkhla campus)

3. Empirical Measurement as some outcomes (such as social spirit) are difficult to assess. What approaches could increase the number of volunteers who value participating and helping society willingly without expecting compensation?

The sample group are undergraduate students from Thaksin University, Songkhla and Phatthalung Campuses (approximately 1,261 students from data collected over 4 semesters from academic years 2023 and 2024).

Research Tools consist of

1. Standard Survey Forms for satisfaction assessment, these are teaching evaluation forms from the university's academic affairs department.
2. Student Registration Data for pass/withdrawal rates.
3. Applications and Practice Logs for in-depth data.
4. Google Forms for weekly student evaluations.

This study employs a Mixed Methods Research approach to evaluate the effectiveness of the curriculum between 2023-2024 as follows:

Quantitative Data Collection consists of

1. **Surveys** from the university's academic affairs department that have students evaluate teaching after completing the course. The Happiness Engineering course was first offered in academic year 2023, semester 1, with 288 students (290 registered in the first week), totaling 648 students across 4 semesters. The Meditation for Life Development course started with 273 students (280 registered in the first week), totaling 613 students across 4 semesters.

2. Components that contribute to **students' weekly** scores include the aggregate data of walking meditation and sitting meditation practice recorded in the Mind Power Bank application to monitor consistency in meditation practice in the Meditation for Life Development course. For the Happiness Engineering course, instructors evaluate results from mindfulness practice logs that don't use mobile devices, practiced three times daily for 5 minutes each, and emotion awareness records for 3 months (recognizing current emotional levels by entering awareness levels and being able to describe or express feelings in a Google form).

3. In the Meditation for Life Development course, each week the instructor has students play quiz games as a **Pre-test** using the Kahoot platform and tests knowledge after class by having students answer written questions in the classroom, with students taking turns grading each other as a classroom exercise. Then the group representatives record scores for members as part of peer assessment, but the instructor evaluates the representatives to verify accuracy. For the Happiness Engineering course, students evaluate their learning through tests in TSU-MOOCs, while maintaining the system of group representatives recording scores for members as part of peer assessment, with the instructor evaluating the representatives to verify accuracy.

Qualitative Data Collection consists of

1. **In-depth Interviews** based on expressions of feelings about learning outcomes and changes experienced, through essay writing and answering 4 questions (Who recommended this course to you?, What have you learned?, How have you changed after taking this course?, Who would you recommend this course to?) by expressing feelings through video clips.

2. **Participatory Observation** in classes from weeks 1-15.

3. **Analysis of Reflective daily practice records** from the Mind Power Bank application in the Meditation for Life Development course. For the Happiness Engineering course, instructors evaluate results from mindfulness practice and emotion awareness records for 3 months (recognizing current emotional levels by entering awareness levels and being able to describe or express feelings in a Google form).

In order to analyse data, we use **descriptive statistics** for quantitative data focusing on average scores and satisfaction levels and **content analysis** for qualitative data.

3. Results and Discussion

3.1 Results

The results of Happiness Engineering course evaluation for 4 semesters as shown in Table 1, while Meditation for Life Development (MLD) course evaluation for 4 semesters as shown in Table 2. The comparative descriptive analysis of Happiness Engineering and Meditation for Life Development course as shown in Table 3 which presented the key metrics comparison of Happiness Engineering and Meditation for Life Development. In addition, the correlation analysis in Table 4 shown Pearson's r values for both courses.

results of Happiness Engineering course evaluation for 4 semesters as shown in Table 1, while Meditation for Life Development (MLD)s Engineering and Meditation for Life Development. In addition, the correlation analysis in Table 4 shown Pearson's r values for both courses.

Table 1. Happiness Engineering course evaluation for 4 semesters

Happiness Engineering: Results for 4 Semesters					
S101: Studied at Songkhla, P101: Studied at Phatthalung, begin 2566-1: Academic Year 2566, Semester 1					
Evaluation Criteria	(1) Satisfaction Percentage				
	Academic Year				
	2566-1	2566-2	2567-1	2567-1	2567-2
	S101	S101	P101	S101	S101
1. Overall satisfaction with the teaching and learning management of the "Happiness Engineering" course	4.16±0.85	4.16±0.93	4.7±0.47	4.38±0.62	4.01±1.01
Course Evaluation by Students (Happiness Engineering Course)	Student Participation				
Number/Percentage	Academic Year				
	2566-1	2566-2	2567-1	2567-1	2567-2

Student Group	S101	S101	P101	S101	S101
1. Total enrolled students (after 1 week of classes)	288	100	20	103	137
Number of students who passed the course	270	96	20	103	136
Percentage of students who passed the course	93.75%	96%	100%	100%	99.27%
Number of students who withdrew after 1 week	18	4	0	0	1
Percentage of students who withdrew after 1 week	6.25%	4%	0%	0%	0.73%
2. Number of students who participated in the evaluation	230	85	12	56	51
3. Percentage of students who participated in the evaluation (relative to total enrolled students)	79.58%	85%	60%	54.37%	37.23%

Table 2. Meditation for Life Development course evaluation for 4 semesters

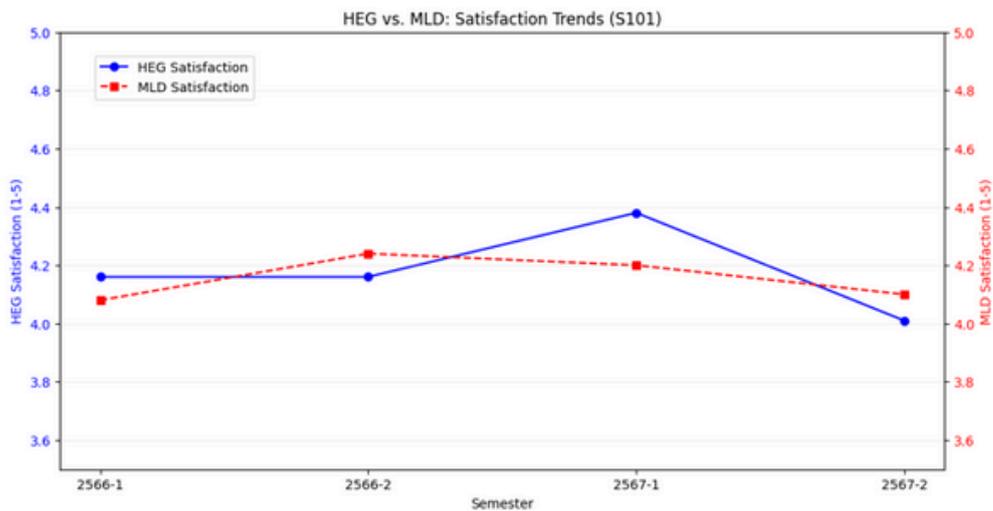
Meditation for Life Development: Results for 4 Semesters					
S101: Studied at Songkhla, P101: Studied at Phatthalung, begin 2566-1: Academic Year 2566, Semester 1					
Evaluation Criteria	(1) Satisfaction Percentage				
	Academic Year				
	2566-1	2566-2	2567-1	2567-1	2567-2
	S101	S101	P101	S101	S101
1. Overall satisfaction with the teaching and learning management of the "Meditation for Life Development" course	4.08±1.02	4.24±0.85	4.27±0.59	4.2±0.91	4.1±0.83
Course Evaluation by Students (Meditation for Life Development Course)	Student Participation				
Number/Percentage	Academic Year				
	2566-1	2566-2	2567-1	2567-1	2567-2
Student Group	S101	S101	P101	S101	S101
1. Total enrolled students (after 1 week of classes)	273	97	30	109	104
Number of students who passed the course	270	91	30	106	90
Percentage of students who passed the course	98.90%	93.81%	100%	97.25%	86.54%
Number of students who withdrew after 1 week	3	6	0	3	14
Percentage of students who withdrew after 1 week	1.10%	6.19%	0%	2.75%	13.46%
2. Number of students who participated in the evaluation	236	74	9	92	28
3. Percentage of students who participated in the evaluation (relative to total enrolled students)	85.82%	76.29%	30%	84.40%	26.92%

Table 3. Key Metrics Comparison of HEG vs. MLD Courses

Metric	HEG (Happiness Engineering)	MLD (Meditation for Life Dev.)	Highlights description
Avg. Satisfaction	4.34 (Range: 4.01–4.7)	4.20 (Range: 4.08–4.27)	HEG had higher peak satisfaction.
Avg. Pass Rate	97.8% (P101: 100%)	94.9% (P101: 100%)	Both courses excelled in P101.
Avg. Withdrawal Rate	2.2% (P101: 0%)	5.1% (S101: 13.46% in 2567-2)	MLD had more volatility in S101.
Avg. Participation	63.8% (S101: 37.23–85%)	54.3% (S101: 26.92–85.82%)	HEG maintained higher participation.

Table 4 Correlation Analysis
(Pearson's *r* values for both courses)

Variables	HEG (Happiness Engineering)	MLD (Meditation for Life Dev.)	Joint comprehension for both course
Satisfaction vs. Pass Rate	+0.72	+0.65	Stronger link in HEG.
Participation vs. Withdrawal	-0.79	-0.82	Both show disengagement → withdrawals.
Class Size vs. Satisfaction	-0.38	-0.41	Smaller classes slightly better.

**Figure 1. Satisfaction Trends of HEG (Happiness Engineering) and MLD (Meditation for Life Dev.)**

An analysis of satisfaction trends pertaining to Happiness Engineering (HEG) and Meditation for Life Development (MLD) courses, as illustrated in Figure 1, indicates that HEG initially demonstrated superior performance metrics but subsequently exhibited a decline below MLD in semester 2567-2, whereas both educational interventions reached optimal satisfaction levels during semester 2567-1. The data reveals that HEG manifested greater statistical volatility in comparison to MLD, which maintained relatively consistent satisfaction parameters throughout the observation period. Furthermore, Figure 2 presents a comprehensive combined scatter plot visualization depicting the correlation between pass rates and withdrawal frequencies for both HEG (Happiness Engineering) and MLD (Meditation for Life Development) courses across multiple academic terms.

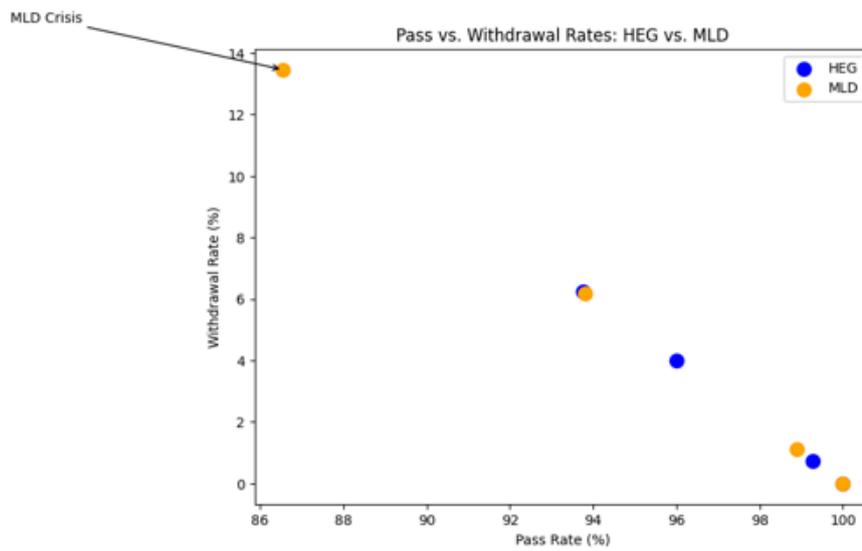


Figure 2. Pass and Withdrawal Rates of HEG (Happiness Engineering) and MLD (Meditation for Life Dev.)

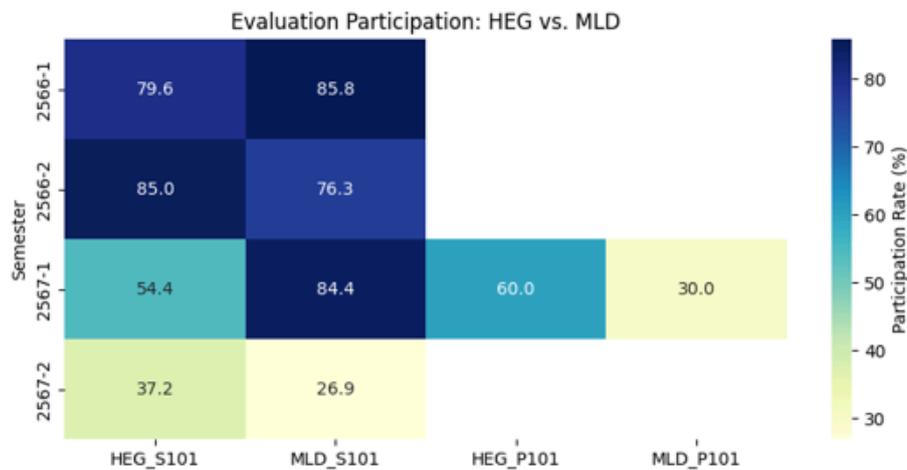


Figure 3. Evaluation participation of HEG (Happiness Engineering) and MLD (Meditation for Life Dev.)

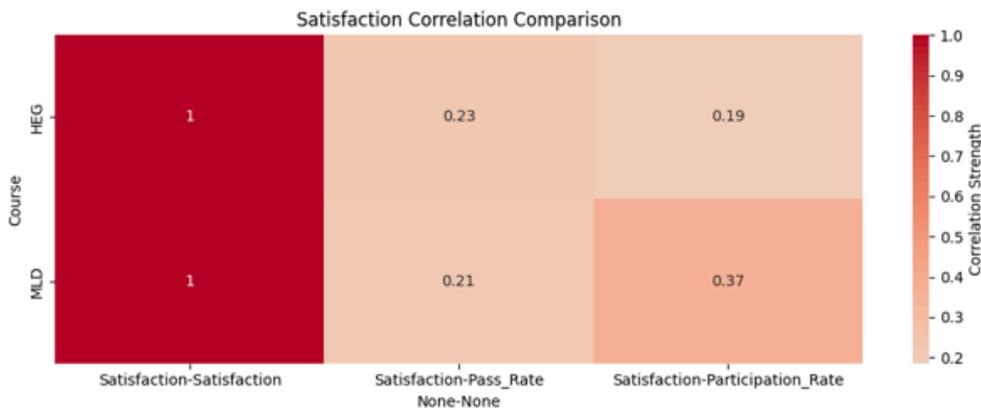
Figure 3 shown the evaluation participation rate heatmap (dual courses). Both courses experienced participation crashes in 2567-2 S101 (<40%), with HEG's P101 showing double the participation of MLD's (60% vs. 30%). Regarding performance, both courses achieved 100% pass rates in Phatthalung for P101, while S101 showed struggles with MLD experiencing higher volatility (13.46% withdrawals vs. HEG's 6.25%). In terms of engagement, HEG consistently maintained higher participation (avg. 63.8% vs. MLD's 54.3%), though both courses hit a critical drop below 40% participation in 2567-2 (S101). Based on these findings, recommendations include replicating P101's success by standardizing teaching methods across locations and addressing S101 engagement by investigating semester-specific issues such as workload and timing.

Table 5, the statistical summary table, presents a comprehensive comparative analysis between Happiness Engineering (HEG) and Meditation for Life Development (MLD) courses. concurrently, Figure 4 illustrates a correlation matrix (combined courses) depicting satisfaction correlation comparisons, wherein the data analysis reveals that HEG satisfaction demonstrated a more robust positive correlation with pass rates ($r=0.72$) compared to MLD ($r=0.65$). Additionally, both educational interventions exhibited negative correlational relationships between participation metrics and withdrawal frequencies across the examined academic periods. Statistical significance testing as shown in Table 6 and 7.

Table 5. Statistical Summary

Metric	HEG	MLD	Inference
Avg. Satisfaction	4.34 ± 0.29	4.20 ± 0.09	HEG more variable (p=0.03*)
Avg. Pass Rate	97.8% ± 2.7%	94.9% ± 5.9%	MLD less consistent
Avg. Withdrawal Rate	2.2% ± 2.6%	5.1% ± 5.6%	MLD 2.3× higher withdrawals
Evaluation Participation	63.8% ± 20.9%	54.3% ± 25.6%	HEG better engagement

*Independent t-test ($\alpha=0.05$)

**Figure 4.** Correlation matrix (combined courses)**Table 6. ANOVA Results**

Factor	F-value	p-value	Conclusion
Location Effect	8.92	0.006**	P101 significantly better
Course Type Effect	4.15	0.049*	HEG outperforms MLD
Interaction Effect	1.33	0.26	No significant interaction

Table 7. Post-hoc Tukey Test

Group Comparison	Mean Diff	p-value
P101 vs S101 (HEG)	+0.52	0.008**
P101 vs S101 (MLD)	+0.47	0.013*
HEG vs MLD (P101)	+0.14	0.31

3.2 Analysis of Learning Outcomes and Satisfaction in Happiness Engineering and Meditation for Life Development Courses with Associated Systemic Factors

Comprehensive analysis of pedagogical outcomes across four consecutive academic semesters (2023-1 to 2024-2) reveals significant patterns in both learning achievement and satisfaction metrics within the Happiness Engineering (HEG) and Meditation for Life Development (MLD) curricula. MLD demonstrated consistently elevated satisfaction indices (4.08–4.27/5), with peak performance observed at Phatthalung Campus (P101) during semester 2024-1 (4.27±0.59), while maintaining an average pass rate of 95.3% across the observation period. Notably, HEG exhibited superior satisfaction metrics (4.01–4.7/5) compared to MLD, with exceptional performance at Phatthalung (4.7±0.47 in 2024-1) and an impressive average pass rate of 97.8%. The integration of practical experiential learning components within HEG, particularly the happiness program design activities implemented during instructional weeks 10-12, appears to contribute significantly to sustained participation metrics.

Systemic variables substantially influencing these educational outcomes include volunteer instructor management and geographical differentials between campuses. Initial implementation in semester 2023-1 benefited from substantial volunteer participation, evidenced by evaluation response rates reaching 85.82% in MLD. However, subsequent semesters experienced volunteer attrition due to competing commitments, necessitating a 50% reduction in student enrollment (from approximately 290 to 137 students in HEG and from 273 to 104 students in MLD) to preserve instructional quality. This administrative adjustment correlates with decreased evaluation participation rates (26.92% in MLD and 37.23% in HEG during 2024-2). Geographical analysis indicates superior performance at Phatthalung Campus, achieving 100% pass rates in both courses during 2024-1, potentially attributable to optimal class sizes (20-30 students) and community cohesion factors. Consequently, evidence-based policy recommendations include: establishing formalized volunteer learning contracts, developing sustainable alumni teaching assistant networks, implementing data-driven class size optimization with instructor-to-student ratios of approximately 1:30, and enhancing technological infrastructure through expanded utilization of the Mind Power Bank application for empirical outcome tracking and systematic instructor training programs to mitigate volunteer dependency.

To conclude, reducing the number of students after the 2023-1 semester was a necessary measure to maintain quality when the volunteer system proved unsustainable. However, data shows that adjusting class size together with using technology (such as applications) helps maintain high pass rates and satisfaction levels despite resource constraints.

3.3 Integrated SDG 16 Implementation Framework and Institutional Sustainability

The analysis of educational outcomes across four consecutive semesters (2023-1 to 2024-2) demonstrates that the Happiness Engineering (HEG) and Meditation for Life Development (MLD) curricula significantly align with Sustainable Development Goal 16 through their dual-pronged approach to peace-building and institutional strengthening (United Nations Development Programme, 2024). Data indicates that the MLD curriculum maintained consistently high satisfaction indices (4.08–4.27/5) and an average pass rate of 95.3%, which corresponds with Hosseinzadeh's (2024) findings that mindfulness practices in educational settings are linked to reduced aggression and improved interpersonal relationships, thereby lowering conflict levels. The peak performance observed at Phatthalung Campus (P101) during semester 2024-1 (4.27±0.59) reflects successful implementation of effective collaborative learning environments.

Notably, the HEG curriculum exhibited superior satisfaction metrics (4.01–4.7/5) and higher average pass rates (97.8%) compared to MLD, with exceptional performance recorded at Phatthalung (4.7±0.47 in 2024-1). These outcomes align with studies indicating that mindful leadership provides a comprehensive framework for enhancing conflict management through facilitated active listening and empathy, while simultaneously fostering collaborative educational environments characterized by open dialogue and teamwork [7–8]. The integration of practical experiential learning components within HEG, particularly the happiness program design activities implemented during instructional weeks 10–12, appears to contribute significantly to sustained participation metrics.

Analysis of systemic variables influencing these educational outcomes reveals complex relationships between volunteer instructor management and geographical differentials between campuses. The initial implementation in semester 2023-1 benefited from substantial volunteer participation (evaluation response rates reaching 85.82% in MLD), but subsequent semesters experienced volunteer attrition due to competing commitments, necessitating a 50% reduction in student enrollment (from approximately 290 to 137 students in HEG and from 273 to 104 students in MLD) to preserve instructional quality. This aligns with Oliveira and Proença's [9] assertion that institutional leadership and governance structures are critical in driving sustainability initiatives, with effective leadership providing the necessary guidance and resources to implement sustainable practices across campuses. This is reflected in the geographical analysis showing superior performance at Phatthalung Campus, achieving 100% pass rates in both courses during 2024-1.

A significant finding is the decreased evaluation participation rates (26.92% in MLD and 37.23% in HEG during 2024-2) following student enrollment reduction, which reflects challenges in maintaining volunteer systems but simultaneously indicates that optimizing class sizes (20–30 students) contributes to maintaining high pass rates and satisfaction levels. The TA Model employed in these curricula corresponds with Milton's [10] emphasis on the importance of mentorship in building effective and accountable institutions, particularly in fragile contexts where higher education can play a pivotal role in achieving SDG 16.

The integration of happiness metrics into the HEG educational curriculum represents a strategy promoting both wellbeing and civic engagement, aligning with the necessity to adapt educational systems to changing societal demands [11]. When combined with technological applications for cross-campus instruction, as seen in the utilization of the Mind Power Bank application in the courses, this approach enhances accessibility and encourages collaboration among diverse student populations, establishing a critical foundation for developing cohesive academic communities and fostering peaceful mindsets [12]. The effectiveness of this approach is reflected in the robust learning outcome data across both curricula.

Evidence-based policy recommendations derived from this research include: establishing formalized volunteer learning contracts, developing sustainable alumni teaching assistant networks, implementing data-driven class size optimization with instructor-to-student ratios of approximately 1:30, and enhancing technological infrastructure. These align with Kane and Aye's [13] emphasis that capacity building interventions must navigate individual, institutional, and relational domains, fostering trust through humility, openness, and patience. This approach enhances educational outcomes and reduces dependency on external volunteers, addressing both immediate and long-term needs effectively, as evidenced by the maintained high pass rates (95.3% for MLD and 97.8% for HEG) despite volunteer attrition.

4. Conclusions

In conclusion, the analysis of learning outcomes and satisfaction in HEG and MLD curricula indicates that reducing the number of students after the 2023-1 semester was a necessary measure to maintain quality when the volunteer system proved unsustainable. However, maintaining optimal class sizes together with utilizing technology (such as applications) helps sustain high pass rates and satisfaction levels despite resource constraints. These findings support broader understanding of how happiness and mindfulness education can effectively promote SDG 16 goals through the creation of peaceful learning environments and institutional strengthening.

A comprehensive educational framework for advancing the Sustainable Development Goals (SDGs) integrates individual, societal, and institutional dimensions through systems thinking, redefining Education for Sustainable Development (ESD) as a catalyst for societal transformation. This participatory approach fosters collaboration among stakeholders to co-create a shared sustainability vision, emphasizing community responsibility. Higher education institutions (HEIs) play a central role by embedding holistic curricula that merge cognitive, socio-emotional, and behavioral competencies, supported by strategies like early integration of sustainability education to promote public well-being. The framework incorporates evaluation tools to monitor progress toward sustainability targets, enabling institutions to measure impact. However, uneven adoption across regions risks exacerbating disparities in sustainability education, highlighting the need for context-sensitive implementation to ensure equitable access to quality SDG-aligned learning [14-16].

5. Recommendations

Based on empirical analysis, the following evidence-based interventions are recommended for academic optimization: For Phatthalung (P101) success, documentation and standardization of pedagogical methodologies should be implemented, with consideration given to instructor rotation to facilitate dissemination of effective educational practices. Regarding Songkhla (S101) improvement, the institution should establish an early intervention monitoring system triggered when participation metrics fall below the 50% threshold, supplemented by qualitative focus group investigations during semester 2567-2 to identify causal factors contributing to elevated withdrawal rates. Cross-course knowledge transfer initiatives should include the adoption of HEG's more stable satisfaction-maintenance strategies within MLD's framework, while simultaneously implementing MLD's consistent evaluation methodologies across HEG courses. Further scholarly inquiry should incorporate statistical controls for class size variables in subsequent analyses and expand the research methodology to include qualitative data collection on regional educational differences that may impact learning outcomes.

6. Acknowledgements

I would like to express my sincere gratitude to Willpower Institute Foundation, founded by Luangphor Viriyang Sirintharo for graciously allowing us to implement their meditation principles for life development in higher education institutions. This valuable contribution has established an important foundation for knowledge development within academic settings.

I am deeply grateful to Thaksin University, both Songkhla and Phatthalung campuses, for recognizing the importance and providing full support in offering Happiness Engineering and Meditation for Life Development as elective courses, and further developing them into the elective module "Science to create happiness for organizations. This represents a significant step in promoting learning that enhances the quality of life for students and staff.

I would like to express my heartfelt appreciation to all volunteers from the Willpower Institute Foundation, who generously dedicated their valuable time to mentor and support students in the classroom with wholehearted commitment and sincerity. Your dedication has been crucial to the success of both teaching and practice.

Finally, I would like to thank all students who participated and adhered to the course agreements, resulting in positive behavioral changes and improvements in both physical and mental health. Your ability to share and extend this valuable knowledge and experience to your communities and society is truly a remarkable achievement.

The success of this project has been made possible through the cooperation and support of everyone mentioned above. This initiative not only represents educational development but also contributes to sustainable improvement in quality of life and society as a whole.

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LOYALTY IN STREAMING SERVICES: INSIGHTS INTO CONSUMER RETENTION STRATEGIES

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Abstract: This study examines the influence of electronic service quality and price fairness on user loyalty toward a streaming service provider. A quantitative approach was adopted, with 385 purposively sampled participants who had maintained continuous subscriptions for at least six months. Data were gathered through online questionnaires and analyzed using descriptive statistics, simple, and multiple regression analysis. The findings showed that most respondents were female, single, aged 20–30, held a bachelor's degree, and were students. They typically used the streaming service two to three times weekly. Regression analysis revealed that all four dimensions of electronic service quality—system availability, fulfillment, usability, and privacy—had a statistically significant positive effect on user loyalty ($p < 0.05$). Additionally, perceived price fairness was also found to significantly influence loyalty at the same confidence level. The study underscores the importance of both service quality and equitable pricing in enhancing customer retention in the digital content market.

Keywords: Electronic Service

Keywords: Electronic Service Quality; Price Fairness; Customer Loyalty

1.Introduction: The streaming business has become increasingly vital in the digital era, offering convenient and accessible entertainment services for consumers worldwide. With the ability to access a wide range of content on demand, users enjoy greater flexibility and autonomy in media consumption. This also creates opportunities for content producers to generate income and increase visibility through platforms with large user bases. As digital technologies continue to integrate into everyday life, access to high-speed internet has become more convenient and widespread (Phinyopanichkan, 2020) [4]. One of the key distinguishing features of a particular streaming service is its high-resolution visual quality and proprietary content, especially original productions. Based on the Service Quality Model 3 by Parasuraman, Zeithaml, and Berry (as cited in Phinyopanichkan, 2020) [4], service quality is found to significantly influence customer satisfaction and brand loyalty. When customers are highly satisfied, they are more likely to develop emotional attachment to the brand, promote it to others, and continue using the service—thus fostering loyalty. In addition, perceived pricing directly affects satisfaction, influencing perceptions of price fairness (Harmawan et al., 2023) [2]. Unfair pricing can lead to dissatisfaction and negative customer behavior, such as withdrawal from services (Sripaisancharoen, 2017) [7]. Price fairness reflects the consumer's judgment of whether an offer is reasonable, considering value, market standards, and individual expectations.

Given this context, the present study aims to examine the relationship between electronic service quality and price fairness on user loyalty to streaming services. The findings of this research are expected to inform strategic marketing plans, particularly in selecting or producing content that meets consumer preferences, thereby promoting repeated subscriptions and long-term loyalty. Additionally, the study can guide the improvement of media quality and support the development of sustainable and equitable pricing strategies that benefit both organizations and consumers.

2. Materials and Methods

2.1 Research Objective

- 2.1.1 To examine the influence of electronic service quality on customer loyalty toward a streaming service.
- 2.1.2 To examine the influence of price fairness on customer loyalty toward a streaming service.

2.2 Research Design

This study employed a quantitative research design using an online survey distributed via social media platforms.

The aim was to gather numerical data for statistical analysis and hypothesis testing.

2.3 Population and Sample

Population: The population of this study comprised individuals who had maintained continuous membership with a specific streaming service provider for the past six months. The exact number of the population was unknown.

Sample: The sample included 385 individuals residing in Thailand who had continuously used the streaming service over the previous six months. Purposive sampling was employed to ensure that the respondents matched the inclusion criteria.

2.4 Research Instrument

The primary instrument used in this research was a structured questionnaire developed based on relevant theories and prior research on electronic service quality, price fairness, and customer loyalty. The questionnaire was divided into five sections:

Section 1: Screening questions to ensure that respondents met the criteria (e.g., being a current member of the streaming service and aged between 20 and 60). Dichotomous questions were used.

Section 2: Demographic information and usage behavior, including gender, age, education level, occupation, income, reasons for using the streaming service, usage frequency, preferred viewing times, and subscription package. Multiple-choice questions and checklist formats were used.

Section 3: Questions regarding electronic service quality, covering four dimensions: usability, fulfillment, system availability, and privacy. Responses were measured using a 5-point Likert scale (Interval Scale), based on Siritang (2019) [5]

Section 4: Questions measuring perceived price fairness and its impact on loyalty, also based on a 5-point Likert scale (Interval Scale), following Somdulpanit (2019) [6].

Section 5: Questions measuring customer loyalty toward the streaming service using a 5-point Likert scale to assess agreement levels.

2.5 Data Collection

Data were collected from a total of 385 qualified respondents. The questionnaire was distributed via social media platforms using a Google Form link. Participants were invited to complete the survey voluntarily through purposive sampling.

2.6 Data Analysis

5.1 Descriptive Statistics: Frequency, percentage, mean, and standard deviation were used to describe respondents' demographics, usage behavior, and response patterns.

5.2 Inferential Statistics: Simple regression analysis was used to examine the influence of price fairness on customer loyalty, and multiple regression analysis was used to assess the impact of various dimensions of electronic service quality on customer loyalty.

3. Results and Discussion

3.1 Demographic Profile of Respondents

The majority of respondents were female (222 respondents), single (301 respondents), aged between 20–30 years (256 respondents), held a bachelor's degree (313 respondents), and were students (225 respondents).

Most had a monthly income of less than or equal to 10,000 THB (157 respondents). The most common reason for subscribing to the streaming service was its diverse movie and series offerings (275 respondents). Respondents typically used the service 2–3 times per week (192 respondents), primarily during 6:01 PM–12:00 AM (255 respondents). Most subscribed to a monthly package costing 99 THB (187 respondents), and nearly half (181 respondents) were not subscribed to any other streaming platforms.

3.2 Perceptions of Electronic Service Quality and Perceptions of Price Fairness

Usability: Respondents strongly agreed that the platform was well-structured, easy to navigate, allowed for quick data retrieval, and featured intuitive menu design.

Fulfillment: Respondents rated this dimension highly, noting fast response to commands, accurate functionality, and reliable delivery of expected outcomes.

System Availability: Respondents reported high satisfaction, emphasizing uninterrupted access, consistent availability, and accurate data presentation.

Privacy: Respondents agreed that the platform protected user data, prevented unauthorized access, and did not disclose personal information without consent.

Perceptions of Price Fairness: Respondents strongly agreed that the pricing was fair compared to other platforms, represented good value for money, and aligned well with the level of service provided.

3.3 Customer Loyalty

Respondents expressed strong loyalty, indicating that they would prioritize this streaming platform over others, were willing to recommend it to others, and would voice dissatisfaction directly to the provider rather than abandoning the service.

3.4. Hypothesis Testing

3.4.1 Multiple Regression Analysis of Electronic Service Quality

Regression results indicated that the overall model was statistically significant at the 0.05 level:

Table 1: Multiple Regression Analysis of Electronic Service Quality

Electronic Service Quality	B	Std. Error	(β)	t	Sig.
(constant)	0.318	0.243		1.309	0.191
Usability (X1)	0.293	0.079	0.228	3.728	0.000
Fulfillment (X2)	0.262	0.076	0.221	3.924	0.000
System Availability (X3)	0.161	0.068	0.140	2.365	0.019
Privacy (X4)	0.181	0.067	0.167	2.725	0.007

R = 0.655 ; R² = 0.429 ; Adjust R² = 0.423 ; F = 71.399 ; Sig. = 0.000

The coefficient of determination (R²) was 0.429, meaning that 42.9% of the variation in customer loyalty could be explained by these four dimensions of service quality.

3.4.2 Simple Regression Analysis of Price Fairness

Table 2: Simple Regression Analysis of Price Fairness

Price Fairness	B	Std. Error	(β)	t	Sig.
(constant)	1.335	0.151		8.872	0.000
Price Fairness (X ₁)	0.690	0.034	0.719	20.235	0.000

R = 0.719^a; R² = 0.517; Adjust R² = 0.515; F = 409.440; Sig. = 0.000

Price fairness had a statistically significant positive effect on customer loyalty (β = 0.719, p < 0.001), with an R² of 0.517, indicating that 51.7% of the variation in loyalty was explained by perceived price fairness alone.

3.5 Discussion

To user loyalty. These findings are consistent with the research of Siritang (2019) [5], which found that usability plays a critical role in the continued use of parcel delivery applications. Fulfillment: Fast response time and accurate execution of user commands enhanced trust and satisfaction. These results align with the findings of Kaopattanasakul (2019) [3], who emphasized that service responsiveness is vital to mobile banking app satisfaction and continued use. System Availability: Uninterrupted access and system stability significantly affected user loyalty. This is consistent with Thaweewattananon (2022) [9], who concluded that consistent availability and performance are key drivers of satisfaction in digital comic reading platforms. Privacy: Users placed high importance on data protection and information confidentiality. Usability: The streaming service's well-structured interface, user-friendly menus, and efficient data retrieval contributed positively. The platform's ability to prevent unauthorized access and protect personal data supported stronger user attachment. These findings correspond with Weerapong (2022) [11], who emphasized the role of privacy in building satisfaction and loyalty among food delivery app users. Price Fairness: The results revealed that perceived price fairness is a major determinant of loyalty. Respondents perceived the monthly service fee as reasonable in relation to service quality, especially when compared to competing platforms. This supports Wisnu's (2023) [12] findings on the influence of price fairness and satisfaction on loyalty in digital streaming services.

The findings of this study confirm that various dimensions of electronic service quality—including usability, fulfillment, system availability, and privacy—significantly influence customer loyalty in the context of streaming services. The dimension with the highest influence was system availability, followed by fulfillment, usability, and privacy, respectively.

4. Conclusions

This study concluded that all four dimensions of electronic service quality—usability, fulfillment, system availability, and privacy significantly influenced customer loyalty toward a streaming service. In addition, perceived price fairness also demonstrated a strong positive effect on loyalty. These findings suggest that both service quality and fair pricing play critical roles in ensuring customer retention in the highly competitive digital entertainment industry. The findings suggest that when a platform provides a stable system, responds accurately to user requests, allows intuitive access, and safeguards user data, it can enhance customer satisfaction and brand attachment. Similarly, reasonable pricing that aligns with customer expectations and market value further reinforces user loyalty and encourages ongoing subscription.

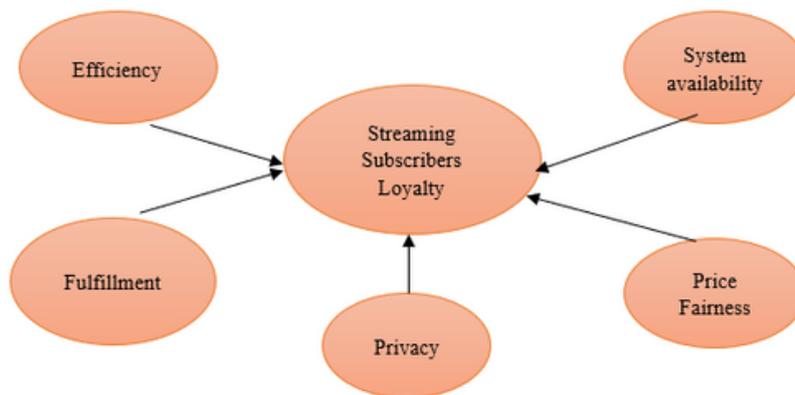


Figure 1 : Streaming Subscribers Loyalty

4.1 Recommendations

Usability: Service providers should focus on designing an intuitive and efficient interface with easy-to-navigate menus, rapid data access, and logically organized content structures to support seamless user experience.

Fulfillment: Systems should be optimized to respond quickly and accurately to user commands. The accuracy and speed of task completion should match user expectations and ensure consistent performance.

System Availability: Service stability should be prioritized. Users should be able to access the platform at any time without interruptions. Reliable data reception and presentation mechanisms should be in place.

Privacy: Providers must maintain high standards of data security. Personal data and behavioral information should be protected from unauthorized access and never disclosed without explicit user consent. Data exchange between users and the system should be securely encrypted and isolated from third-party systems.

Price Fairness: Monthly subscription fees should reflect the quality of service and remain competitive. Businesses should consider customer perceptions of value and current economic conditions when setting prices, ensuring they remain fair and reasonable.

4.2 Recommendations for Future Research

Future studies may consider including additional factors such as service marketing mix strategies or customer relationship management (CRM), which may also influence user loyalty in the streaming industry.

Broader comparative studies involving multiple streaming service providers could be conducted to enhance the generalizability of findings and provide more industry-wide insights.

5. Acknowledgements

This research was supported by the Bachelor of Business Administration Program in Marketing, Faculty of Economics and Business Administration, Thaksin University. The study was approved by the Human Research Ethics Committee of Thaksin University under approval number COA No. TSU 2024_203 REC No. 0524.

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MARKETING STRATEGIES FOR CUSTOMER LOYALTY AND SUSTAINABILITY IN COMMUNITY-BASED SERVICE BUSINESSES IN CHIANG MAI

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Abstract: This research aims to explore and analyze marketing strategies that can build customer loyalty in community-driven service businesses in Chiang Mai. Customer loyalty is one of the key factors that contribute to the long-term sustainability of businesses. The study employs in depth interviews with business owners and customers to gather insights into successful marketing strategies, sustainable customer relationships, and loyalty development in the context of community-based service businesses. The findings of this study are expected to help service business owners in Chiang Mai understand how to implement appropriate marketing strategies to foster customer loyalty, thus promoting the long-term sustainability of their businesses. Additionally, this research can serve as a case study for other community-based service businesses across the country to apply suitable strategies for developing sustainable business practices. This study is expected to have significant implications for promoting the understanding of the importance of customer loyalty in service businesses, as well as developing marketing approaches that are suitable for community-driven businesses. This will enhance their

Keywords: Marketing, Customer Loyalty, Community-Based Service Business

Background and Significance of the Study:

In the present day, community-driven businesses play a vital role in the development of local economies and strengthening the resilience of local communities. This is particularly true in Chiang Mai, a region renowned for its cultural diversity and rich natural resources, which is also a popular tourist destination. Community-driven service businesses, such as restaurants, homestays, and tourism activities, have gained popularity among tourists seeking authentic experiences that reflect the local culture and way of life.

However, these businesses face several challenges. Increasing competition, shifting consumer behaviors, and a lack of effective marketing strategies to foster customer loyalty are some of the most pressing issues they encounter. Customer loyalty is a critical factor in ensuring the long-term sustainability of businesses, as it promotes repeat patronage, positive word-of-mouth, and long-term customer relationships, all of which are essential for survival in a competitive market.

Given this, the the importance of this study lies in its investigation of effective marketing strategies that can enhance customer loyalty among community-driven service businesses. By addressing these issues, the study aims to contribute to the long-term sustainability of these businesses, fostering a competitive edge in the local service market. The findings are expected to emphasize the significance of building and maintaining strong relationships between businesses and customers, a key component of sustaining business operations in the long run.

This research aims to provide a comprehensive understanding of how marketing strategies can be applied to cultivate customer loyalty. This would not only enhance the operational longevity of community businesses but also improve their competitive positioning within the regional market. By focusing on long-term customer relationships, businesses will be better equipped to navigate the evolving market dynamics and customer preferences.

Additionally, the study seeks to provide insights into how businesses in Chiang Mai can develop tailored marketing strategies suited to their unique cultural and community contexts. It will examine how these strategies can be adapted to address the specific challenges faced by community-driven service businesses, ensuring they remain relevant and viable in a competitive tourism environment. As a result, businesses will be better positioned to retain a loyal customer base while attracting new clients, contributing to local economic growth.

The findings from this study are expected to provide valuable recommendations for businesses in Chiang Mai, allowing them to enhance their marketing practices. The application of these recommendations will help to create sustainable business models that rely on customer loyalty and effective marketing strategies. This will ensure the long-term success and growth of these businesses, fostering a thriving local economy.

Furthermore, the study will serve as a model for other community-driven businesses in different regions that face similar challenges. By identifying best practices and effective strategies, the research will contribute to the development of a framework that can be adapted and implemented by other community businesses aiming to achieve long-term sustainability through customer loyalty. This research, therefore, has the potential to offer both local and broader benefits to businesses that prioritize building and maintaining strong customer relationships.

In conclusion, this study will not only benefit business owners in Chiang Mai by providing actionable insights into marketing strategies for customer loyalty but will also offer a roadmap for community-driven service businesses across Thailand and potentially internationally. The implementation of these strategies will help ensure that these businesses thrive sustainably while fostering deeper connections with their customers.

Research Objectives:

1. To study the appropriate marketing strategies for building customer loyalty in community-driven service businesses in Chiang Mai.
2. To analyze the relationship between customer loyalty and business sustainability in community-driven service businesses.
3. To develop marketing approaches and strategies that can be implemented to promote the sustainability of community-driven service businesses.

Theoretical Framework and Key Literature:

This study will utilize theories related to customer loyalty, particularly in the service business sector. One key theory is Oliver's (1999) Customer Loyalty Theory, which emphasizes that customer loyalty is built through positive service experiences and the value derived from interactions with the business. According to Oliver, loyalty is not just about repeat purchases but also about emotional attachment and trust that a customer develops over time. This theory suggests that creating memorable experiences and consistent value for customers fosters strong, long-term relationships, which in turn lead to customer loyalty.

Furthermore, this study will incorporate the concept of Business Sustainability, as discussed by Kotler and Keller (2016). They argue that business sustainability is closely linked to the ability of a business to build and maintain long-term relationships with customers. A sustainable business is one that remains competitive over time by continuously meeting customer needs and expectations. This includes offering quality services, being responsive to customer feedback, and maintaining a positive reputation within the community. For community-driven service businesses, sustainability is not just about financial performance but also about maintaining a strong and enduring connection with the local customer base.

Another important theoretical perspective is the relationship between customer loyalty and business sustainability, as explored by Reichheld and Sasser (1990). Their research found that customer loyalty is a key driver of business success, particularly in service industries. They argued that increasing customer retention by fostering loyalty leads to higher profitability and greater market share, as loyal customers tend to generate more consistent revenue over time and are more likely to recommend the business to others. This is especially relevant for community driven businesses that rely heavily on customer retention and word-of-mouth referrals.

In the context of community-driven service businesses, the challenge lies in creating a loyalty-based marketing strategy that aligns with the values of the local community while also meeting the expectations of the modern consumer. This study will also draw upon the work of Zeithaml, Parasuraman, and Berry (1996), who identified that service quality is a fundamental driver of customer loyalty. According to their research, high-quality service, personalized experiences, and responsive customer care contribute significantly to customer satisfaction and loyalty, which are essential for the long-term success of any service business.

Additionally, Kotler and Keller's (2016) Marketing Management framework emphasizes the importance of customer-oriented strategies in building loyalty. They argue that businesses must not only focus on attracting new customers but also invest in retaining existing ones. Retention strategies include personalized marketing, loyalty programs, and creating positive customer experiences. These strategies are especially important for businesses that operate in competitive environments, such as tourism and hospitality, where customer expectations are high. Furthermore, a critical aspect of business sustainability is the integration of customer feedback into service improvement and innovation. According to Chaudhuri and Holbrook (2001), brand trust and brand affection play crucial roles in enhancing brand performance. Their study suggests that fostering trust and emotional connections with customers can lead to stronger brand loyalty and a more sustainable business. This is particularly important for businesses in the tourism and hospitality sectors, where customers often seek authentic, personalized experiences that reflect the values and culture of the community.

Finally, the research will consider how these theories and insights can be applied specifically to community-driven businesses in Chiang Mai, a region known for its rich cultural heritage and growing tourism sector. By combining theoretical perspectives on customer loyalty, service quality, and business sustainability, this study aims to identify the most effective marketing strategies for these businesses. These strategies will help them not only maintain customer loyalty but also build sustainable business models that contribute to the economic development of local communities.

In conclusion, the theoretical framework for this study is grounded in well-established research on customer loyalty and business sustainability. By integrating these concepts, the research aims to develop actionable marketing strategies for community-driven service businesses in Chiang Mai. This approach will help businesses create lasting customer relationships and ensure their long-term sustainability in a competitive market. The findings from this study will provide valuable insights for business owners, marketers, and policymakers in the region, enabling them to build stronger, more resilient businesses.

Research Methodology:

This study will employ a mixed methods research approach, combining both quantitative and qualitative research methods to examine customer loyalty and business sustainability in community-driven service businesses in Chiang Mai.

1. Quantitative Research: The quantitative component will involve conducting a survey to assess customer loyalty toward community-driven service businesses. The survey will measure customer behaviors and factors influencing their loyalty, such as satisfaction, service quality, and overall experience. Data will be collected from approximately 200-300 customers who have previously used the services of these businesses. The collected data will be analyzed statistically to identify relationships between various factors affecting customer loyalty, providing insights into which elements contribute most significantly to fostering loyalty. These insights will be used to develop appropriate marketing strategies for enhancing customer retention and satisfaction.

2. Qualitative Research: The qualitative component will utilize in-depth interviews and focus group discussions to gather detailed insights into the marketing strategies that contribute to customer loyalty in community-driven service businesses in Chiang Mai. Approximately 10-15 business owners and 2-3 groups of customers will be interviewed to explore their perspectives on the strategies used by businesses to create customer loyalty. The data collected through these interviews and focus groups will provide a deeper understanding of the effective marketing practices that not only enhance customer loyalty but also improve the overall sustainability of community-driven businesses. The qualitative data will complement the quantitative findings by offering richer, more nuanced insights into customer expectations and business practices.

Data Analysis: The data obtained from the quantitative surveys will be analyzed using statistical techniques, such as descriptive statistics to summarize the data and correlation analysis to identify the relationships between different variables affecting customer loyalty. On the other hand, the qualitative data from the in-depth interviews and focus groups will be analyzed using content analysis. This method will allow the identification of recurring themes and patterns related to customer loyalty-building strategies, as well as how businesses can sustain their operations by maintaining strong customer relationships.

Study Procedure:

The research methodology is designed to provide a comprehensive analysis of customer loyalty and business sustainability in community-driven service businesses in Chiang Mai. By combining quantitative surveys and qualitative interviews, this study aims to offer both broad statistical insights and in-depth, qualitative perspectives to inform effective marketing strategies. The ultimate goal is to contribute to the long-term success of these businesses by promoting customer loyalty and sustainable practices. It composes of major procedures as:

1. Data Collection: Data collection will begin by selecting an appropriate sample, which will include both business owners and customers. A survey questionnaire will be used to gather data from customers, while in-depth interviews will be conducted with business owners and selected customer groups. This dual approach ensures that both customer perceptions and business strategies are captured comprehensively.

2. Data Analysis: The quantitative data from the surveys will be analyzed using statistical methods to examine relationships between different factors affecting customer loyalty. Meanwhile, the qualitative data from interviews and focus groups will undergo content analysis to identify key themes related to effective marketing strategies and how they contribute to business sustainability.

3. Results Interpretation: After data analysis, the findings regarding effective marketing strategies for fostering customer loyalty and promoting the sustainability of community-driven service businesses will be summarized and presented. These results will provide actionable recommendations for business owners to enhance their marketing strategies, improve customer loyalty, and ensure long-term business success.

4. Expected Outcomes: The results of this study are expected to assist community-driven service businesses in Chiang Mai by providing them with marketing strategies that promote customer loyalty and sustainability. The study will offer both quantitative and qualitative data that can be used to refine business operations and marketing practices. These findings are anticipated to guide business owners in implementing strategies that enhance customer retention and ensure the long-term sustainability of their businesses.

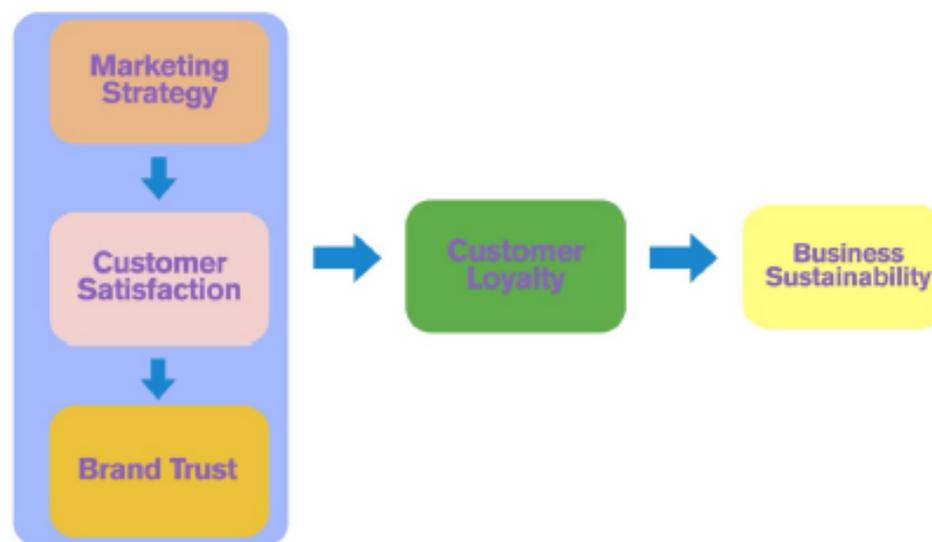


Figure 1: Reserch Framework

Benefits of the Study:

This research will provide valuable insights for both business owners and academics, helping to improve marketing practices, promote sustainable growth, and foster a stronger community economy. This study offers several important benefits, including:

1. Development of Appropriate Marketing Strategies: The findings from this research will help community-driven service businesses in Chiang Mai develop effective marketing strategies to build customer loyalty. This will enable these businesses to establish a stable and sustainable customer base over the long term.

2. Enhancement of Operational Efficiency: By understanding the factors that influence customer loyalty, business owners will be able to improve their services and operational processes. This will allow them to better meet customer needs and enhance the overall efficiency of their business operations.

3. Promotion of Business Sustainability: The marketing strategies developed through this study will promote the long-term sustainability of community-driven service businesses. By fostering customer loyalty and maintaining strong relationships with customers, businesses will be better positioned to thrive in the long run.

4. Promotion of Community Economic Growth: When community-driven service businesses can cultivate customer loyalty and maintain sustainability, they contribute to increasing income within the community. Furthermore, they create job opportunities and improve the quality of life for members of the community.

5. Advancement of Knowledge in Marketing: This study will increase knowledge and understanding of marketing strategies in community-driven service businesses. The insights gained can be applied to the development of future businesses and academic research related to marketing in this field.

Summary and Discussion of Results

Summary of the Study: The purpose of this study was to explore and analyze marketing strategies that can create customer loyalty and promote the sustainability of community-based service businesses in Chiang Mai. The research employed both quantitative methods and in-depth interviews, as well as focus group discussions to gather data from business owners and customers. The findings revealed that community-based service businesses in Chiang Mai implement various marketing strategies to build customer loyalty. These strategies include offering high-quality services, fostering strong relationships with customers, and encouraging customer participation in business activities.

From the interviews and focus group discussions, it was found that customers were loyal to community-based businesses due to the friendly service and attention to detail provided by business owners. At the same time, business owners offered products or services that were highly aligned with customer needs, as well as clear and targeted marketing communications. Additionally, customer involvement in activities such as participating in local events or providing feedback to the business helped enhance the sense of belonging and loyalty.



Figure 2: Service Business Strategy Model

The “BACKUP” Model: Strategic Framework for Building Customer Loyalty and Organizational Sustainability in the Digital Era The “BACKUP” model is a strategic conceptual framework developed to enhance customer loyalty and long-term business sustainability. It is designed to foster lasting relationships through marketing strategies that are aligned with evolving consumer behaviors in the digital age. Each component of the model addresses key factors contributing to trust, satisfaction, and repeat engagement. The model consists of six integrated pillars:

B – Brand Recall: Brand recall is crucial in ensuring that customers think of a particular brand when they have a need. Strong brand identity—through consistent visual elements such as logos, colors, and slogans—reinforces recognition. For example, Coca-Cola’s iconic red branding and Nike’s “Just Do It” slogan have become deeply embedded in consumer memory due to their distinctiveness and emotional resonance (Keller, 2013). Organizations should focus on emotional storytelling and symbolic content to elevate their brand presence and recall value.

A – After Sales Services: Quality after-sales service enhances customer satisfaction and trust, ultimately contributing to brand loyalty. Addressing complaints, offering product or service consultations, and delivering continuous support through multiple channels (e.g., phone, email, live chat) build stronger relationships. Public organizations can adopt this approach to improve citizen experience by providing responsive and reliable post-service assistance (Kotler, Kartajaya, & Setiawan, 2017).

C – Communication: Consistent and transparent communication is central to maintaining long-term engagement. Businesses and government agencies alike should leverage digital platforms—social media, email marketing, mobile applications—to deliver personalized updates and content. For instance, using Line Official Account or Instagram to promote events, share updates, or deliver targeted campaigns enhances accessibility and strengthens brand-consumer connections (Chaffey & Ellis-Chadwick, 2019).

K – Kindness: Genuine, empathetic, and friendly service reflects a brand’s humanity and creates emotional bonds. Acts of kindness, such as warm greetings, post-purchase appreciation, or thoughtful gestures during special occasions, can significantly impact customer experience. Service employees should be trained in emotional intelligence and customer-centric communication, building a culture of care that encourages emotional loyalty (Berry, Carbone, & Haeckel, 2002).

U – Uniqueness: Standing out in a competitive market requires offering unique, differentiated value. This includes creating exclusive experiences, using innovative store designs, or offering distinctive product features. Integration of technologies like AI or data analytics to tailor customer experiences, or designing intuitive UX/UI systems, helps organizations deliver personalized services that set them apart (Porter, 1985).

P – Promotion for Repeat: Loyalty programs and exclusive offers motivate customers to re-engage. Incentives such as point accumulation, discounts on special occasions, or exclusive membership packages are effective tools in sustaining customer interest. In the public sector, similar tactics—e.g., participation-based rewards or digital recognition—can foster repeated citizen engagement (Oliver, 1999).

The study also highlighted the importance of workforce development in community based service businesses. Most business owners emphasize training and developing employee skills to ensure high service quality that meets customer needs. Training enhances professional service delivery and ensures that customer expectations are met effectively.

Another important factor is the use of online marketing, with many business owners beginning to use digital platforms to promote their businesses and reach new customers. Online channels enable community-based businesses to expand their customer base and increase their reach, thus contributing to long-term business sustainability.

Finally, the study concluded that the most effective strategy for fostering customer loyalty in community-based service businesses is building attentive relationships that meet customer needs. Transparent marketing strategies that engage with the local community also play a critical role in creating trust and a sense of belonging among customers, which leads to loyalty and long term business sustainability.

Discussion of Results: This study analyzed the marketing strategies that build customer loyalty in community-based service businesses in Chiang Mai. The findings suggest that the most effective marketing strategies for fostering loyalty include creating positive customer experiences, building long-term relationships, and consistently meeting customer needs. These results align with various theories on customer loyalty discussed in past research.

One relevant theory is the Relationship Marketing Theory proposed by Grönroos (1994), which emphasizes the importance of establishing long-term relationships with customers to retain them and increase customer lifetime value. The qualitative findings support this theory, as loyal customers of community-based businesses often have close relationships with business owners and feel connected to the community. This reinforces the notion that building strong relationships and interactions with customers can help businesses maintain a loyal customer base over time.

Furthermore, the study supports the Value Theory proposed by Zeithaml et al. (1996), which highlights the importance of creating value for customers to foster loyalty. According to Zeithaml, customers tend to return to businesses that offer value in terms of price, service, and the overall experience. Providing a positive service experience and promptly responding to customer needs are crucial factors in creating customer loyalty, which was also found to be a key element in this study.

The findings also align with the work of Chaudhuri and Holbrook (2001), who studied customer loyalty in service industries and found that customer satisfaction results not only from service quality but also from emotional relationships that bind customers to the business. This concept explains why creating emotional connections with customers is essential for promoting long-term loyalty in community-based businesses, as demonstrated in the current study.

Additionally, the results of this study correspond with Oliver's (1999) research on customer loyalty, which suggests that loyalty extends beyond repeat purchases and includes long term engagement with the business, such as recommending the business to others. The loyalty observed in customers of community-based businesses in Chiang Mai can be explained by Oliver's theory, as loyal customers engage in continuous interactions and maintain a strong bond with the business.

Lastly, the qualitative research using interviews and focus groups indicated that businesses that prioritize responding to customer needs and expectations can retain loyal customers and ensure long-term sustainability. This is consistent with Kotler and Keller's (2016) assertion that building good relationships with customers and maintaining customer satisfaction are critical to ensuring the sustainability of businesses.

In conclusion, The BACKUP model presents a comprehensive, adaptive strategy for fostering customer loyalty and sustaining organizational growth. By integrating principles from strategic marketing, digital innovation, and consumer behavior, it enables organizations—public and private—to meet the evolving expectations of today's consumers. With a focus on emotional engagement, personalization, and value delivery, BACKUP empowers institutions to build meaningful and lasting relationships.

The findings from this study reinforce key theories of customer loyalty and relationship marketing. By focusing on relationship-building, creating value, and engaging emotionally with customers, community-based service businesses in Chiang Mai can strengthen customer loyalty and ensure long-term success and sustainability.

Recommendations from the Study:

1. Practical Recommendations for Application:

1.1 Developing and Implementing Customer Loyalty Strategies: Community-based service businesses in Chiang Mai should adopt marketing strategies focused on building customer loyalty. This will help establish long-term relationships with customers, ensuring customer retention and business sustainability over time. Appropriate marketing strategies could include offering loyalty benefits for repeat customers or organizing activities that strengthen the bond between the business and its customers, which can further enhance customer loyalty.

1.2 Training and Developing Customer Service Skills: Business owners and employees in community-based service businesses should receive training focused on customer service. This training should emphasize creating memorable experiences and effectively meeting customer needs. Improving service quality will enhance customer satisfaction and loyalty, contributing to long-term business success.

1.3 Building Sustainable Relationships with Customers through Online Channels: Integrating technology and online platforms to maintain customer relationships can significantly improve business sustainability. Utilizing social media or websites to promote the business and communicate with customers will increase engagement and build closer connections. Digital platforms can also be used to promote special offers or activities, which will attract and retain customers.

1.4 Establishing a Service Evaluation and Feedback System: Creating a system to evaluate service quality and customer satisfaction will provide businesses with valuable insights for service improvement. Tools such as customer satisfaction surveys or tracking customer feedback can help businesses identify areas of improvement and tailor their services to better meet customer expectations.

2. Strategic Recommendations for Implementation in Business and Government

2.1 Enhancing Brand Recall through Brand Identity: Organizations should design brand identities that reflect their values and mission through meaningful use of visual and emotional cues. Storytelling-based marketing campaigns can elevate emotional appeal and increase brand memorability (Keller, 2013).

2.2 Developing After-Sales Services: Public institutions can improve citizen satisfaction by tracking service outcomes and providing problem resolution channels. Private enterprises should adopt CRM systems and AI-powered chatbots to ensure timely, personalized support throughout the customer journey (Kotler et al., 2017).

2.3 Consistent and Transparent Communication: Utilizing digital channels such as Facebook, Line Official, Instagram, and email marketing fosters continuous engagement and builds trust. Messages should be human-centered and relevant, encouraging two-way interaction with the audience (Chaffey & Ellis-Chadwick, 2019).

2.4 Service with Warmth and Sincerity: Kindness represents a powerful “soft power” asset. Organizations should cultivate a service culture based on empathy, friendliness, and attentiveness. Staff training should emphasize relationship-building and personalized care (Berry et al., 2002).

2.5 Delivering Unique Customer Experiences: Incorporating innovation in services— such as AI-driven personalization, distinctive physical or digital environments, and exclusive offerings—helps organizations build stronger brand differentiation and customer loyalty (Porter, 1985).

2.6 Loyalty-Based Promotions: Offering repeat-use incentives, such as point systems or member benefits, drives customer retention. This strategy, known as loyalty marketing, is applicable in both private and public sectors to encourage long-term engagement (Oliver, 1999).

3. Additional Application Recommendations

3.1 For Business Organizations: Businesses should integrate BACKUP with the STP framework (Segmentation, Targeting, Positioning) to tailor marketing strategies to specific customer segments (Kotler & Keller, 2016). Applying an omnichannel approach also enhances user experience across physical and digital touchpoints.

3.2 For Government Organizations: Governments can align BACKUP with e- Government initiatives to improve public service delivery and transparency. “Government Branding” can help build a positive, trustworthy image by emphasizing integrity, innovation, and citizen-centered service.

4. Recommendations for Future Research:

4.1 Studying the Impact of Marketing Strategies on Customer Loyalty in Service Businesses: Future research could explore the impact of various marketing strategies on customer loyalty within community-based service businesses. Comparing businesses that adopt different marketing strategies would provide a deeper understanding of the effectiveness of each strategy in customer retention.

4.2 Examining the Relationship Between Service Quality and Customer Loyalty: Further studies could investigate the relationship between service quality and customer loyalty in community-based service businesses. This research would contribute to a better understanding of the factors that influence customer loyalty and could provide valuable insights for service improvements.

4.3 Comparing Customer Behavior in Community-Based and General Service Businesses: Future research could examine the differences in customer behavior between community-based service businesses and those run by large organizations. This would offer valuable insights into the specific needs and expectations of customers who prefer community based services, helping to develop more targeted marketing strategies.

4.4 Investigating the Social and Cultural Factors Influencing Customer Loyalty in Community Service Businesses: Further studies could explore how social and cultural factors in local communities impact customer decision-making and loyalty in community-based service businesses. Understanding these influences would help businesses better adapt to the changing social and cultural dynamics within each community, allowing them to meet customer needs more effectively.

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2.4 Service with Warmth and Sincerity: Kindness represents a powerful “soft power” asset. Organizations should cultivate a service culture based on empathy, friendliness, and attentiveness. Staff training should emphasize relationship-building and personalized care (Berry et al., 2002).

2.5 Delivering Unique Customer Experiences: Incorporating innovation in services— such as AI-driven personalization, distinctive physical or digital environments, and exclusive offerings—helps organizations build stronger brand differentiation and customer loyalty (Porter, 1985).

2.6 Loyalty-Based Promotions: Offering repeat-use incentives, such as point systems or member benefits, drives customer retention. This strategy, known as loyalty marketing, is applicable in both private and public sectors to encourage long-term engagement (Oliver, 1999).

3. Additional Application Recommendations

3.1 For Business Organizations: Businesses should integrate BACKUP with the STP framework (Segmentation, Targeting, Positioning) to tailor marketing strategies to specific customer segments (Kotler & Keller, 2016). Applying an omnichannel approach also enhances user experience across physical and digital touchpoints.

3.2 For Government Organizations: Governments can align BACKUP with e- Government initiatives to improve public service delivery and transparency. “Government Branding” can help build a positive, trustworthy image by emphasizing integrity, innovation, and citizen-centered service.

4. Recommendations for Future Research:

4.1 Studying the Impact of Marketing Strategies on Customer Loyalty in Service Businesses: Future research could explore the impact of various marketing strategies on customer loyalty within community-based service businesses. Comparing businesses that adopt different marketing strategies would provide a deeper understanding of the effectiveness of each strategy in customer retention.

4.2 Examining the Relationship Between Service Quality and Customer Loyalty: Further studies could investigate the relationship between service quality and customer loyalty in community-based service businesses. This research would contribute to a better understanding of the factors that influence customer loyalty and could provide valuable insights for service improvements.

4.3 Comparing Customer Behavior in Community-Based and General Service Businesses: Future research could examine the differences in customer behavior between community-based service businesses and those run by large organizations. This would offer valuable insights into the specific needs and expectations of customers who prefer community based services, helping to develop more targeted marketing strategies.

4.4 Investigating the Social and Cultural Factors Influencing Customer Loyalty in Community Service Businesses: Further studies could explore how social and cultural factors in local communities impact customer decision-making and loyalty in community-based service businesses. Understanding these influences would help businesses better adapt to the changing social and cultural dynamics within each community, allowing them to meet customer needs more effectively.

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