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การบูรณาการเทคโนโลยีสารสนเทศในอุดมศึกษาไทย: การวิเคราะห์ SWOT ก่อนโควิด-19 ด้วยกระบวนการลำดับชั้นเชิงวิเคราะห์ (AHP)

ICT Integration in Thai Higher Education: A Pre-COVID SWOT Analysis Using AHP

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บทคัดย่อ

การศึกษานี้สำรวจการบูรณาการเทคโนโลยีสารสนเทศและการสื่อสาร (ICT) ในการศึกษาระดับอุดมศึกษาในประเทศไทยก่อนเกิดการแพร่ระบาดของโรค COVID-19 โดยทำการสำรวจนักศึกษาระดับปริญญาตรีจำนวน 519 คนจากหลากหลายสาขาวิชาเพื่อประเมินการใช้ ICT ทั้งในและนอกห้องเรียน นอกจากนี้ยังมีการสัมภาษณ์แบบกึ่งโครงสร้างกับอาจารย์ 17 คนและผู้เชี่ยวชาญด้านการศึกษา 3 คน เพื่อให้ข้อมูลเชิงลึกเพิ่มเติมเกี่ยวกับแนวปฏิบัติและกลยุทธ์ของสถานศึกษา การวิจัยนี้ใช้การวิเคราะห์ SWOT ร่วมกับกระบวนการลำดับชั้นเชิงวิเคราะห์ (AHP) เพื่อประเมินจุดแข็ง จุดอ่อน โอกาส และอุปสรรคที่เกี่ยวข้องกับการบูรณาการ ICT ผลการวิจัยสำคัญพบว่าแม้จะมีการบูรณาการ ICT ในระดับปานกลาง แต่ก็พบปัญหา เช่น การเข้าถึงเทคโนโลยีที่จำกัด การฝึกอบรมที่ไม่เพียงพอ และการมีส่วนร่วมในห้องเรียนที่น้อยเกินไป การศึกษานี้สรุปด้วยข้อเสนอแนะเชิงกลยุทธ์เพื่อเพิ่มประสิทธิภาพการใช้ ICT ในมหาวิทยาลัยไทย โดยมุ่งเน้นการปรับปรุงโครงสร้างพื้นฐาน การฝึกอบรม และการสร้างเนื้อหาดิจิทัลที่เน้นนักเรียนเป็นศูนย์กลางและมีความน่าสนใจมากขึ้น ผลลัพธ์เหล่านี้ยังคงมีความสำคัญในบริบทที่การศึกษาได้เปลี่ยนไปสู่การใช้ดิจิทัลมากขึ้นหลังการแพร่ระบาด

คำสำคัญ: การบูรณาการเทคโนโลยีสารสนเทศและการสื่อสาร (ICT), การศึกษาระดับอุดมศึกษา, ผลกระทบจากโควิด-19, การวิเคราะห์ SWOT, กระบวนการลำดับชั้นเชิงวิเคราะห์ (AHP)

Abstract

This study investigates the extent of Information and Communication Technology (ICT) integration in Thai higher education prior to the COVID-19 pandemic. A total of 519 undergraduate students across various disciplines were surveyed to assess their use of ICT in both classroom and non-classroom settings. Semi-structured interviews were conducted with 17 lecturers and 3 education experts to provide additional insights into institutional practices and strategies. The research utilized a SWOT analysis, combined with the Analytic Hierarchy Process (AHP), to evaluate the strengths, weaknesses, opportunities, and threats related to ICT integration. Key findings reveal that while ICT was moderately integrated, challenges such as limited access to technology, insufficient training, and a lack of engagement in classroom use were prevalent. The

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study concludes with strategic recommendations for enhancing ICT use in Thai universities, focusing on improving infrastructure, training, and the creation of interactive, student-centered digital content. These findings remain relevant given the post-pandemic shift toward increased digitalization in education.

Keywords: ICT Integration, Higher Education, COVID-19 Impact, SWOT Analysis, AHP (Analytic Hierarchy Process)

■ Introduction

Information and Communication Technology (ICT) has played a central role in Thai education since 2000, with the government implementing ICT Master Plans to make the internet a foundational element of schools. By 2008, nearly 90% of basic education instructors used computers for teaching, and over 90% of students utilized ICT several days per week (Makaramani, 2013). However, questions remain about how effectively ICT has been integrated into higher education and its ability to meet evolving educational needs.

By 2021, students had become regular users of technology, and proficiency in technology and innovation became critical for learning. This research assesses the extent of ICT integration in Thai higher education through a survey of bachelor's students, evaluating practices within their universities and faculties. It also examines student satisfaction with technology usage, both inside and outside the classroom, to measure the effectiveness of ICT adoption.

The study, based on data collected in 2019 before the COVID-19 pandemic, provides a historical view of ICT integration in Thai education, allowing for comparisons with post-pandemic practices. The rapid shift to online platforms like Google Classroom and Moodle during the pandemic further underscores the importance of long-term ICT strategies in education. Although pre-pandemic, the findings are relevant to understanding the challenges and opportunities of digital learning today.

This research employs a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) to provide a comprehensive assessment of ICT integration in higher education. SWOT enables a balanced evaluation of internal institutional factors—such as technology adoption capabilities—and external influences, like opportunities for improvement and potential barriers. Combining SWOT with the Analytic Hierarchy Process (AHP) ensures effective prioritization of the identified factors, leading to actionable strategies that align with institutional goals and the evolving digital education landscape.

■ Research Question

How was ICT technology integrated into higher education in Thailand in 2019, and what are the strengths, weaknesses, opportunities, and threats (SWOT) associated with ICT integration strategies, as determined by the Analytic Hierarchy Process (AHP)?

■ Research Objectives

1)   To assess the extent of Information and Communication Technology (ICT) integration in higher education in Thailand in 2019, prior to the COVID-19 pandemic.

2)   To evaluate student satisfaction with the use of ICT in both classroom and non-classroom settings, identifying key areas for improvement.

3)   To analyze the strengths, weaknesses, opportunities, and threats (SWOT) of ICT integration strategies in educational institutions, using the Analytic Hierarchy Process (AHP).

4)   To provide a comparative analysis of ICT integration before and after the COVID-19 pandemic by incorporating updated literature and current trends.

5)   To propose long-term strategies for enhancing ICT integration in Thai higher education based on both pre-pandemic data and post-pandemic developments.

■ Principles, Concepts, and Related Theories

Global ICT Integration in Education

The integration of Information and Communication Technology (ICT) in higher education is a global trend aimed at improving educational quality and accessibility. Various studies highlight the growing impact of ICT adoption across regions. ICT plays a transformative role by replacing traditional educational practices with technology-enhanced environments. As noted by Goldhaber et al. (2021), integrating ICT fosters innovative teaching methods that meet contemporary educational demands. Countries are increasingly prioritizing ICT to modernize education and equip students with essential skills for the information age (Kandel, 2022).

The COVID-19 pandemic significantly accelerated the adoption of online platforms and digital tools in higher education worldwide (Khalid & Ali, 2021; Cavus & Sekyere-Asiedu, 2021; Pang et al., 2023). What began as a temporary solution during the pandemic has now become a permanent fixture in many institutions, changing the landscape of higher education (Wambui et al., 2022).

However, successful ICT integration depends on several factors, including infrastructure, teacher training, and institutional support. Inadequate infrastructure and financial limitations, particularly in developing countries, pose significant challenges (Al-Ansi, 2021; Ramadan et al., 2018). Studies show that insufficient training and limited resources hinder teachers from integrating ICT effectively into their teaching practices (Ramadan & Chen, 2018). Awareness of educational policies and leadership within institutions also plays a crucial role in fostering ICT adoption (Apsorn et al., 2019). Leaders can promote innovation and collaboration by offering clear visions and technological support (Habiballah et al., 2021)

Educator attitudes towards ICT are equally influential. Teachers with positive perceptions of technology are more likely to integrate ICT successfully, while negative attitudes or lack of familiarity can create barriers to adoption (Lokpo & Kumah, 2023; Msowoya, 2022). Addressing these challenges requires a

multifaceted approach involving improvements in infrastructure, comprehensive teacher training, and leadership support to cultivate a positive environment for ICT use. Despite the obstacles, the potential for ICT to revolutionize education remains significant.

ICT in Thai Higher Education

ICT integration in Thai higher education has evolved through a series of national policies and institutional initiatives. A key policy, the "Digital Thailand" initiative, aimed to transform the country into a digital economy, emphasizing the importance of ICT in various sectors, including education (Tatnall, 2013). The Ministry of Education encouraged universities to incorporate ICT into their curricula, although adoption varied widely due to differences in readiness and infrastructure (Saekow & Samson, 2011).

Universities developed their own ICT policies to promote technology use in teaching, including faculty training and infrastructure development (Wongwuttiwat & Lawanna, 2018). Despite these efforts, research shows that the actual implementation of ICT in classrooms often fell short, with inadequate training and lack of institutional support cited as key barriers (Siritongthaworn et al., 2006; Teo et al., 2011).

Thai educational reforms have also focused on aligning university curricula with labor market demands, emphasizing ICT skills to prepare graduates for the digital economy (Winley & Wongwuttiwat, 2013). However, challenges persist, including varying levels of ICT literacy among students and educators, and the need for a cultural shift towards embracing technology in education. While infrastructure exists, many educators still rely on traditional teaching methods, underscoring the importance of fostering an environment conducive to effective ICT use (Buraphadeja & Kumnuanta, 2011).

Before 2019, ICT adoption in Thai higher education was shaped by national policies, university initiatives, and ongoing challenges. The success of these efforts hinged on addressing barriers such as inadequate infrastructure, training, and cultural resistance to technology.

Challenges of ICT Integration

ICT integration in Thai education faces three main barriers: technological, skill-based, and cultural challenges. Technological barriers include unreliable internet connectivity, insufficient hardware, and a lack of technical support, which impede effective ICT use in teaching (Nyagorme et al., 2022). Inadequate power sources further exacerbate these issues, making it difficult for educators to depend on technology (Haji et al., 2023)

Skill-based challenges arise from the limited ICT competencies of many educators, which restrict their ability to use technology effectively in the classroom (Tondeur et al., 2015; Shah et al., 2020). Teachers often lack the necessary skills and knowledge to implement ICT, compounded by insufficient professional development opportunities to keep them updated on the latest advancements (Nyagorme et al., 2022).

Cultural barriers also play a significant role in ICT adoption. Resistance to change among educators, often due to a lack of confidence in using new technologies, is a major obstacle (Kandel, 2022). The hierarchical structure of educational institutions can further hinder open communication and collaboration,

which are essential for fostering a culture of innovation (Castro & Nyvang, 2018). Overcoming these challenges requires targeted efforts to improve infrastructure, provide training, and create a culture that embraces technological change.

SWOT and AHP in Education

SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) and the Analytic Hierarchy Process (AHP) have become essential tools for educational institutions to enhance decision-making and improve outcomes. SWOT analysis provides a comprehensive framework for assessing both internal and external factors that influence institutions, aiding in strategic planning (Chusniyah et al., 2023). This method allows institutions to identify areas for improvement, such as faculty development and community partnerships, to create new opportunities for students.

AHP complements SWOT by providing a structured approach to quantifying the importance of the factors identified through SWOT. By integrating AHP with SWOT, institutions can prioritize initiatives, such as sustainable development strategies in education (Liu & Suk, 2021). This synergy allows institutions to make informed decisions aligned with their strategic goals.

While SWOT and AHP offer valuable insights, their effectiveness depends on the quality of data collected and stakeholder engagement. Successful implementation requires a thorough understanding of the context and active participation from all stakeholders (Helms & Nixon, 2010). Additionally, educational environments are dynamic, necessitating regular updates to ensure that strategies remain relevant. In conclusion, leveraging SWOT and AHP provides educational institutions with a robust framework for strategic planning and continuous improvement.

◼ Research Methodology

Sample and Target Group

There were three groups involved in this research:

1. **Group 1 – Students**

The first group comprised 519 bachelor's students from various universities in Thailand, selected using random sampling to ensure a diverse cross-section across multiple disciplines, including:

- Science/Technology/Health Sciences
- Business Management and Economics
- Social Studies
- Education
- Arts

The inclusion of students from these fields aimed to capture a wide range of experiences regarding ICT integration in higher education.

2. **Group 2 – Lecturers**

The second group included 17 lecturers recruited via an open call on social media platforms (e.g., Facebook). These lecturers had at least three years of teaching experience in higher education and had taught both before and during the COVID-19 pandemic. Their inclusion allowed for comparative analysis of ICT practices before and after the pandemic, providing insights into institutional ICT strategies and responses.

3. Group 3 – Experts

The third group consisted of three experts in higher education management, selected based on their extensive experience in educational technology. One expert was from outside Thailand to offer a broader international perspective. Purposive sampling was used to ensure their expertise would inform the SWOT analysis and strategy recommendations.

Research Tool and Data Collection

For the data collection, two primary instruments were used: a survey form for students and semi-structured interviews for lecturers and experts.

1. Survey Validation Process

- Development: The survey form consisted of six sets of questions: (1) personal and university information, (2) students' knowledge of ICT, (3) their ICT skills, (4) purposes and uses of technology, (5) ethics in using ICT, and (6) trends in ICT usage inside and outside the classroom. The survey used a Likert scale ranging from 1 (minimum) to 5 (maximum).

- Preliminary Research: Initially, the survey questions were designed based on discussions with 10 randomly selected students in Bangkok, allowing for an initial understanding of the educational environment and ICT practices. These discussions helped shape relevant questions for the formal survey, but their responses were not included in the final dataset.

- Face Validity: To ensure that the questions were clear and relevant, face validity checks were conducted. Five students from the target population completed a preliminary version of the survey. Feedback from these students confirmed the relevance and clarity of the questions, and minor adjustments were made based on their input.

- Pilot Testing: A pilot study involving 30 randomly selected students was conducted to test the reliability of the survey. Reliability analysis using Cronbach's Alpha resulted in a value of 0.740, indicating acceptable internal consistency for the survey instrument.

2. Interview Validation Process

- Development of Interview Questions: Semi-structured interviews with 17 lecturers and three higher education experts were designed to explore their practices and insights on ICT integration in higher education. The interview questions covered topics such as teaching materials, technology resources, and strategies for improving ICT integration.

- Expert Review: The interview questions were reviewed by three educational management experts to ensure their comprehensiveness and relevance to the research objectives. The

experts confirmed that the questions were appropriate for eliciting meaningful insights about ICT integration, thus ensuring content validity.

Data Collection

For students, data was collected using the validated survey form. During the COVID-19 pandemic, telephone interviews were conducted with the lecturers and experts. The interviews were transcribed and analyzed later using content analysis.

Data Analysis

Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to analyze the survey responses. Pearson's correlation coefficient was applied to examine relationships between variables such as students' knowledge, skills, and satisfaction levels with ICT. For interviews, qualitative content analysis was used to extract common themes, which were then incorporated into a SWOT analysis. The Analytic Hierarchy Process (AHP) was employed to rank the importance of factors identified in the SWOT analysis.

■ Findings

Overview of Thai Education Before COVID-19

Demographics of the Respondents

This study surveyed 519 university students from various institutions across Thailand. The sample consisted of 138 students from public universities (26.59%), 128 from Rajabhat universities (24.66%), 132 from Rajamangala universities (25.43%), and 121 from private universities (23.31%). The geographical distribution was nearly equal, with 261 respondents studying in Bangkok (50.29%) and 258 in other provinces (49.71%).

The respondents represented a range of academic disciplines: 42 students from science, technology, or health science (8.09%); 158 from business and economics (30.44%); 63 from social studies (12.14%); 86 from education (16.57%); and 170 from art (32.76%). Of these students, 71.48% were in Thai-taught programs, and 28.52% were in English-taught international programs. Notably, income level was not considered relevant to the ownership of educational devices, as all students possessed at least one device.

Technology and Device Usage

Nearly half of the students (48.75%) regularly brought electronic devices, such as laptops or tablets, to class. Smartphone ownership was high (51.40%), followed by laptops (49.90%), tablets/iPads (48.17%), and desktop computers (47.98%). However, only 25.6% of students reported that their lecturers explicitly allowed the use of technology during lessons. About 23.7% indicated that their instructors had no clear stance, while 24.9% stated that their instructors did not permit any technology use.

Technology Integration in Teaching

Students rated technology integration in their courses across several dimensions. Rajabhat universities received the highest scores for using platforms like Google Classroom and Moodle, which facilitated access to teaching materials, assignments, and online collaboration. Public universities also performed well, particularly in business and economics courses, where Wi-Fi access and software tools were readily available.

Technology Management in Classrooms

Students evaluated various aspects of technology management, such as assignment distribution and communication with instructors. On a 5-point scale, material distribution (Mean = 3.67) and assignment management (Mean = 3.61) were the most positively rated aspects. However, teamwork promotion (Mean = 2.29) and communication with lecturers (Mean = 2.45) scored lower, indicating room for improvement in fostering collaboration and interaction.

Technology in Teaching Materials and Internet Services

Students also rated the availability of online resources, such as QR codes, photos, and videos, with average satisfaction levels around 3.3 out of 5. The internet and program services, such as Wi-Fi access and learning software, received similar ratings. These moderate scores suggest that while universities provided some technological support, there was potential for further enhancement.

Students' Knowledge and Skills

The survey found that students possessed an intermediate level of technological knowledge (Mean = 3.29–3.38), but many felt uncertain about how to apply this knowledge to their studies and future careers. Skills such as using Excel (Mean = 3.41) and PowerPoint (Mean = 3.34) were ranked as the top competencies, although the high variability in responses suggests differences in the quality of instruction across universities.

Student Satisfaction with Technology

Satisfaction with technology use inside the classroom (Mean = 3.35) was slightly lower than outside the classroom (Mean = 3.39). Interestingly, the Pearson correlation analysis revealed that satisfaction inside the classroom was only weakly related to students' knowledge of technology ($r = 0.092$, $p < 0.05$). In contrast, satisfaction outside the classroom was more strongly correlated with students' skills ($r = 0.118$, $p < 0.01$) and the use of technology for specific purposes ($r = 0.118$, $p < 0.01$).

Key Challenges and Insights

The overall findings suggest that while students are equipped with the necessary technological tools, the effective integration of these tools into teaching practices is still inconsistent. Students generally possess intermediate technological skills but often lack guidance on applying these tools in academic settings or future careers. This indicates a gap between technological proficiency and its practical application, which could be addressed by increasing instructors' engagement with technology-based teaching methods.

While technology is widely available in Thai higher education, its potential is not fully realized. Enhanced training for both students and instructors, coupled with more innovative uses of technology in the classroom, could significantly improve educational outcomes.

Developing SWOT Factors from Lecturer Interviews and Literature Review

To develop strategies for technology integration, the SWOT Matrix can help summarize and focus on the most important factors derived from the common practices and needs of lecturers, as identified from the interviews and literature.

Table 1

Strengths and weaknesses as internal factors

	ICT integration, internal factors
Strengths	*S1*: The students have access to learning material any time they want on the Learning Management System (LMS). *S2*: Computerized Assessment of learners' academic performance becomes easier for the instructor especially for courses with high enrolment. *S3*: Gives easy access to the instructor (or the lecture) at any place and time. *S4*: Educators can use a combination of audio, videos, and text to reach out to their students. *S5*: Beneficial in times of crisis, such as Covid-19. *S6*: Available platform or channel for students to effectively manage their study time and easily complete online/offline assignments on time. *S7*: Facilitates administrative tasks such as recording lectures and marking attendance. *S8*: Enhanced social, interaction, communication, and collaboration *S9*: Cost-effectiveness. Online-based training content combining face-to-face or live sessions may make learning effective. *S10*: Upskilling in new technologies.
Weaknesses	*W1*: The lack of access to internet services, power supply, and digital devices like computers, smartphones, and tablets. *W2*: Lack of proper training skills on the use of online learning platforms for both lecturers and students. *W3*: Easier for students to cheat or plagiarize than in traditional classes without ICT integration. *W4*: Lack of face-to-face relationships and direct communication between students and lecturers.

ICT integration, internal factors
W5: Information available via the Learning Management System (LMS) can be erroneous at times.
W6: Downloading errors, issues with installation, login problems, problems with audio and video, and so on.
W7: Some challenges in dealing with computer-related and technical issues.

The acknowledged strengths highlight the significant benefits of integrating ICT, such as the flexibility of accessing educational materials (S1), enhanced administrative efficiency (S7), and improved social interaction and collaboration (S8). The features listed above demonstrate the ability of ICT to enhance and strengthen the educational process, particularly in times of crisis like the Covid-19 pandemic (S5). Nevertheless, these imperfections also highlight the weaknesses that we need to overcome in order to take full advantage of the benefits of ICT integration.

Several weaknesses, including the scarcity of necessary technology (W1), inadequate training for both instructors and students (W2), and technical issues (W6), can hinder the effective use of ICT in education. Moreover, the concerns about academic dishonesty and the lack of face-to-face communication (W3, W4) highlight the need to take steps to tackle these issues. By giving priority to these areas of expertise and identifying areas that need improvement, educational institutions can develop precise strategies to enhance the integration of information and communication technology (ICT). This may entail investing in infrastructure to ensure reliable technology access, implementing comprehensive training programs for educators and students, and implementing robust procedures to prevent academic dishonesty.

By using the results of this SWOT analysis, we can develop policies and strategies that maximize the benefits of ICT while minimizing its limitations. This will ultimately lead to a more streamlined and comprehensive integration of technology in higher education.

Table 2

Opportunities and threats as external factors

ICT integration, External factors	
Opportunities	*O1*: Reuse content/materials. E.g., Google Slides, VDO content, Google Form
	O2: An App version of the LMS (online platform) could have made it more user friendly for students,
	O3: Provide opportunity for work-life balance.
	O4: Using flipped classroom learning modalities, giving shorter lectures, and increasing instructor-student interaction.

ICT integration, External factors

	O5: Social media and various group forums can be used to communicate with students. Communication is the key when it gets difficult to reach out to students via texts only.
	O6: The quality of the courses should be improved continuously, and instructors must try to give their best.
	O7: Lessons can be designed in such a way that they are creative, interactive, relevant, student-centered, and group based.
	O8: Effective channel for feedback from students, allow them to ask questions, and broaden the learner horizon for the course content.
	O9: Lecturers can practice technology and can design various flexible programs/activities for students' better understanding.
	O10: Stimulate role-playing or case study analysis for history talking, clinical reasoning, and communication skills.
Threats	*T1*: Most videos that are uploaded on the Learning Management System (LMS) lose quality due to the limited formats that users have to adopt.
	T2: ICT integration/E-learning method of training is not suitable for all courses. Disrupts study or does not promote learning at all.
	T3: Scale and personalized teaching and learning are the biggest challenges for teaching.
	T4: It is challenging to develop content which not only covers the curriculum but also engages the students.
	T5: A lack of clarity at setting standards for quality, quality control, development of e-resources, and e-content delivery.
	T6: Group study issues, for example, - Student antipathy towards group work. - Possible inequalities of student abilities. - The free-rider, due to unavailable devices or knowledge of technology.
	T7: Instructors' response time. May take a longer time than face-to-face, or not proper time to request a response.

The suggested possibilities and risks emphasize crucial external elements that impact the integration of ICT in education.

Implementing solutions such as content reuse (O1), developing a mobile application for the learning management system (O2), and leveraging social media for communication (O5) can greatly improve the quality of the learning experience. These features indicate possible opportunities for enhancement and

originality, such as the development of user-friendly platforms and the creation of captivating, interactive teaching (O7).

However, there are several issues that highlight the difficulties of integrating technology into education, including the risk of decreased video quality on learning management system platforms (T1), the limitations of information and communication technology for particular courses (T2), and the obstacles in developing captivating content (T4). It is crucial to handle these hazards in a careful manner in order to guarantee the efficient and purposeful application of ICT.

By focusing on the potential and mitigating the risks, educational institutions can formulate effective strategies for integrating ICT. This may involve allocating resources towards improving infrastructure, offering ongoing professional development opportunities for educators, and enforcing strict quality control standards for e-learning content.

Moreover, the knowledge gained from this SWOT analysis can guide the formulation of policies and strategic plans, thereby optimizing the advantages of ICT while avoiding any potential disadvantages. This strategy will facilitate the development of a more robust and flexible educational setting, better prepared to address upcoming obstacles and disruptions.

Analytic Hierarchy Process (AHP) for Technology Integration Strategies

According to the three education experts, the top 5 factors of each SWOT dimension were listed in Table 3 based on the average of their scores. Focusing only on the highest-ranked factors, the main points for building strategies should be as follows:

- Strength: Beneficial in times of crisis, such as COVID-19.
- Weakness: Lack of access to internet services, power supply, and digital devices like computers, smartphones, and tablets.
- Opportunity: Social media and various group forums can be used to communicate with students. Communication is key when it is difficult to reach out to students via texts only.
- Threat: It is challenging to develop content that not only covers the curriculum but also engages students.

Table 3

SWOT ranking based on the scores from three experts

Strengths	E1	E2	E3	Average	Rank	Weakness	E1	E2	E3	Average	Rank
S1	7	9	9	8.33	2	W1	8	9	9	8.67	1
S3	7	7	8	7.33	4	W2	7	7	6	6.67	4
S4	6	7	8	7.00	5	W3	3	9	9	7.00	3
S5	8	9	9	8.67	1	W4	8	7	9	8.00	2
S10	8	7	9	8.00	3	W6	5	6	9	6.67	5

Opportunities	E1	E2	E3	Average	Rank	Threats	E1	E2	E3	Average	Rank
O1	5	7	9	7.00	3	T1	2	7	9	6.00	5
O2	3	9	9	7.00	4	T2	2	8	9	6.33	3
O5	5	9	8	7.33	1	T4	5	7	9	7.00	1
O6	7	6	9	7.33	2	T5	7	6	8	7.00	2
O7	7	6	8	7.00	5	T7	2	8	9	6.33	4

Using only the average scores from the experts within the same dimension may not be strong enough for drawing conclusions on the factor ranking. Pairwise comparisons between factors provide the weight of importance between factors. The average scores in pairwise comparisons help rank factors appropriately. Table 4 presents the results from the pairwise analysis with a consistency ratio of less than 0.10. The ranking of factors in Table 4 differs from the original scales.

Table 4

SWOT ranking based on pairwise comparisons

Strengths	E1	E2	E3	Average	Rank	Weakness	E1	E2	E3	Average	Rank
S1	0.113	0.254	0.181	0.548	3	W1	0.388	0.269	0.150	0.807	2
S3	0.188	0.156	0.138	0.482	4	W2	0.175	0.171	0.068	0.414	4
S4	0.080	0.082	0.087	0.248	5	W3	0.024	0.356	0.195	0.575	3
S5	0.353	0.400	0.337	1.090	1	W4	0.350	0.133	0.335	0.817	1
S10	0.267	0.109	0.256	0.632	2	W6	0.064	0.070	0.252	0.386	5
Opportunities	E1	E2	E3	Average	Rank	Threats	E1	E2	E3	Average	Rank
O1	0.085	0.120	0.173	0.378	5	T1	0.045	0.112	0.139	0.297	5
O2	0.038	0.436	0.355	0.830	1	T2	0.066	0.389	0.333	0.788	2
O5	0.112	0.285	0.086	0.483	4	T4	0.180	0.146	0.173	0.499	4
O6	0.434	0.091	0.270	0.795	2	T5	0.641	0.081	0.094	0.816	1
O7	0.331	0.068	0.115	0.514	3	T7	0.068	0.272	0.260	0.600	3

To derive strong strategies from the findings, this research will use the average of the summation of the normalized scales (E_{nor}) of the raw scores from the experts based on Table 3 and the weight of factors from the pairwise comparison (P) in Table 4 for ranking the factors in Table 5.

Then, the factors in the same rank will be used for strategy formulation. The five strategies are prioritized for implementation according to the rank in Table 5 for the short term, as the experts were influenced by the COVID-19 situation when selecting the factors. In the long term, these strategies will have no priority of ranking.

Table 5

SWOT ranking based on a combination of normalized factors from experts and pairwise comparison methods

Strengths	E_{nor}	P	Average	Rank	Weakness	E_{nor}	P	Average	Rank
S1	0.212	0.548	0.380	3	W1	0.234	0.807	0.521	1
S3	0.186	0.482	0.334	4	W2	0.180	0.414	0.297	4
S4	0.178	0.248	0.213	5	W3	0.189	0.575	0.382	3
S5	0.220	1.090	0.655	1	W4	0.216	0.817	0.517	2
S10	0.203	0.632	0.418	2	W6	0.180	0.386	0.283	5
Opportunities	E_{nor}	P	Average	Rank	Threats	E_{nor}	P	Average	Rank
O1	0.196	0.378	0.287	5	T1	0.184	0.297	0.241	5
O2	0.196	0.830	0.513	1	T2	0.194	0.788	0.491	2
O5	0.206	0.483	0.345	4	T4	0.214	0.499	0.357	4
O6	0.206	0.795	0.501	2	T5	0.214	0.816	0.515	1
O7	0.196	0.514	0.355	3	T7	0.194	0.600	0.397	3

Strategy 1: S5, W1, O2, T5

A crisis-like situation or challenges that disrupt the typical classroom might lead to new experiences of ICT integration and increased ICT usage for university lecturers. To ensure everyone benefits from such circumstances, internet services, power supplies, and digital devices must be affordable and sufficient. A supportive plan should be implemented by the government, colleges, and private businesses. The online platform may become crucial in the future for technology integration and will require continual improvement. The platform's app version must be user-friendly, and appropriate organizations or corporations should invest more effort to benefit students and lecturers in the long run. Quality control is essential for integrating technology. To ensure the quality of education, there should be established criteria for e-resources and e-content.

Strategy 2: S10, W4, O6, T2

ICT integration should be adopted to upskill students and instructors in emerging technologies. Lecturers focusing on new technology training must push themselves out of their comfort zones. E-learning may be suitable for some elective courses for full-time students who want to learn new skills. If the class is not held on-site, communication between students and lecturers may suffer. Education management must be aware of the disadvantages of a lack of face-to-face interaction. When the quality of a course needs to be maintained or improved over time, both direct and indirect communication should be monitored and controlled. Additionally, not all content is appropriate for e-learning or ICT integration. When creating a technology-based course, the purpose of employing the technology must be clear in terms of enhancing learning.

Strategy 3: S1, W3, O7, T7

Materials should be available for download on an online platform, allowing for constant accessibility. These materials should be creative, interactive, and centered around the students, responding to their learning needs. Some assignments should include group work to foster creativity, teamwork, and interaction. In traditional classes, efforts to prevent and control plagiarism must continue to promote originality and creativity. In e-learning, measures for detecting cheating and plagiarism must be clear and effective. To encourage student learning, lecturers must maintain good relationships with their classes. They can use online channels to provide prompt responses to individuals or the entire class. While quick responses from lecturers can motivate students, lecturers should also allocate sufficient time to manage their workload and maintain a work-life balance. The mental and physical health of lecturers is crucial for conducting efficient, interactive, and creative classes.

Strategy 4: S3, W2, O5, T4

Technology should be available to lecturers at all times and in all places. The goal for technology integration must be to maximize classroom management, allowing instructors to organize teaching and related tasks conveniently, quickly, and cost-effectively. A primary obstacle to maximizing technology use in the classroom is that some lecturers lack proper training in using online learning platforms and other relevant tools. Students may also need similar training, as one-sided use of technology will not be effective. Whatever lecturers know, students should also know.

Social media and various online applications should be acceptable for two-way communication, in addition to email. When developing teaching content, it is essential to focus not only on knowledge and skill development according to the curriculum but also on creating content that engages students and encourages participation.

Strategy 5: S4, W6, O1, T1

Teaching should incorporate a combination of audio, video, and other media. This approach enhances student understanding and engagement with the lesson content. Media can support lecturers by explaining details, providing briefings, or introducing topics, reducing the need for lecturers to handle all tasks themselves. Additionally, media can create a more friendly classroom environment, be reused to save time, and support students in preparing for or reviewing lessons. Media can also be used for quizzes and exams.

However, there are concerns about controlling and improving the platform for uploading media. Lecturers and students may face login problems and downloading errors, and some learning management systems may reduce the quality of video, audio, or other media. Therefore, selecting the right learning management system is crucial, and relevant parties should continuously seek ways to improve the system.

◼ Discussion

The findings of this study offer valuable insights into the state of ICT integration in Thai higher education before the COVID-19 pandemic and provide a foundation for analyzing the impacts of the

pandemic on education. The survey data, which reveals that the overall level of ICT integration was not particularly high in 2019, highlights areas where improvement is needed. Students' satisfaction with technology use was more evident outside the classroom, indicating that classroom-based integration of technology lagged behind.

This study also demonstrates a correlation between students' knowledge of ICT provided by their faculties and their satisfaction with its use in the classroom. However, the lower level of correlation (coefficient of 0.092) between students' ICT knowledge and classroom satisfaction suggests that theoretical understanding alone does not significantly enhance satisfaction. This may be due to limited opportunities for practical application of ICT in the classroom, where students might not be engaging with technology as interactively as outside the classroom. To reinforce the argument, several studies highlight the importance of practical ICT application in improving student satisfaction and engagement. For instance, Purwadi et al. (2021) investigated student perceptions of online learning during the COVID-19 pandemic. Their findings emphasize that while students recognize the benefits of online learning, satisfaction is closely linked to how effectively technology is used in the classroom. They concluded that theoretical knowledge of ICT does not necessarily translate into satisfaction without opportunities for interactive engagement with technology.

Similarly, Mukhtar et al. (2020) discuss the limitations of online learning during the pandemic and emphasize that students' satisfaction is heavily influenced by the effective integration of ICT tools into the learning process. Their research suggests that without practical engagement, students may not fully appreciate the advantages of ICT in education.

Additionally, the higher satisfaction with technology outside the classroom correlates with students' kills and purposeful use of ICT, indicating that providing students with practical, real-world applications of technology may enhance their experience and engagement.

The SWOT analysis identifies key factors that must be addressed to improve the integration of ICT in Thai higher education. The strengths, such as the flexibility ICT offers in times of crisis like COVID-19, emphasize the potential of technology to enhance educational resilience. However, weaknesses like limited access to necessary resources (e.g., internet services, power, and digital devices) highlight ongoing challenges that need to be addressed.

The post-pandemic acceleration of ICT adoption presents opportunities for long-term improvements in higher education. For example, developing user-friendly learning management systems (LMS) and ensuring equitable access to technology can create a more inclusive educational environment. However, potential threats, such as the difficulty of developing engaging digital content and the risk of academic dishonesty, must be managed carefully to avoid undermining these advances.

The Analytic Hierarchy Process (AHP) results provided a clear prioritization of SWOT factors, which are crucial for developing effective strategies for ICT integration in Thai higher education. The strategies that emerge from this study focus on leveraging the strengths of technology integration while addressing weaknesses through improvements in infrastructure and training.

■ Conclusion

This study provides an in-depth analysis of the state of ICT integration in Thai higher education prior to the COVID-19 pandemic, highlighting both the progress made and the challenges still to be addressed. The survey results from 519 bachelor's degree students and interviews with lecturers and experts reveal that, while some advancements had been made in technology use within classrooms, overall integration remained at a moderate level. Students' knowledge of ICT and their skills showed room for improvement, particularly in the areas of purposeful technology use and satisfaction within classroom environments.

The SWOT analysis, complemented by the Analytic Hierarchy Process (AHP), offers a strategic roadmap for enhancing ICT integration. The findings emphasize the importance of addressing key weaknesses such as inadequate access to digital devices and insufficient training for both students and lecturers. Strengths, including the flexibility of ICT in times of crisis, and opportunities such as leveraging social media for communication, offer promising avenues for future development.

The COVID-19 pandemic has acted as a catalyst for ICT adoption, pushing educators and institutions to adapt rapidly. Moving forward, it will be essential to build on this momentum by refining ICT strategies, ensuring equitable access to technology, and improving the quality of digital content to enhance student engagement. Long-term strategies for ICT integration should focus on upskilling students and lecturers, improving infrastructure, and developing more interactive and student-centered digital platforms. By doing so, Thai higher education can better prepare for future disruptions and support continuous innovation in teaching and learning.

■ Limitations or Suggestions

Limitations

While the survey included 519 bachelor's degree students, the sample size may not fully represent the diversity of experiences and perspectives across all universities in Thailand. The findings might be more reflective of certain regions or institutions. Additionally, biases such as the tendency to present oneself in a socially acceptable manner or the potential for inaccurately evaluating one's own skills and knowledge may influence the data that students and instructors themselves submit for the study.

Technological advancements may have changed or replaced the tools and platforms mentioned in this research, potentially impacting the applicability of the findings. This research focused on select parts of ICT skills and technology utilization while neglecting to thoroughly investigate other crucial elements such as digital literacy, cybersecurity awareness, and the incorporation of upcoming technologies like AI and VR.

Furthermore, the findings from Thai higher education institutions may not be directly applicable to other countries or regions with different educational systems, cultural contexts, or levels of technological development.

Finally, since the study was conducted before the pandemic, the subsequent shifts in education practices due to COVID-19 might have led to different attitudes and practices regarding technology integration that are not reflected in this research.

Suggestions

Conducting a post-pandemic survey will help capture the changes and latest status of ICT integration in education systems. Examining the long-term impact of the pandemic on educational practices and technology use will lead to more robust and adaptive ICT integration strategies. A larger and more diverse sample of students and instructors from different regions and institutions will better represent the broader educational landscape. Examining how economic conditions and infrastructure differences affect access to and success in ICT integration across regions will provide a more comprehensive understanding of these economic and infrastructural factors. Moreover, comparing the findings with other countries will help contextualize the application of ICT integration strategies on a global scale.

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