Report on Digital Transformation in Higher Education in Southeast Asia

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Authors: Hong T. M. Bui, Tinh T. T. Le, and Hoa T. M. Nguyen

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Cover image: Generated by Dreamina using the prompt 'Creating a cover that reflects the digitisation of higher education in Southeast Asia. Background should reflect the Southeast Asian region, and also include technological elements such as mechanical gears and intelligent devices, together with educational elements such as paper, pen and graduation caps. Several rows of young people are arranged in the middle of the picture. The background is a dynamic abstract pattern with strong colour contrasts. Technological elements are depicted with a heavy texture as if steeped in history, while educational elements are shown with delicate strokes'.

For more information, please contact: bangkok@unesco.org office@ichei.org www.ichei.org 0755-88010925

Report on Digital Transformation in Higher Education in Southeast Asia

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Foreword

In recent years, the rapid development of digital technologies has triggered a new wave of transformation in various sectors. The integration of technology in teaching, learning and institutional management is an essential step for the advancement of higher education systems. While digital technologies offer immense potential for higher education development and innovation, a persistent tension exists between the speed of technological iteration and the adaptability of educational systems, posing challenges to the smooth digital transformation of higher education.

In Southeast Asia, a region marked by the convergence of diverse civilizations, digital transformation in higher education manifests itself through a wide range of initiatives. From Cambodia's rounded policies for implementing digital transformation to address barriers to digital education, to Indonesia's "Freedom to Learn" program promoting the integration of digital tools into everyday practices; from Malaysia's "Higher Education 4.0" driving paradigm shifts, to Singapore's Smart Nation Strategy, which reshapes the industry-academia-research system; from Thailand's efforts to promote international collaboration in higher education through faculty exchanges, cooperative research and joint programs, to Vietnam's policies encouraging HEIs to modernize curricula and invest in digital infrastructures - these practices across eleven Southeast Asian countries collectively form a unique developmental map towards the digital transformation of higher education. While numerous achievements are noteworthy, challenges, such as weak digital infrastructure, widened digital divide, and insufficient policy coherence and implementation, remain.

Against this backdrop, the UNESCO Regional Office in Bangkok and the International Centre for Higher Education Innovation under the auspices of UNESCO (UNESCO-ICHEI) jointly conducted a study to explore how digital technologies are reshaping the regional higher education landscape, highlighting the current challenges, opportunities and solutions for effective digital transformation in higher education. This outcome report presents a panoramic view of the regional digital transformation ecosystem through systematic literature review, analysis of 35 national policy documents, and in-depth case studies. To chart the way forward, the report proposes five strategic pillars for higher education institutions to accelerate their digital transformation processes, encompassing teacher professional development, digital equity and inclusion, digital organizational identity, digital well-being, and digital change management.

Following the spirit of UNESCO's Higher Education Roadmap 2030: Beyond Limits - New Ways to Reinvent Higher Education, the report emphasizes a human-centered and technology-empowered approach to educational transformation. We hold the firm belief that by promoting digital equity, enhancing digital skills, and effectively integrating new technologies, Southeast Asia can build a more inclusive, diverse, resilient, and innovative higher education system.

Jin Li

Director of UNESCO-ICHEI

How is digital transformation reshaping higher education in Southeast Asia—not just in the use of technology, but in how universities function, connect, and prepare learners for a rapidly evolving future? What are the most significant shifts in digital culture? And how are higher education institutions navigating the widening gap between digital ambition and on-the-ground realities?

These questions are particularly urgent in Southeast Asia, a region of nearly 700 million people and over 7,000 universities serving some 12 million students. While many institutions began experimenting with digital tools over a decade ago, it was the disruption of the COVID-19 pandemic that catalyzed widespread transformation and exposed deep divides in digital skills, infrastructure, funding, and institutional readiness. As artificial intelligence and other emerging technologies reshape the global education and labour landscape, the region's higher education systems are under pressure to evolve.

This report offers a comprehensive response to this moment. It is the product of a joint research initiative between the UNESCO Regional Office in Bangkok and Office for UN Coordination for Asia and the Pacific (UNESCO Bangkok) and the UNESCO International Centre for Higher Education Innovation (UNESCO-ICHEI), combining a systematic literature review, regional policy analysis, and a critical examination of case studies across Southeast Asia. It draws on more than 270 studies from the past decade and reflects the diversity of digital transformation across the region—from Malaysia and Indonesia to Cambodia, Lao PDR, and Timor-Leste.

Conducted by the UNESCO Regional Office in the framework of SDG4 coordination efforts in the Asia-Pacific and the transforming higher education agenda, this report reflects UNESCO's commitment to supporting evidence-based policy dialogue, building institutional capacity, and promoting equitable and quality-driven digital transformation in higher education. It will inform SDG4 coordination and acceleration efforts under the Learning and Education 2030+ Networking Group, which is part of the UN Regional Collaborative Platform advancing the Sustainable Development Goals.

At UNESCO, we believe that digital transformation must be guided by public values—principles like equity, inclusion, and the right to quality education for all. Done right, digital transformation can accelerate progress toward Sustainable Development Goal 4 by expanding access, improving quality, and strengthening the resilience of higher education systems. That means supporting institutions to develop the leadership, capacity, and pedagogical strategies needed to ensure that digital change benefits all learners.

This report is offered as both a resource and a catalyst—for policy dialogue, institutional reflection, and collaborative action across Southeast Asia's vibrant and diverse higher education landscape.

Soohyun Kim

Regional Director

UNESCO Regional Office in Bangkok and Office for UN Coordination for Asia and the Pacific

Acknowledgements

This report is a snapshot of a rapidly evolving landscape, and we hope it contributes to the broader dialogue on educational innovation in the region.

The research would not have been possible without the generous support, collaboration, and insights of numerous individuals and institutions across Southeast Asia. We would like to acknowledge their commitment to advancing a deeper understanding of digital transformation in higher education.

This research was made possible through the institutional support of the International Centre for Higher Education Innovation under the auspices of UNESCO (UNESCO-ICHEI).

We are extremely grateful to the authors of the report, Hong T. M. Bui, Tinh T. T. Le, and Hoa T. M. Nguyen. Our sincere thanks go also to the research assistants – Faisal Mustafa, Nina Inayati, and Hoa Le – whose contributions to the systematic literature review were invaluable. We also extend our appreciation to the reviewers, whose insightful comments greatly enhanced this report.

We would like to gratefully acknowledge the coordination of the Education Section team at the UNESCO Regional Office in Bangkok, as well as the contributions of our colleagues from the UNESCO Offices in Hanoi and Phnom Penh, who provided valuable country insights to help review, contextualize, and enrich the study.

Disclaimer

Acronyms and Abbreviations

AR	Augmented reality
ASEAN	Association of Southeast Asian Nations
AUN	ASEAN University Network
AUN-TEPL	AUN Thematic Network on Technology-enhanced Personalized Learning
BI	Business intelligence
CHED	Commission on Higher Education
COIL	Collaborative online international learning
COVID	Coronavirus disease
DEPA	Digital economy promotion agency
DOI	Digital organizational identity
DT	Digital transformation
DTxHE	Digital transformation in higher education
EDI	Equity, diversity, and inclusion
EdTech	Educational technology
EMA	Electronic management of assessment
EU	European Union
GenAI	Generative artificial intelligence
Generation Z	People who were born between 1995 and 2012
GOL	Globalized online learning
HE	Higher education
HEI	Higher education institution
ICT	Information communication technology
IoT	Internet of Things
IP	Intellectual property
IPST	Institute for the Promotion of Teaching Science and Technology
IR 4.0	Fourth Industrial Revolution
IT	Information technology
JISC	Joint Information Systems Committee (UK)
KPI	Key performance indicator
LMS	Learning management system
MOOC	Massive open online courses
MYREN	Malaysia Research and Education Network
NRF	National Research Foundation
NUS	National University of Singapore
NTU	Nanyang Technological University
OERs	Open educational resources
OHEC	Office of HE Commission
PLC	Professional Learning Community
R&D	Research and development
SEA	Southeast Asia
SEAMEO	Southeast Asian Ministers of Education Organization
SHARE	Support to Higher Education in the ASEAN Region
TEL	Technology-enhanced learning
TNE	Transnational education
TPD	Teacher professional development
VLE	Virtual learning environment
VPN	Virtual private network
VR	Virtual reality

Executive Summary

Southeast Asia (SEA) is a diverse region with eleven countries: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (Lao PDR), Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam. The region's population has reached nearly 700 million (UN, 2024). Based on the data of the European Union (EU) SHARE project[1], more than 7,000 universities in this region are hosting around 12 million students. Singapore has made significant progress in both its economy and higher education sector, with notable differences compared to some other countries in the region, such as Cambodia, Lao PDR, Myanmar, and Timor-Leste.

The digital transformation in higher education (DTxHE) in the region is not homogeneous. It is rooted in national strategies that enable a digital economy, and each country is different in the stage of digitalization. Many SEA universities started their digitalization process over a decade ago. However, that process did not substantially take off until the disruption of the COVID-19 pandemic. The pandemic has caused significant disruptions to higher education institutions (HEIs) worldwide, including in Southeast Asia (SEA). It has urged SEA's HEIs to digitally transform faster to adapt to the disruption of several waves of complete lockdowns.

DTxHE is a complex and multifaceted process that leverages technologies to innovate and transform the HE ecosystem, particularly in the context of fast-changing artificial intelligence (AI) development. This process involves changes in structure, function, culture and mindsets to enable the systems to achieve stronger operational vitality and enhance value creation. Thus, DTxHE is beyond digital delivery. It creates new and novel teaching and learning paradigms, especially in readiness to adapt disruptive technologies for a future workforce that needs constant reskilling and upskilling.

As a dynamic economic region in the world, DTxHE is particularly urgent in SEA. According to a UNESCO (2021) report on digitalization, inadequate digital skills and competencies rank as the single most significant barrier to using technology for education. Together with the challenges of a shortage of quality teachers and insufficient funds for universities, developing countries face a significant digital divide. DTxHE seems to be a unique solution to the dilemmatic triangle problem of balancing cost, scale, and quality, and enhancing the teaching and learning quality to meet the needs of the global labor market. In other words, DTxHE may create values that have never been anticipated.

This report is rooted in a joint research initiative between the UNESCO Regional Office in Bangkok (UNESCO Bangkok) and the International Centre for Higher Education Innovation under the auspices of UNESCO (UNESCO-ICHEI). It focuses on SEA's DTxHE. It aims to provide stakeholders with a better understanding of the following:

- How has digital technology changed the landscape of HE in recent years in the region, and what are some of the most significant trends and developments that have emerged?

- What are the key challenges and opportunities associated with DTxHE in the region, and how are universities and governments addressing them?

This DTxHE report comprises three studies: (a) a

[1] See www.share-asean.eu.

systematic literature review, (b) a policy analysis, and (c) a critical analysis on case studies. Both systematic literature review and policy analyses are anchored on the United Kingdom Joint Information Systems Committee's (JISC) comprehensive framework (2023) for DTxHE. The framework has widely been employed for DT analysis because it provides "a comprehensive perspective on how the digital environment can support positive work, research, and learning experiences, and promote a sense of belonging and wellbeing" (JISC, 2023, p. 6). It consists of six dimensions: (1) organizational digital culture, (2) knowledge creation and innovation, (3) knowledge development, (4) knowledge management and use, (5) knowledge exchange and partnerships, and (6) digital and physical infrastructure.

The systematic literature review study investigates studies on DT in SEA countries published in the period of 2014-2023 to identify opportunities and challenges associated with DT in the region. A total of 279 studies included in the review were extracted from three reputable databases, i.e., Scopus (99 studies or 35%), Web of Science (54 studies or 20%), and ProQuest (126 studies or 45%). Some 35.5% of those articles are about DTxHE in Malaysia, 28% in Indonesia, 12.5% in Vietnam, 11.5% in Thailand, 6.8% in the Philippines, 3.9% in Singapore, 0.7% in Brunei Darussalam, 0.7% in Cambodia, and 0.4% in Myanmar. The systematic literature review identified no studies from Lao PDR and Timor-Leste. Most of the studies were published between 2020 and 2023, which shows that the COVID-19 pandemic has impacted digital transformation in the region.

Research on DTxHE in SEA reveals more opportunities than challenges. However, it also shows that in the last decade, this region's DTxHE focused more on dimensions (1) organizational digital culture and (4) digital knowledge management and use but less on the other four dimensions. Dimension (6) digital and physical infrastructure had been discussed in research long before the studied period. In contrast, dimensions (2) knowledge creation and innovation, (3) knowledge development, and (5) knowledge exchange and partnerships do not seem to be studied on a grand scale by HEIs in this region. The systematic literature review study shows that the digital technology profile across countries in SEA varies considerably. Digital technology adoption in HE not only presents opportunities but also comes with various challenges. It also requires ongoing efforts to maximize the opportunities, address challenges, and ensure that all students can benefit equally.

The policy analysis study thoroughly reviews 35 national policy documents about DTxHE from the region. Thematic coding was employed to analyze the policy documents, offering a comparative view of how SEA countries have navigated DTxHE. It reveals that DTxHE in SEA is increasingly shaped by national and regional policy frameworks designed to integrate digital technologies into teaching, learning, and administrative processes.

A prominent policy trend is the prioritization of knowledge development and innovation. Countries like Vietnam and Cambodia have introduced policies encouraging HEIs to modernize curricula and invest in digital infrastructures, positioning themselves to

align with global standards. Despite progress in digital innovation, many SEA countries lack comprehensive policies for effectively managing institutional knowledge and digital resources. While current policies promote knowledge creation, there is insufficient attention to building systems that capture, share, and utilize knowledge to enhance institutional capacity. A stronger policy focusing on knowledge management would ensure that institutions can sustainably benefit from the digital information they generate.

Policies across the region aim to embed digital learning and assessment into national strategies. Singapore and Malaysia, in particular, are leveraging advanced technologies like artificial intelligence (AI) and virtual reality (VR) as part of their policy-driven educational frameworks, reflecting a broader commitment to innovation in educational delivery. The rapid shift towards digital learning requires policies that better support educators in adapting to new teaching modalities. Although some progress has been made, there is still a lack of structured, policy-driven professional development programmes that provide faculty with the necessary digital teaching skills. Expanding national strategies to include continuous professional development in digital pedagogy would ensure that educators are fully equipped to deliver effective digital learning experiences.

Policy directives in the region also focus significantly on infrastructure development. Governments are investing in digital infrastructure as a foundational pillar for education reform. Singapore, Malaysia, and Timor-Leste have established policies aimed at expanding internet access, developing digital learning centers, and upgrading IT systems to support a more inclusive and technologically equipped educational environment. These infrastructural investments are central to the region's long-term strategies for achieving both national and regional education goals. However, policies often fail to provide adequate specialized support for researchers, particularly in terms of IT services, data management, and cybersecurity. Future policy initiatives should focus on enhancing digital research capabilities by providing clear frameworks for the management and security of research data and tools.

A key aspect of policy focus is the fostering of a digital organizational culture within HEIs. Governments across SEA emphasize the need for educational institutions to adapt their internal cultures to be more innovation-driven and technologically receptive. Policies such as Malaysia's Higher Education 4.0 (HE 4.0) and Indonesia's Merdeka Belajar (Freedom to Learn) initiative reflect a concerted policy push toward fostering environments where digital tools are integrated into everyday educational practices. At the same time, digital literacy is being elevated through national policy initiatives, with countries like Vietnam and Cambodia implementing programs to ensure that educators and students acquire the digital competencies necessary to thrive in a rapidly evolving technological landscape. However, cultivating a digital organizational culture is not yet fully reflected in policy frameworks across the region. While governments are pushing for innovation and technological adoption, policies often lack the depth needed to foster an organizational culture that promotes digital literacy, adaptability, and continuous learning. More robust policy measures are needed to embed DT into the ethos of educational institutions,

ensuring that they remain responsive to future technological advancements.

In terms of international collaboration, regional policies are encouraging partnerships with global institutions to enhance the quality of digital education. Vietnam and Thailand, for instance, have used policy tools to drive international faculty exchanges, research collaboration, and joint programs, which are critical for embedding global best practices in DT. These efforts are reflected in national education strategies that aim to build capacity and raise the international profile of SEA's HEIs.

Digital equity and inclusion also present significant policy challenges. While some countries, like Singapore and Malaysia, have made strides in addressing digital disparities, many policies do not sufficiently address the needs of disadvantaged groups, particularly students in remote or underserved areas. There is an urgent need for policy interventions that promote digital access and ensure that all students can participate equitably in digitally transformed educational environments.

The critical analysis of cases selects three typical cases: Singapore, Cambodia, and Vietnam. These cases are chosen for at least two reasons. First, they represent different perspectives and stages of DTxHE development in policy and practice. Second, successes, challenges, and issues presented in these cases are all helpful for other countries both within and outside this region to learn and enhance their DTxHE accordingly.

Singapore has become one of the world's leading and innovative digitalized countries with outstanding DT policies, investment and implementation over the last four decades. Its DTxHE started in the early 1980s to consider information communication technology (ICT) as its unique choice to develop the country and its HE. The country has invested significantly and consistently in building concrete digital infrastructures and talent pools for a vision of "Digital to the Core, Serves with Hearts" via the Smart Nation Strategy, SkillsFuture Program. Smart universities are the consequent output of Singapore's efforts and investments in DTxHE.

Cambodia is one of the region's least developed economies. Its education system was severely disrupted during the Khmer Rouge regime (1975-1979). With assistance from other countries, Cambodian universities were gradually restored in the 1980s. Under such a context, its DTxHE must have been a longer and more painful journey. Fortunately, the Cambodian government seems to have paid attention to DT via its rounded policies, which are reflected in all six components of the JISC's DT framework. It is a rare case of rounded and comprehensive policy development in SEA, except Singapore. An appropriate strategic vision of DT is vital for countries in their DTxHE processes.

Vietnam's DTxHE is chosen because its digital development looks similar to many other developing countries in the region and around the world: while policy implementation varies across institutions, the government has made efforts to strengthen coherence through national digital transformation roadmaps and cross-ministerial initiatives. There are observable differences in the pace of digital transformation between public and private HEIs, partly due to variations in institutional autonomy and resource mobilization capacity.

A tight budget and tensions about autonomy for public HEIs have hindered DTxHE substantially. Budget constraints and ongoing discussions regarding institutional autonomy present challenges to the advancement of DTxHE. Some private HEIs, especially resource-rich ones, with greater flexibility in mobilizing resources, have been able to adopt proactive approaches to digital transformation.

The absence of a nationally coordinated approach and leading institutions in the sector has contributed to fragmented progress in digital transformation. HE lacks a holistic approach to DT, as DTxHE was not fully embedded into and engaged in the national DT in the early days. The lack of coordination in DTxHE may limit the sector's ability to align with the broader digital economy, potentially impacting the readiness of graduates for future labor market needs. The country needs to speed up its DTxHE process to harmonize with the world's digital development trend.

Since 2023, generative AI (GenAI) has been seen as a significant disruption, which has put HEIs in a dilemma of "to use or not to use GenAI" and is changing DTxHE toward an uncertain future. The application and integration of GenAI in DTxHE, again, largely rely on the universities' research-informed evidence, resources, and autonomy. It will take a while for the scholarly community to fully understand GenAI and its impact on DTxHE. Emerging ethical concerns include the legitimacy of data used to train GenAI, as well as potential risks to academic integrity through misuse in student assessments. These challenges are being faced globally.

This report proposes five strategic pillars for HEIs to accelerate their DT process as follows:

- Strategic Pillar 1: Enhancing teacher professional development (TPD) via promoting digital literacy curriculum innovation, cross-disciplinary digital innovation labs, digital ethics in education, peer learning groups, and digital teaching recognition schemes.

- Strategic Pillar 2: Promoting digital equity and inclusion to reduce digital gaps via digital access initiatives, inclusivity workshops for university lecturers and managers, and monitoring and evaluating these activities.

- Strategic Pillar 3: Developing a digital organizational identity (DOI) that aligns with the university's mission, the digital economy, and global digital trends.

- Strategic Pillar 4: Integrating digital wellbeing into the university's wellness programs to manage the impacts of digital usage, such as digital detox initiatives (Marciano et al., 2024), and digital wellbeing workshops.

- Strategic Pillar 5: Managing digital change by empowering staff and students to adapt to and benefit from emerging digital technologies and trends, including GenAI, via strategic foresight committees, risk mitigation framework, and a culture of adaptability.

Introduction of the Report

Southeast Asia (SEA) is one of the most diverse regions in the world, with eleven countries: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (Lao PDR), Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam. The region's population has reached nearly 700 million (UN, 2024). Based on the European Union (EU) SHARE project data, more than 7,000 universities in this region are hosting around 12 million students[2].

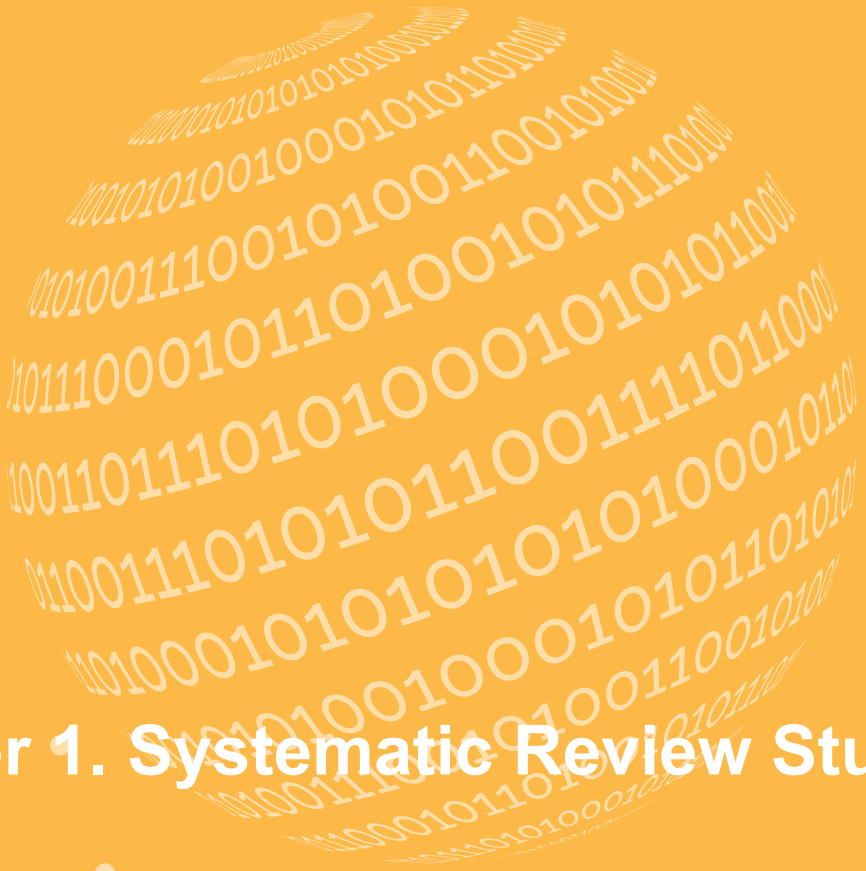
The region has set up an organization called the Southeast Asian Ministers of Education Organization (SEAMEO) to promote cooperation in education, science, and culture. Ten countries in the region, except Timor-Leste, are members of the Association of Southeast Asian Nations (ASEAN). ASEAN member countries founded the ASEAN University Network (AUN) in 1995. It was formed to "address the need for the region to quickly develop a regional identity and solidarity while promoting the fostering of ASEAN talents by creating a platform to allow the region's leading HEIs to collaborate" (AUN website). AUN has 30 university members, but all are large public universities in ASEAN countries; none are private, even though private universities have flourished for at least the last decade.

The digital transformation in higher education (DTxHE) in the region is not homogeneous. It is rooted in national strategies that enable a digital economy, and each country is different in the stage of digitalization. For many countries in the region, the DTxHE process did not proactively take off until the COVID-19 pandemic in 2020. The pandemic has caused significant disruptions for higher education institutions (HEIs) worldwide, including those in SEA. It has surged SEA's HEIs to digitally transform faster to adapt to the disruption of several waves of complete lockdowns. However, the digitalization process in the eleven SEA countries varies, depending on not only their government's policies but also the determinations of each HEI in the region. For example, Singapore had its vision and strategy towards a digital economy in the 1980s, while digitalization was not a policy focus for many other countries until recent decades. The differences in digitalization stages among Southeast Asian countries are reflected in the DTxHE of the region, as discussed in this report.

This report is anchored on the United Kingdom Joint Information Systems Committee's (JISC) comprehensive framework for DTxHE. The framework has widely been employed for DT analysis because it provides "a comprehensive perspective on how the digital environment can support positive work, research, and learning experiences, and promote a sense of belonging and wellbeing" (JISC, 2023, p. 6). The framework consists of six dimensions: organizational digital culture, knowledge creation and innovation, knowledge development, knowledge management and use, knowledge exchange and partnerships, and digital and physical infrastructure. The JISC framework is illustrated in Figure 1. Two main studies were conducted for this report. One was a literature systematic review analysis, and the other was a policy analysis. Secondary data on universities' websites, the AUN website, and 44 interviews with university leaders on DT in the post-COVID-19 pandemic era were collected and analyzed to develop three case examples. All is to gain insights into the DT process in SEA.

The report is structured as follows. It begins with a systematic review of the literature on DTxHE and then a policy analysis of DT over the past decade. After that, it discusses how DTxHE policies have been translated into implementation with some prominent examples. The report concludes with implications for practice, policy and further research.

[2]See www.share-asean.eu.



Chapter 1. Systematic Review Study

Chapter 1. Systematic Review Study

Abstract

The COVID-19 pandemic has forced HEIs, including those in eleven SEA countries, to embrace swift DT. The objective of this systematic literature review is to explore the opportunities and challenges of institutions in eleven countries in SEA (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam) between 2014 and 2023.

The study reviewed the articles published in peer-reviewed journals indexed in Scopus, Web of Science, and ProQuest databases between 2014 and 2023. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) proposed by Page et al. (2021). From 1,145 articles that resulted after the initial search, 279 were selected after eliminating articles that did not meet the selection criteria. The studies are based on research conducted in Malaysia (35.5%), Indonesia (28%), Vietnam (12.5%), Thailand (11.5%), the Philippines (6.8%), Singapore (3.9%), Brunei Darussalam (0.7%), Cambodia (0.7%), and Myanmar (0.4%). The literature search found no relevant studies based on research in Lao PDR or Timor-Leste.

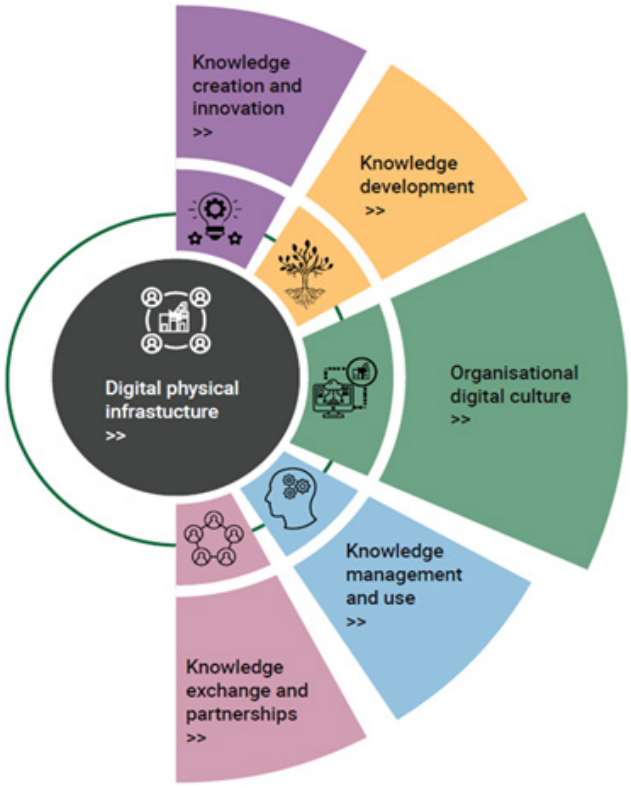
The review results are organized following framework (JISC, 2023), consisting of six dimensions: (1) organizational digital culture, (2) knowledge creation and innovation, (3) knowledge development, (4) knowledge management and use, (5) knowledge exchange and partnership, and (6) digital and physical infrastructure.

In general, the results show that DT provides more opportunities than challenges in all dimensions of DT in most SEA countries. In addition, research on DTxHE has adequately addressed organizational digital culture and digital knowledge management, but less focus was directed to the other four dimensions.

1.1. Introduction

This systematic review study on DTxHE in SEA is anchored on JISC's framework (2023) to understand how far SEA's HEIs have gone in the DT process. Based on 279 studies from the region published between 2014 and 2023, and drawing on JISC's framework, this systematic review investigates how eleven countries in SEA have implemented their DTxHE over the last decade.

Figure 1. DTxHE Framework (JISC, 2023)



A total of 279 studies, constituting approximately 45%, were disseminated through ProQuest, while 99 studies (35%) found their dissemination platform in Scopus, and the remaining 54 studies (20%) were distributed through Web of Science. The research landscape comprises 169 quantitative studies (61%), 65 qualitative studies (23%), and 45 studies (16%) adopting mixed methods[3]. Figure 2 and Figure 3 depict a comprehensive representation of the distribution of publications and their associated methodologies across various years and countries.

Figure 2. Publication years of reviewed studies

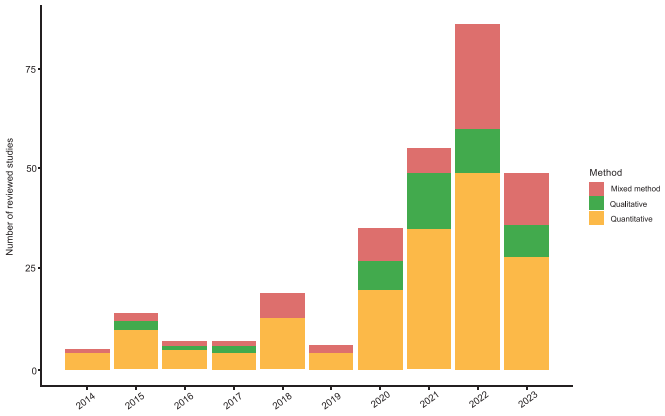
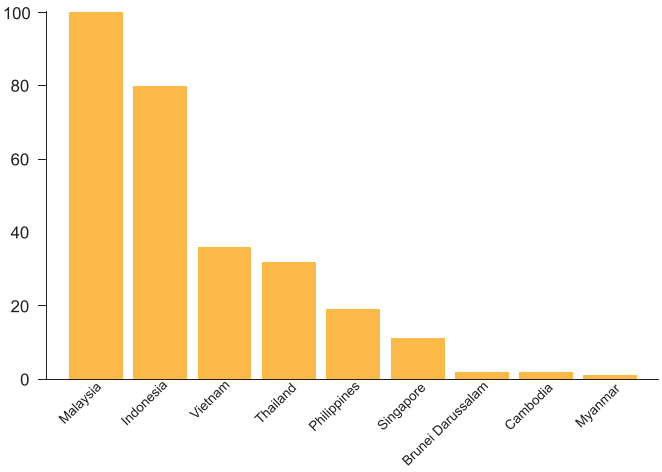


Figure 2 shows that quantitative research has dominated the publication since 2014. However, more qualitative studies were published during the pandemic and post-pandemic eras. The figure also indicates that mixed-method studies became popular in the post-pandemic period, which suggests that there was a need to understand the digital transformation in greater detail.

More than half of the studies included in the review were conducted in Malaysia and Indonesia. This number is expected because there is an urgency to publish research among academicians in these two countries. The details of the countries where the research was conducted are visualized in Figure 3.

Figure 3. Number of reviewed studies per country



Subsequently, the analysis will expound upon the discerned findings pertaining to the six constituents encapsulated within the DTxHE framework, as articulated by JISC (JISC, 2023).

Review inclusion criteria:

- Research topic related to 6 dimensions of DTxHE;
- Research context within Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam;
- Only empirical studies;
- Only publications in English;
- Published between 2014 and 2023;
- Within the databases of Scopus, Web of Science, and ProQuest.

Since the coding process was performed by three coders, it was necessary to ensure that all coders had the same understanding of coding process. Cohen's kappa coefficient is one of the statistical

[3]Full list of reviewed papers can be provided upon request.

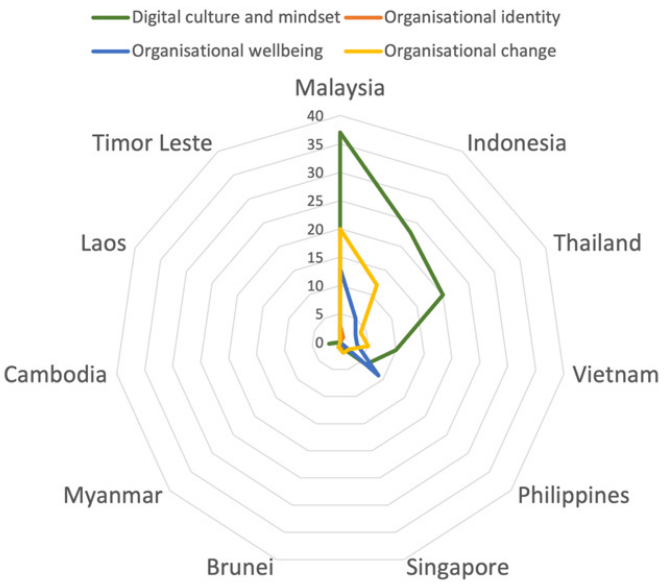
tests to determine how much one coder agreed with another in a coding article. The Cohen's kappa coefficients of inter-coder reliability were 0.83 (Coder A and Coder B), 0.70 (Coder A and Coder C), and 0.70 (Coder B and Coder C). These figures show that the levels of agreement or known as inter-coder reliability levels are considered substantial (Cheung & Tai, 2023; Landis & Koch, 1977).

1.2.Findings

1.2.1. Component 1: Organizational Digital Culture

According to JISC (2023), organizational digital culture refers to values, beliefs, and practices related to the use of digital technology in HE. This DT component is divided into four subcomponents: digital culture and mindset, organizational identity, organizational wellbeing, and organizational change (JISC, 2023). The subcomponent of digital culture and mindset encompasses individuals' attitudes, behaviors, beliefs, and practices regarding digital technologies and their impact on organizational activities. In addition, organizational identity refers to the distinct features and traits that set an organization apart from others. This subcomponent describes digital activities that promote strategic principles and values, influence business practices, and affect stakeholders. Furthermore, digital wellbeing focuses on enhancing the physical, emotional, and mental health of all involved. It covers the influence of digital technologies on living, working, learning, and personal wellbeing management. Finally, organizational change refers to the endeavor by higher education institutions to facilitate adaptation among stakeholders through deliberate changes and actions. Figure 4 presents the number of studies on each subcomponent in each country in the region.

Figure 4. Density of literature on organizational digital culture per country



The literature shows great interest from Malaysia and Indonesia in universities' digital culture in terms of digital mindset, organizational change and organizational wellbeing. No study regarding university digital culture in Cambodia, Lao PDR, Myanmar, and Timor-Leste was found, but that may not indicate a lack of interest. It is possibly because researchers in these countries do not publish their findings in English.

The opportunities and challenges concerning each subcomponent of the organizational digital culture component in SEA's HE are summarized below. The key challenges for SEA regarding organizational digital culture are the lack of mindset to build an agile culture for DT (e.g., Ong & Annamalai, 2023; Rahim et al., 2023; Werang & Leba, 2022; Yoshida et al., 2021) and the lack of care for wellbeing of employees (e.g., Amboy et al., 2023; Martinez & Cabale, 2021), particularly during the COVID-19 pandemic. In the area of organizational digital culture, the studies analyzed mostly cover

digital culture and mindset, followed closely by organizational wellbeing. Limited studies focus on organizational identity and organizational change; both should direct future studies to advance the understanding of SEA's HE digital culture and inform HE practices.

Challenges

Digital mindset

- Lack of mindset to build an agile culture for DT among different stakeholders (teachers, tutors, students, course designers, etc.).
- Declining student interaction in online learning during the pandemic.

Organizational identity

- Lack of agency from learners' and lecturers' perspectives in online learning and teaching experience.

Organizational change

- Governments are not ready for DT, particularly in terms of efficiency, transparency, and accountability.

Organizational wellbeing

- Lack of emotional resilience: negative emotional experiences, such as stress and loneliness.
- Online bullying.
- Limited e-health literacy.
- Physical issues related to prolonged online activities.

Opportunities

Digital Mindset

- Teachers' and students' motivations to learn digital technology.
- Higher readiness for blended learning among students.
- Student online solidarity in the form of peer tutoring.
- Facilitate student's learning activities such as enhanced collaborative learning.

Organizational identity

- Enhancing ICT competencies for Generation Z (people who were born from 1997 to 2012), who are often called digital natives.

Organizational change

- Teachers' shifts to online mode of work due to COVID-19 pandemic.

Organizational wellbeing

- Not covered in the reviewed literature.

1.2.2. Component 2: Knowledge Creation and Innovation

Knowledge creation and innovation in DTxHE refers to the emerging trends and developments across all areas of universities' business to inform policymakers and practitioners (JISC, 2023). Digital knowledge creation and innovation consists of four subcomponents, namely digital vision and horizon scanning, research, innovation, and wider impact (JISC, 2023). In this case, digital vision and horizon scanning refers to efforts by leaders to anticipate and prepare for the impact of current and future digital trends on higher education institutions. In addition, the research subcomponent in knowledge creation and innovation refers to how higher education institutions provide infrastructure to support research. Furthermore, the subcomponent of innovation is considered as a support to the development of new ideas and solutions by encouraging creativity, entrepreneurship and supporting digital leadership. Another subcomponent, wider impact, ensures the impact of research and innovation projects can be analyzed and appropriately disseminated to different

audiences. Figure 5 presents the number of studies on each subcomponent in each country in SEA.

Figure 5. Density of literature on knowledge creation and innovation per country

The opportunities and challenges regarding each subcomponent of knowledge creation and innovation for the last decade are illustrated below. The key challenges for SEA regarding knowledge creation and innovation are the lack of digital vision among top management and research culture. Such challenges are more obvious among the less developed countries in the region, such as Cambodia, Lao PDR, Myanmar and Timor-Leste, where their national DT strategies started late.

The empirical evidence from Malaysia (e.g. Ong & Annamalai, 2023), Indonesia (e.g., Makrakis & Kostoulas-Makrakis, 2023), and Thailand (e.g., Amnouychokanant et al., 2021; Yoshida et al., 2021) suggested that the opportunities regarding knowledge creation and innovation are closely related to adequate support from the government and HEIs. This promotes innovative ideas and solutions in teaching and learning. Literature seems to pay less attention to the remaining sub-components. Many studies were directed towards the area of research and innovation, with limited focus on the wider impact, as well as in the area of digital vision and horizon scanning. Therefore, future studies could be directed towards both areas to better link research and innovation to wider practical aspects of education in the region.

Challenges

Digital vision and horizon scanning

- Top management lacks digital vision and the ability to develop comprehensive DT strategies.
- Lack of wider and more profound university-industry partnerships.
- Competitive pressures within the sector pushed many HEIs to adopt a DT strategy hastily without carefully scanning the international markets.

Research

- More support is needed to enhance students' research skills through digital literacy and critical thinking skills.

Innovation

- The mismatch between the intension and actual use of innovation.
- Lack of innovative behaviors and mindsets.

Wider impact

- Lack of evaluations to measure the impact of knowledge creation and innovation on the wider society.

Opportunities

Digital vision and horizon scanning

- Top management and competitive pressure influence HE adoption of ICT.

Research

- Development of theoretical frameworks and research instruments.
- Research to establish innovation related to online pedagogy and management.
- Development of online instruction model through research.

Innovation

- Innovation related to online pedagogy.
- Innovation related to HE management.

Wider impact

- Partnership between HE and the industry significantly encourages knowledge acquisition by the industry.
- Thailand's MOOC (massive open online course), for example, facilitates the dissemination of innovative public services through lifelong learning to improve expertise of individuals in public service.

1.2.3. Component 3: Knowledge Development

Knowledge development refers to efforts made to ensure all stakeholders in an HEI have a chance to learn using digital technology. This DT component covers four subcomponents, including curriculum development to accommodate digital technology integration, digital learning, digital teaching, and learner experience (JISC, 2023). In terms of curriculum development, HEIs or their departments review, plan, or develop digital literacy or technology-enhanced courses. Furthermore, the knowledge development component covers digital teaching and learning, where technology is used to support these activities. Another subcomponent, learner experience, refers to supporting students with their learning through technology. Figure 6 summarizes the number of available studies on each subcomponent of knowledge development in DTxHE in each country for the last decade.

Figure 6. Density of literature on knowledge development per country

Figure 6.:The density of literature on Knowledge Development per countries

Analysis of the reviewed studies found that most studies fall into the category of knowledge development, but with a notable lack of focus given towards the subcomponent of curriculum development. As most studies in this category are directed towards digital teaching and learning as well as learner experience, future studies could cover more areas of curriculum development related to DTxHE in SEA to inform research and practice. Again, the literature shows great interest from Malaysian (e.g., Kabilan & Annamalai, 2022; Taleb et al., 2023) and Indonesian universities (e.g., Iskandar, 2022; Makrakis & Kostoulas-Makrakis, 2023) in digital knowledge development, particularly regarding learner experience and digital teaching. Cambodia, Lao PDR, Myanmar, and Timor-Leste are relatively invisible in research in this area. Singapore's HEIs did not contribute much to the digital knowledge development literature in this period. It is largely because they started their DT substantially several decades ago.

The key challenges for SEA regarding digital knowledge development are the lack of professional

development in digital technologies for lecturers due to financial constraints and unsuitable curricula for the digital age (Chin et al., 2022; Makrakis & Kostoulas-Makrakis, 2023).

Challenges

Digital learning

- Lack of autonomy and confidence (self-efficacy) among learners to express themselves in online instructions.
- Under-utilized simulation software.
- Pre-recorded materials may not be able to meet the diverse needs of students.
- Lack of motivation from students and teachers to engage in digital learning.
- Students' distractions when studying online.

Digital teaching

- Increased demands and frequencies of teacher professional development.
- Financial challenges for teacher professional development.
- Teachers' lack of online pedagogical knowledge and skills.
- Under-qualified peer tutors contribute to the spread of inaccurate information.
- Online and AI academic integrity and plagiarism.

Learner experience

- Abrupt change of instructional design for learning from home during the COVID-19 pandemic caused negative learning experiences.
- Students from lower socio-economic backgrounds experience more constraints in learning, such as a lack of digital devices and limited access to interactive internet platforms.

Curriculum development

- Unsuitable curricula for digital teaching in the digital age.
- Abrupt changes in instructional design during and after the COVID-19 pandemic require a high level of agility in curriculum development.

Opportunities

Digital learning

- Learners use various online tools to support their learning.
- E-learning positively impacts students' achievement and learning experience.
- Learning happens informally and formally through engagement with online media resources.
- Learners prefer online writing assessments due to supportive aids.
- Online peer tutoring as a supportive aid.

Digital teaching

- E-teaching can be utilized by using various digital platforms.
- Positive perceptions and experience in online teaching.

Learner experience

- Positive perceptions of online instruction.

Curriculum development

- Integration of collaborative online international learning (COIL) in evidence-based practice curriculum.

1.2.4. Component 4: Knowledge Management and Use

The discussion about knowledge management and use revolves around how SEA's HE attempts to effectively enhance access to the use of data and information to inform decision-making processes and support the organization. It comprises four subcomponents, including information management and use, data management and use, business intelligence, and decision-making to support DTxHE (JISC, 2023). Information management and use is related to collecting, organizing, storing information to ensure it can be retried and used efficiently. Meanwhile, data management and use refers to collecting, organizing, storing, and sharing data to be analysed to support higher education institutions. Furthermore, collecting, managing, and using such data and information for the purpose of business decisions and strategies fall under the subcomponent of business intelligence. Finally, decision-making covers the evaluation of evidence to be used for decision-making in all aspects of business. Figure 7 summarizes the literature on these four subcomponents of digital knowledge management and use in HE in SEA.

Figure 7. Density of literature on knowledge management and use per country

Figure 7: The density of literature on Knowledge Management and Use per countries

The literature shows that relatively few studies cover this area. SEA's HEIs, in general, have conducted limited research on information management and use, data management and use, business intelligence, and decision-making in the last decade. To be more specific, no HEI in any country in the region has researched all four subcomponents of digital knowledge management and use. Knowledge management and use seems to be limited among SEA's HEIs, except Singaporean HEIs (e.g., Chua & Goh, 2008; Hogan & Gopinathan, 2008). Considering the limited studies found in the areas of information management and use, as well as decision making, and with no study found covering the area of business intelligence, these areas should serve as the direction for future research and practice.

The key challenges for HEIs in most countries in SEA regarding digital knowledge management and use are missing systems to store and manage data and information (Sofyani et al., 2022), a lack of business intelligence to optimize existing data and information, and a lack of strategic decision-making to support digital knowledge management and use for faster DT (Aditya et al., 2022).

Challenges

Data management and use

- Contextual, technical and cultural issues that impede effective data management and use.
- Limited forms of IT development for internal control purposes.
- Barriers to teacher professional development.

Information management and use

- Not covered in the reviewed literature.

Business intelligence

- Not covered in the reviewed literature.

Decision making

- Not covered in the reviewed literature.

Opportunities

Data management and use

- Responsive digital management.
- Dynamic digital management due to different technology usage.

Information management and use

- Innovative digital management.
- Positive impact of research outcomes on technological practices.

Business intelligence

- Not covered in the reviewed literature.

Decision making

- IT development strategic plan.

1.2.5. Component 5: Knowledge Exchange and Partnerships

The knowledge exchange and partnerships component shows how digital technology improves knowledge exchange to communicate and encourage collaboration and community participation of HE stakeholders. This component is divided into four subcomponents: communication, collaboration, community participation, and relationship management (JISC, 2023). Higher education institutions use digital technology to communicate with stakeholders or members of the society to share information or to collaborate with them in an effort to achieve a shared goal. For the component of community participation, higher education institutions encourage stakeholders to make decisions which affect them. Finally, technology can be used to build or maintain positive relationships with stakeholders or partners. Figure 8 summarizes the review results of this component based on the four subcomponents for each country in SEA.

Figure 8. Density of literature on knowledge exchange and partnership per country

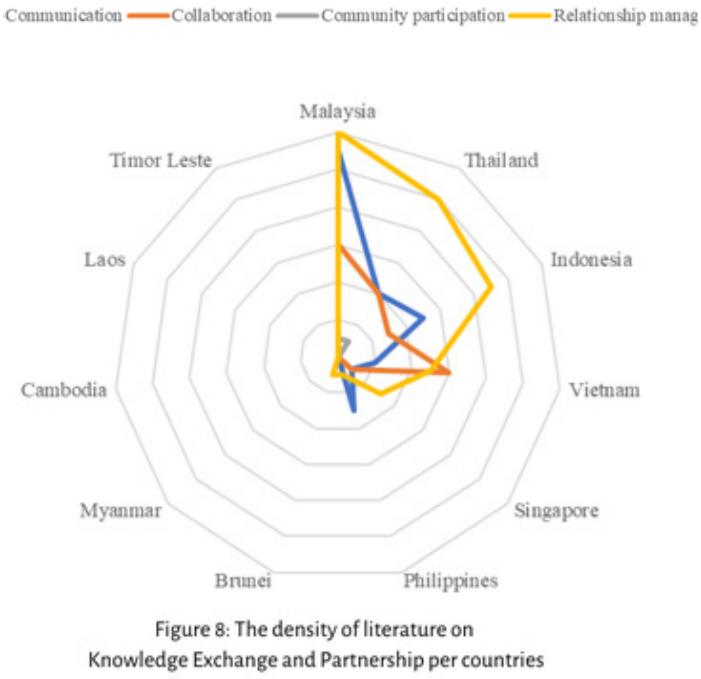


Figure 8: The density of literature on Knowledge Exchange and Partnership per countries

The literature review shows that relationship management, communication and collaboration attract the most attention from HEIs in Malaysia (Radzuan et al., 2023; Teoh et al., 2023), Indonesia (Djajadikerta et al., 2021), and Thailand (Yoshida et al., 2021). Research on community participation in SEA universities is limited, with only two studies identified in the whole decade, one in Malaysia and the other in Thailand. HEIs in Cambodia, Lao PDR, Myanmar, and Timor-Leste are absent from the literature on digital knowledge exchange and partnerships, while HEIs in Brunei Darussalam, the Philippines, and Viet Nam show limited engagement in this DT component.

HEIs in most countries in SEA face challenges in all four subcomponents of digital knowledge exchange and partnerships. Digital communication is a new skill that was not taught properly at the primary and secondary school levels. Therefore,

many university students have limited knowledge of digital etiquette and conduct. Digital collaboration can also be challenging with Generation Z, who live with more privileges than previous generations due to the region's thriving economy (Brailovskaia & Bierhoff, 2020). Besides, issues related to the lack of collaborative practices in online contexts among learners in Vietnam was considered by some researchers (Q. T. Pham & Tran, 2020) as one of the hindrances in the moves towards online instruction designs. Finally, in community participation and relationship management, lack of partnership between higher education and industry was seen as an obstacle in moving towards digital transformation (Le et al., 2023), which needs to be addressed by policy makers and future research.

Challenges

Communication

- Cyber scams hinder intention to use.
- Cyber security is costly for universities.
- Digital communication is a new skill for many.

Collaboration

- Different personality traits and personal values can hinder collaboration.
- Time-zone difference for international collaboration.
- Lack of financial support from the government to develop knowledge-transfer partnerships with other stakeholders.

Community participation & relationship management

- Lack of industry/stakeholder partnerships.
- Lack of initiatives to engage with local communities.
- Alumni associations are limited or do not exist.
- Limited or no business engagement.
- Overlook or under-value social media in relationship management.

Opportunities

Communication

- Most students are on social media.
- Learners spend a considerable amount of time on social media.
- Staff and students communicate on various platforms.
- Digital marketing can promote HEI branding and reputation.
- Social media disseminates information fast to a broad audience.

Collaboration

- Students can collaborate more easily via online discussion forums.
- International collaborations can be made more easily.

Community participation & relationship management:

- Thailand's MOOC, for example, supports the improvement of public service quality.

1.2.6. Component 6: Digital and Physical Infrastructure

Digital and physical infrastructure refers to the provision of robust and secure infrastructure through relevant expertise and vision, including suitable investment in networks, systems, hardware, software, and digitally equipped physical spaces, and ensuring effective management and standards

compliance (JISC, 2023). This component is divided into four subcomponents, namely digital infrastructure, digital connectivity, digital support, and estate management (JISC, 2023). Digital infrastructure is related to the procurement of technology or equipment to support the operation and growth of a higher education institution. In addition, digital connectivity refers to the availability of secure and reliable digital connections and networks within the institution or with stakeholders. Furthermore, digital support covers resources, services, and support to help stakeholders use technology for educational purposes. Finally, estate management deals with the physical and virtual infrastructure required for educational purposes. Figure 9 summarizes the review results of this component based on the four subcomponents for each country in SEA.

Figure 9. Density of literature on digital and physical per country

Figure 9: The density of literature on Digital and Physical per countries

Singapore possesses the most robust digital and physical infrastructure in the region due to the size of the country, the amount of investment, and, most importantly, its early strategies for DT. This literature review shows that HEIs in Indonesia and Malaysia pay great attention to robust digital infrastructure and digital connectivity regarding digital and physical infrastructure, followed by those in Vietnam, Thailand, and the Philippines. Digital support for students and lecturers and estate management are under-researched across this region. According to Statista (2024), Lao PDR and Timor-Leste are the least developed countries in terms of digital infrastructure, with less than 50% of their population covered with 4G; the rest of the region is estimated to be 4G-networked, covering up to 100.00% in 2024.

The most critical challenge for HEIs in most countries in SEA regarding digital and physical infrastructure is the inequality between developed and developing/underdeveloped countries and between the urban and rural/mountainous areas. Digital and physical infrastructure in Lao PDR and Timor-Leste is left behind.

Challenges

Digital infrastructure

- Digital divide between central and local, as well as urban and rural areas.
- Some countries' digital infrastructure, including cyber security, heavily relies on external support.

Digital connectivity

- Poor internet connectivity, particularly in disaster-prone areas.
- Electricity instability.
- Many students lack access to personal computers or smartphones.

Digital support

- Technical constraints of online learning platforms.

Estate management

- Challenging physical environment for TPD.
- Limited educational facilities.

Opportunities

Digital infrastructure

- Many universities are well equipped with ICT infrastructure.
- Quality of e-learning has been enhanced, particularly after the COVID-19 pandemic.

Digital connectivity

- Nearly 100% access to the internet, except in some areas in Lao PDR and Timor-Leste.
- Improved access to digital devices.
- Ownership of digital media.

Digital support

- Not covered in the reviewed literature.

Estate management

- Digitally well-supported facilities.

1.3. Conclusion

This systematic review serves as a foundation for a better understanding of DTxHE in SEA. Most studies in this review are based on research conducted in Malaysia (35.5%), Indonesia (28%), Vietnam (12.5%) and Thailand (11.5%). Studies in the Philippines and Singapore during the same period are limited, representing 6.8% and 3.9%, respectively, followed by Brunei Darussalam (0.7%), Cambodia (0.7%), and Myanmar (0.4%). Few studies on any aspect of DTxHE are found in Lao PDR and Timor-Leste. Consequently, there is little understanding of DTxHE in these countries, which need more support on HE capacity building, including research capacity.

This review focuses on the opportunities and challenges in DT. Generally, the reviewed studies show that opportunities outweigh challenges in all almost components of DT. However, studies addressing knowledge management and use show that there were more challenges than opportunities in a number of HEIs in some countries such as the Philippines, Lao PDR, and Vietnam. More studies need to be conducted in these countries to discover the underlying causes of this unexpected result.

The research on DTxHE in this region does not fully cover all aspects of the DT framework. More focus and efforts seem to be centered on organizational digital culture and digital knowledge development. This is because, in many HEIs (except Singaporean ones), the DT process significantly took off during the COVID-19 pandemic. HEIs need to build a new organizational culture to adapt to digitalization. At the same time, concerns about university ranking have pushed HEIs to do more research, including studies in their digital transformation.

However, much less focus was put on other components, such as digital and physical infrastructure, digital knowledge creation and innovation, digital knowledge management and use, and digital knowledge exchange and partnership. Many HEIs in the region depend on their government to provide digital and physical infrastructure as they belong to the public sector. Knowledge creation and innovation, knowledge management and use, and knowledge exchange and partnership are relatively weak among SEA HEIs (except in the case of Singapore). These aspects need financial investment from the government and intellectual investment from HEIs themselves before the region can fully transition to a digital economy.

In the next section, the report will investigate DT policies of these countries to understand how the government might have impacted DTxHE in SEA.

Chapter 2. Policy Analysis Study

Chapter 2. Policy Analysis Study

Abstract

This chapter provides a thorough policy analysis of DTxHE within SEA region, highlighting key trends, challenges, and opportunities in integrating digital technologies into teaching, learning, and administrative processes. By examining policy documents from various SEA countries, the study offers actionable recommendations for policymakers, educators, and institutional leaders to leverage DT effectively, aiming to create a more inclusive, efficient, and resilient HE system in the region.

Employing JISC framework for DTxHE, this analysis benefits from a well-regarded theoretical model that elucidates how digital ecosystems can enhance outcomes in 6 components, including organizational digital culture, knowledge creation and innovation, knowledge development, knowledge management and use, knowledge exchange and partnership, as well as digital and physical infrastructure. The study employs a systematic document analysis of 35 national policy documents, using thematic coding and NVivo 14 software to provide a comparative perspective on DTxHE components across the region.

Findings indicate that DT is a significant focus globally, with SEA emerging as a proactive region in integrating digital technologies to improve educational outcomes. The policy landscape emphasizes three core areas: knowledge development, innovation, and infrastructure enhancement. However, there are notable gaps in knowledge management and cultivating organizational digital culture. Policies in the region prioritize enabling stakeholders to navigate and thrive in a digital environment, reflecting a shift towards enhancing digital learning, teaching, and assessment practices.

Furthermore, the promotion of knowledge creation and innovation is evident, with HEIs encouraged to inform policy and foster research and collaboration. Investments in robust digital and physical infrastructures are essential for supporting current and future educational needs.

Despite significant progress, the analysis identifies areas for improvement, such as the need for comprehensive knowledge management strategies and the development of a digital culture that embraces change and supports continuous learning. Addressing these gaps is crucial to ensuring that the region's HE sector remains responsive, resilient, and relevant to the evolving needs of current and future generations.

2.1. Introduction

This policy analysis aims to examine the current state of DT within the HE sectors across SEA by identifying key trends in DTxHE in each country in this region. It explores how policies guide HE to integrate digital technologies in teaching, learning, and administrative processes. The analysis also considers the diverse socioeconomic backgrounds across SEA countries, which influence digital accessibility and the capacity for technological adoption in educational settings. The primary goal of this policy analysis is to provide actionable recommendations for policymakers, educators, and institutional leaders, aimed at harnessing the benefits of DT to improve HE outcomes in SEA. By doing so, it seeks to contribute to developing a more inclusive, efficient, and resilient HE system in the region. By examining policy documents on DTxHE development in the region, this study aims to:

- Identify and analyze emerging and future trends in DT within SEA's HE.
- Critically evaluate the key challenges faced by SEA's HEIs during their DT journeys.

The JISC's framework for DTxHE offers a multi-faceted understanding of how digital ecosystems can bolster positive outcomes across various domains, such as work, research, and learning, while also fostering a sense of community and well-being. Central to its structure are six dimensions: organizational digital culture, knowledge creation and innovation, knowledge development, knowledge management and use, knowledge exchange and partnership, and digital and physical infrastructure. This chapter employs a systematic document analysis approach to review national policies on DTxHE across SEA. The total number of reviewed national policy documents is 35 (see Figure 10 and Table 1).

Figure 10. PRISMA diagram for the systematic data collection for the policy analysis

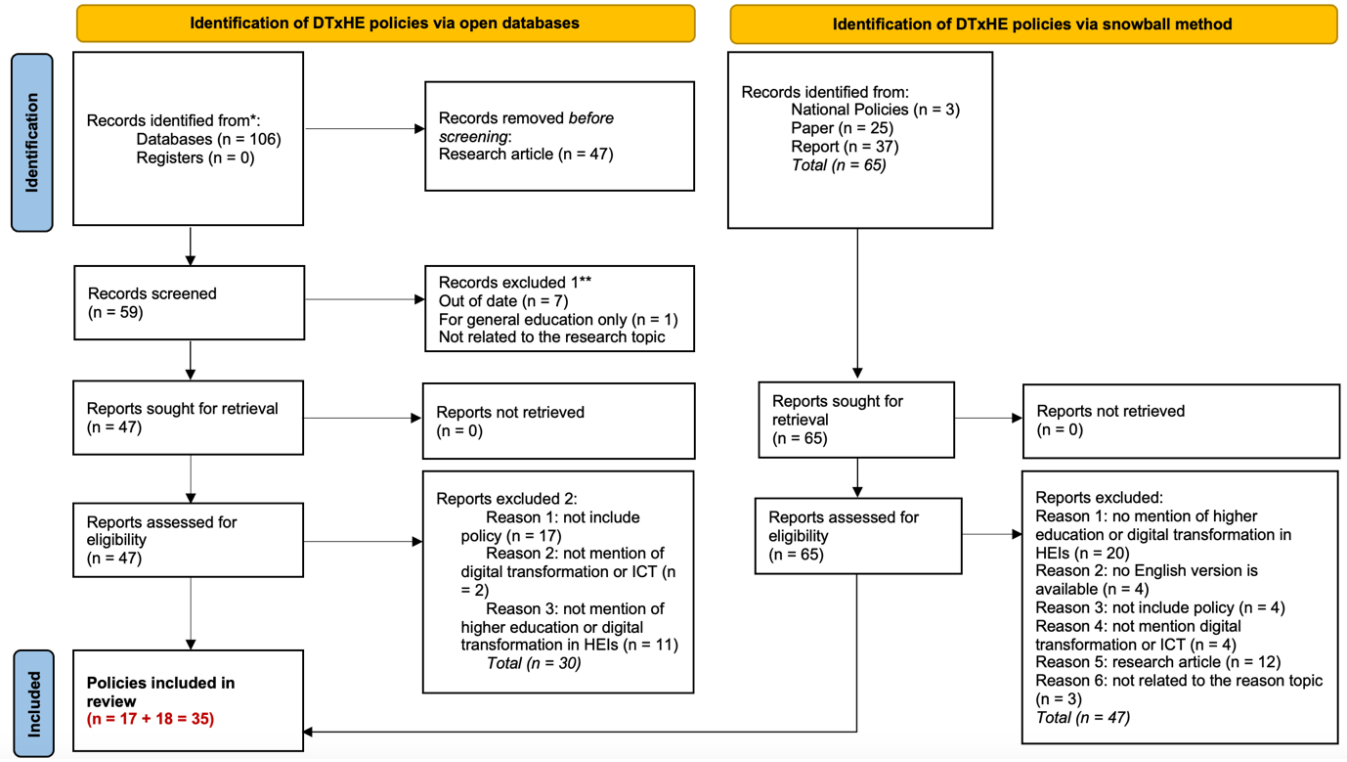


Table 1. List of the reviewed documents

Country	Document name	Issued by	Year
Brunei Darussalam	1. Laws of Brunei Darussalam, Chapter 210: Education	The Constitution of Brunei Darussalam	2011
	2. Strategic Plan 2023-2027	Ministry of Education	2022
Cambodia	3. Summary of Cambodia ICT Masterplan 2020	Korea International Cooperation Agency	2014
	4. Cambodia Digital Government Policy 2022-2035	Royal Government of Cambodia	2022
	5. Cambodia's education 2030 roadmap - Sustainable Development Goal 4	Ministry of Education, Youth and Sport	2019
	6. Education Strategic Plan 2019-2023	Ministry of Education, Youth and Sport	2019
	7. EduTech Roadmap	National Council of Science, Technology and Innovation	2022
	8. Cambodia Industrial Development Policy 2015-2025	Royal Government of Cambodia	2015
	9. Planning processes, policies and initiatives in ICTD education at institutions of higher learning in Asia and the Pacific: Cambodia Country Paper	United Nations Economic and Social Commission for Asia and the Pacific	2017
	10. Policy and Strategy on Information and Communication Technology in Education	Ministry of Education, Youth and Sport	2018

Country	Document name	Issued by	Year
Indonesia	11. Higher Education Law	Ministry of Education	2012
	12. East Ventures - Digital Competitiveness Index 2022 Towards Indonesia's Digital Golden Era	PWC and Katadata Insight Center	2022
	13. Law of The Republic of Indonesia Number 17 of 2017 on Long-term National Development Plan of 2005-2025	President of the Republic of Indonesia	2007
	14. Merdeka Belajar (Freedom to Learn)	Ministry of Education and Culture	2022
Lao PDR	15. 9th five-year national socio-economic development plan	Minister of Planning and Investment	2021
	16. Education and Sports Sector Development Plan (2016-2020)	Ministry of Education and Sports	2015
	17. Education and Sports Sector Development Plan 2021-2025	Ministry of Education and Sports	2020
Malaysia	18. Framing Malaysian HE 4.0: Future-Proof Talents	Ministry of Higher Education	2023
	19. Eleventh Malaysia Plan 2016-2020: Anchoring growth on people	Economic Planning Unit, Prime Minister's Department	2015
	20. Twelfth Malaysia Plan 2021-2025: A prosperous, inclusive, sustainable Malaysia	Economic Planning Unit, Prime Minister's Department	2021
	21. Malaysia Education Blueprint 2015-2025 (HE)	Ministry of Education	2015
Myanmar	22. National Education Strategic Plan 2016-2021	Ministry of Education	2016
	23. The National Education Strategic Plan (2021-2030) (summary)	Ministry of Education	2021
Philippines	24. An act providing for a national DT policy and for purposes	Senate of the Philippines	2020
	25. Commission on Higher Education strategic plan 2011-2016	Office of the President	N/A
Singapore	26. "Transforming Education through Technology" Masterplan 2030	Ministry of Education	2023
	27. Our educational technology journey	Ministry of Education	2023
	28. Smart Nation: The Way Forward Executive Summary	The Government of Singapore	2018
Thailand	29. Kasetsart University ICT Master Plan (2017-2021)	Kasetsart University	2017
	30. National Statement of the Royal Thai Government on Transforming Education	The Royal Thai Government	2022
Timor-Leste	31. Timor Digital 2032: Timor-Leste's National Strategic Plan for Digital and ICT Development	Government of Timor-Leste	2023

Country	Document name	Issued by	Year
	32. National Education Strategic Plan 2011-2030	Ministry of Education	2011
Vietnam	33. Decision to promulgate a set of indicators and criteria for evaluating digital transformation of higher education institutions	Ministry of Education and Training	2022
	34. Decision Approving the National Digital Transformation Program to 2025, with a vision to 2030	Government of Viet Nam	2020
	35. Project "Enhancing the application of information technology and digital transformation in Education and Training for the period 2022 - 2025, with a vision to 2030" (Decision No. 131/QD-TTg, January 25, 2022)	Government of Viet Nam	2022

2.2. Methodology

Data Sampling

Purposive sampling was employed to identify relevant documents. UNESCO provided several policy documents for initial review, and the team conducted further online searches to locate additional sources. The online searches used key terms at both regional and national levels.

- Regional level: The searches incorporated terms like "digital transformation", "ICT", "education technology", "digital roadmap," "digital transformation strategy," "higher education," "tertiary education," "policy", and "Southeast Asia" or "Asia Pacific".

- National level: Country names were included alongside the regional terms to focus searches on specific countries within SEA.

Data analysis

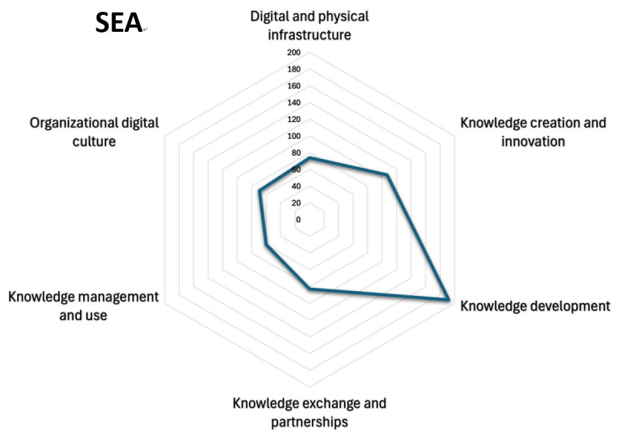
Thematic coding was applied to break down concepts based on JISC (2023) into sequences of specific indicators and examples. Software NVivo 14 was used to analyze the documents. The frequency of codes was used to draw radar charts that offer a comparative perspective on each DTxHE component in the SEA region.

2.3. Findings

2.3.1. The Landscape of DTxHE Policies in SEA

DTxHE has become a pivotal area of focus across the globe, with SEA emerging as a vibrant hub for integrating digital technologies into academic settings. The policy landscape in this region reflects a concerted effort to harness digital advancements for educational improvement, emphasizing three core areas: knowledge development, innovation, and infrastructure enhancement (Figure 11). However, there is a notable gap in knowledge management, use, and the cultivation of an organizational digital culture.

Figure 11. Radar chart depicting SEA's DTxHE policy focus areas



DTxHE policies in SEA heavily prioritize knowledge development within HEIs. This focus aims to ensure that all stakeholders, including students, faculty, and administrative staff, can effectively navigate, contribute to, and thrive in a digital environment. The thrust towards rethinking and enhancing digital learning, teaching, and assessment practices is evident in various initiatives across the region. These efforts reflect a recognition of the need to adapt educational paradigms to the realities of the digital age, where traditional pedagogical approaches are increasingly supplemented or replaced by digital solutions.

Another critical aspect of DTxHE policies in SEA is the promotion of knowledge creation and innovation. The policy analysis shows that HEIs are encouraged to inform policy and make decisions proactively. This approach seems to not only enhance the institution's adaptability to digital advancements but also foster an environment conducive to more research and collaborative activities. The emphasis on innovation extends beyond academic boundaries, seeking to impact local, regional, national, or international communities positively. Several countries in SEA, such as Singapore, aim to position their HE as one of the leading sectors in generating new knowledge and innovative solutions that address local and global challenges and champion DT.

The development of robust and secure digital and physical infrastructures is another cornerstone of the DTxHE policy framework in SEA. Recognizing the foundational role of technology in enabling DT, significant investments are being made in networks, systems, hardware, software, and digitally equipped physical spaces. The goal is to create an infrastructure to support the current needs of the educational community and future demands. This includes ensuring effective management and compliance with international standards, which is crucial for maintaining the security and reliability of digital resources.

Despite those significant strides, there are areas where DTxHE policies in SEA could be strengthened. For example, there is a limited focus on knowledge management and use. Effective knowledge management strategies are essential for capturing, distributing, and utilizing the wealth of information generated within HEIs. Moreover, fostering an organizational digital culture that embraces change, encourages digital literacy, and supports continuous learning seems to be overlooked. Such gaps suggest that while the region is making commendable progress in integrating digital technologies into HE, a more holistic approach that includes these critical aspects could enhance the overall impact and sustainability of DTxHE efforts. All is to ensure that the region remains responsive, resilient, and relevant to the needs of both current and future generations. A detailed analysis of each DTxHE component is presented in the following sections.

The analysis of DTxHE across SEA reveals distinct national priorities, with each country adopting different approaches (Figures 12-22) . For instance, Cambodia emphasizes knowledge creation through research, aiming to enhance academic institutions' capacity by modernizing curricula, expanding infrastructure, and fostering international collaborations. This focus on research-driven transformation aligns with global trends.

Singapore adopts a more strategic and balanced approach. The country integrates advanced technologies to develop smart campuses while embedding digital tools in both academic and administrative processes. Furthermore, Singapore's policies focus on cultivating leadership in DT, ensuring institutions are prepared for an increasingly digital landscape.

Vietnam, likewise, highlights knowledge creation and innovation, aiming to align its research capabilities and curricula with global standards. Additionally, the country emphasizes digital integration in teaching and research, fostering international partnerships, and improving digital literacy to equip students for future challenges.

Malaysia places significant emphasis on digital infrastructure and knowledge exchange. The country's policies aim to improve Internet access, develop smart classrooms, and enhance digital platforms to support online education. Moreover, by fostering international collaborations, Malaysia seeks to improve the quality and accessibility of HE through digital means.

Meanwhile, Indonesia and Myanmar have relatively fewer policies focusing on knowledge development and digital culture. Instead, these countries concentrate on foundational infrastructure and digital literacy. Their policies primarily focus on establishing basic ICT systems as well as creating opportunities for faculty development to better integrate technology into education.

Similarly, Brunei Darussalam demonstrates moderate attention to knowledge development and infrastructure. In this case, the country is focused on gradual improvements in digital education and incremental advancements in innovation-driven programs, signaling a more measured approach to DT.

In conclusion, DT policies across SEA vary in focus and pace. While Cambodia, Singapore, and Vietnam prioritize research-driven DT, countries like Indonesia and Myanmar focus on building foundational infrastructure and digital literacy. Thus, each country's approach reflects its unique challenges and priorities, shaping the region's diverse trajectories in DTxHE.

Figure 12. Radar chart depicting Vietnam's DTxHE policy focus areas

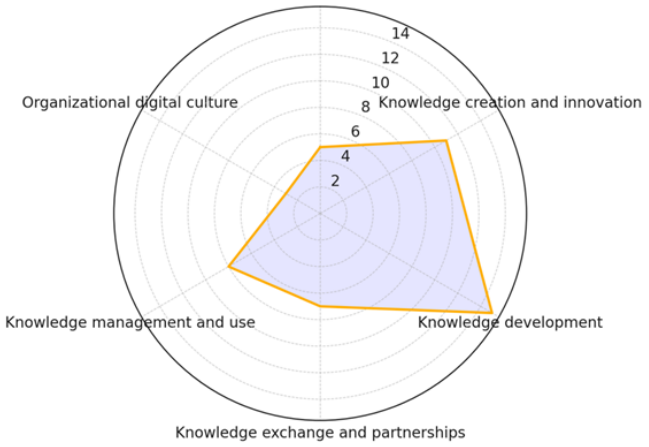


Figure 13. Radar chart depicting Brunei Darussalam's DTxHE policy focus areas

Figure 14. Radar chart depicting Cambodia's DTxHE policy focus areas

Figure 15. Radar chart depicting Indonesia's DTxHE policy focus areas

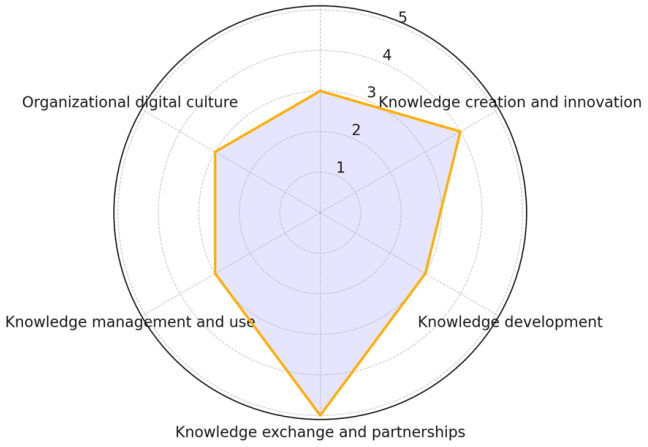


Figure 16. Radar chart depicting Lao PDR's DTxHE policy focus areas

Figure 17. Radar chart depicting Malaysia's DTxHE policy focus areas

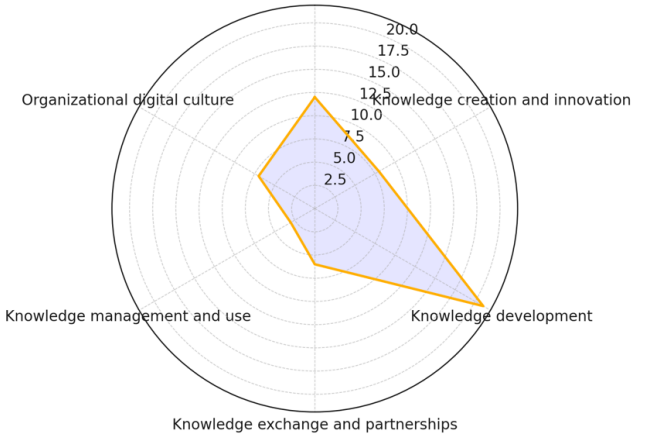


Figure 18. Radar chart depicting Myanmar's DTxHE policy focus areas

Figure 19. Radar chart depicting Singapore's DTxHE policy focus areas

Figure 20. Radar chart depicting Thailand's DTxHE policy focus areas

Figure 21. Radar chart depicting Timor-Leste's DTxHE policy focus areas

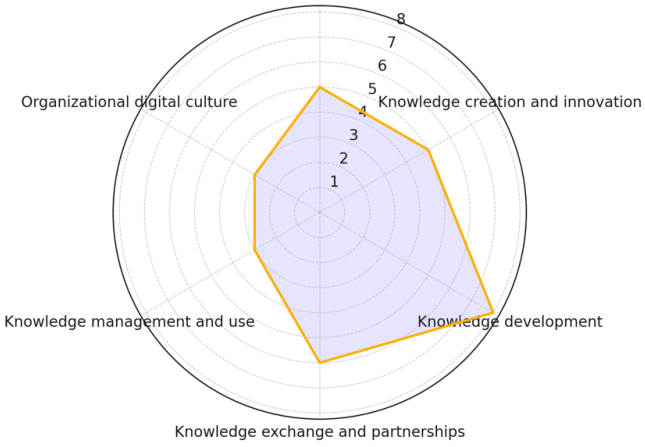


Figure 22. Radar chart depicting the Philippines' DTxHE policy focus areas

2.3.2. Component 1: Organizational Digital Culture

This section gains insights into the evolving digital culture within the HE sector of SEA countries, examining key aspects such as culture and mindset, organizational identity, well-being, and change.

2.3.2.1. Component 1.1. Digital Culture & Mindset

The current state of digital culture and mindset in this region's HE is significantly influenced by varying levels of government policy and regulation. They shape the extent to which institutions can adapt, innovate, and integrate digital technologies into their educational offerings.

Emerging trends:

- **Embracing innovation and experimentation:** A key trend in SEA's HE is the increasing focus on fostering a culture of innovation and technological experimentation. Educational policies across the region stress the importance of creating environments that empower faculty to adopt and experiment with new pedagogical methods using digital tools. For example, in Malaysia, the Higher Education 4.0 (HE 4.0) Framework drives DT by incorporating Fourth Industrial Revolution (IR 4.0) technologies into HE. This framework encourages innovative teaching practices such as blended learning and virtual reality (VR) in classrooms [1]. Similarly, Indonesia's Merdeka Belajar (Freedom to Learn) initiative shifts from traditional models to

Table 2. Trends and areas for improvement in organizational digital culture

Aspect	Emerging trends	Areas for improvement
Digital culture & mindset	• Embracing innovation and experimentation	• Comprehensive strategies for digital literacy
	• Promoting collaboration in digital-based environments	• Support for faculty development
	• Building a culture of digital fluency	• Policies on digital equity and inclusion
Digital organizational identity	• Building a reputable online image • Safeguarding organizational digital identity	• Individual digital identity development • Standardizing DT measurement • Aligning internationalization with digital identity
Digital well-being	• Embedding digital well-being in organizational strategies and policies	• Supportive policies and resources
Digital change	• Leadership in DT • Understanding the transformative nature of digital	• Strategic foresight • Risk mitigation strategies • A culture of adaptability

more flexible, technology-enhanced approaches to improve accessibility and engagement [2]. Myanmar's National Education Strategic Plan 2016-2021 focuses on improving online learning quality, while Cambodia emphasizes using ICT tools and electronic resources to boost teaching productivity and effectiveness [4].

- **Promoting collaboration in a digital-based environment:** DTxHE policies in the SEA region signal a shift toward more collaborative and interdisciplinary learning environments. These policies aim to dismantle traditional departmental silos and promote partnerships across various disciplines. For example, the Malaysia Education Blueprint 2015-2025 advocates for greater industry collaboration to enhance the student learning experience, with a focus on leveraging technology to offer personalized learning models [5]. In Timor-Leste, the National Strategic Plan for Digital and Information Technology Development encourages institutions to form strategic partnerships with universities and external stakeholders, aiming to establish a Center for Capacity Development and Digital Acceleration focused on ICT training and research [6]. These initiatives demonstrate the region's commitment to embedding digital technologies into HE, fostering a more interconnected and dynamic academic ecosystem.

- **Building a culture of digital fluency:** Policies advocate the development of a culture of digital fluency among staff and students. It includes creating training programmes and opportunities to develop the necessary skills and knowledge to thrive in a technology-driven learning environment. Vietnam's Government emphasizes the provision of MOOCs for all citizens, including students, to improve access to education through technology [7]. Lao PDR emphasizes improving ICT infrastructure and access to digital resources in schools and universities. With support from international donors, Lao PDR has initiated training programmes aimed at enhancing the digital skills of educators and students. Those efforts are part of a broader strategy to integrate digital literacy into the curriculum, ensuring that graduates are well-prepared for a technology-driven workplace [8]. Cambodia's Ministry of Education, Youth and Sports has launched policies to promote digital competencies for teachers and students. Since then, the ministry has also planned to guide the application of information technology in teaching and to promote the management capacity of information technology projects and information technology-related systems and services [9]. The Philippines is developing an ICT competency framework for teachers, educators, and trainers to integrate ICT into teaching practice. Furthermore, the framework aims to compare teacher capacity across regions for timely interventions [10].

Areas for improvement:

- **Lack of comprehensive strategies for digital literacy:** A notable gap is the absence of comprehensive strategies within HE policies to develop digital literacy across all stakeholders. While countries like Singapore and Malaysia have made strides through initiatives like the Smart Nation Initiative and the Malaysia Education Blueprint 2015-2025, there is a regional need for more targeted policies that encompass all aspects of digital culture and mindset. The current policies in the region seem to emphasize infrastructure development and access to technology without equally stressing the cultivation of critical thinking, creativity, and ethical considerations in digital spaces.

- **Insufficient support for faculty development:** Another critical gap in the current HE policies lies in the support for faculty development in digital pedagogies. The transition to digital learning environments requires more than just familiarity with digital tools; it also requires a shift in teaching philosophies and methodologies. Moreover, the current educational policies in SEA do not seem to adequately emphasize the importance of developing a shared understanding of digital capability across different institutions. There seems to be a lack of comprehensive plans or frameworks for assessing and enhancing digital capabilities among stakeholders. Additionally, policies in this region do not consistently encourage meaningful engagement and involvement of stakeholders in shaping the organization's digital culture and capabilities.

- **Inadequate policies on digital equity and inclusion:** There are certain efforts to promote equity, diversity, and inclusion (EDI) in HE policies, but the integration of these principles into the digital culture of organizations is often overlooked in practice. Policies, in general, lack careful

consideration for the diverse needs of students, especially those from disadvantaged backgrounds or remote areas.

2.3.2.2. Component 1.2. Digital Organizational Identity

Digital organizational identity (DOI) in the context of SEA's HE reflects a complex interplay of initiatives that aim at harnessing digital technologies to bolster the institution's mission, values, and global presence. This section examines trends in SEA's HE policies regarding DOI, highlighting both emerging trends and areas for improvement below.

Emerging trends:

- **Building a reputable online image:** SEA's policies on DTxHE emphasize the importance of building a strong digital identity that aligns with institutional missions and values. Governments across the region encourage universities to cultivate a professional and engaging online presence to showcase academic excellence, research, and community engagement to a global audience. For instance, Singapore's Ministry of Education highlights the significance of user-friendly websites and active social media in strengthening the online presence of educational institutions [11]. Similarly, the National Statement of the Royal Thai Government on Transforming Education underscores the importance of free, inclusive and equitable online educaion through open-source platforms, while also promoting teacher training and ensuring the safe use of digital technologies and artificial intelligence [12]. In Malaysia, efforts to become a leading education hub are reflected in the global online initiative, which focuses on enhancing the global visibility of HE by supporting the global online ecosystem, establishing governance structures, and creating a dynamic, flexible online education environment [13].

- **Safeguarding organizational digital identity:** To enhance digital presence, HEIs must address the challenges of safeguarding organizational digital identities. This involves mitigating risks associated with negative online behaviors through policies that establish clear guidelines for online conduct, grievance mechanisms, and awareness campaigns on digital footprints. In Malaysia, guidelines for responsible online behavior aim to prevent cyberbullying, plagiarism, and the spread of misinformation, all of which are essential to maintaining institutional reputations and fostering a respectful digital environment [14]. Similarly, Cambodia's ICT policy promotes media literacy, online safety, ICT ethics, and the prevention of cyberbullying, while advocating for the use of secure technologies [15]. Singapore's "Transforming Education Through Technology" Masterplan 2030 highlights the importance of cybersecurity and digital health, promoting cyber-health training for responsible technology use. Singapore's "Find, Think, Apply, Create" programme enhances students' digital competencies, including technology skills and digital etiquette, with all materials stored on open platforms [16].

Areas for improvement:

- **Supporting individual digital identity development:** Developing a strong DOI relies on the positive online identities of its members. However, SEA's policies often lack detailed strategies to equip staff and students with the necessary digital literacy skills to succeed online. Faculty training in responsible online communication and student workshops on digital citizenship have proven to be highly effective. For instance, while the Philippines aims to enhance technology access in public schools, this initiative could be further strengthened by incorporating digital literacy training alongside hardware provision. Teaching skills like information evaluation and responsible online interaction would enable students to manage their digital presence effectively, enhancing the institution's reputation [17]. In Lao PDR, the focus on integrating technology into teaching could benefit from additional training programmes for educators to promote responsible online behavior among students [18]. This would empower educators to create positive digital learning environments that encourage responsible online participation.

- **Developing standardized DT progress measurement:** While HE policies in SEA promote the development of a strong DOI, a key challenge remains: the lack of a standardized framework to measure institutions' DT progress. This gap makes it difficult to evaluate the effectiveness of implemented policies and to identify areas for improvement. For instance, Singapore has set goals for building a strong online presence, but without a standardized framework, it is challenging to gauge how much progress universities have made toward these

objectives [19]. Similarly, Thailand encourages "effective communication strategies" through digital tools, yet measuring the success of these strategies is difficult without a unified measurement system [20].

- **Aligning internationalization with digital identity:** This is crucial in today's globally connected academic landscape. However, many current policies fail to fully integrate these initiatives into broader digital communication strategies. To effectively align internationalization with digital identity, universities could highlight international collaborations and research partnerships on their websites and foster online communities that engage diverse student populations, including international students. For instance, Brunei Darussalam identifies internationalization as a key strategic objective, and its universities could strengthen their global digital presence by showcasing success stories from international student exchanges and hosting online seminars featuring international scholars, thereby enhancing their global reach [21]. Similarly, while Thailand prioritizes internationalization, its strategy could benefit from leveraging digital platforms to communicate these efforts to a global audience, further amplifying the institution's digital presence on the international stage [22].

2.3.2.3. Component 1.3. Digital Organizational Well-being

The digital landscape of HE is constantly evolving, demanding a focus on digital organizational well-being. This concept acknowledges the impact of digital technologies on the mental and physical health of staff and students. This section examines emerging trends and gaps in HE policies across SEA regarding organizational well-being.

Emerging trends:

- **Embedding digital well-being in organizational strategies and policies:** Some SEA countries are beginning to recognize the importance of digital well-being in HE. While policies in this area are still in their early stages, institutions are increasingly prioritizing the development of well-being strategies that address the health impacts of DT. Thailand's Ministry of Education underscores the importance of digital literacy in promoting digital well-being, integrating it into educational strategies to equip students with the skills necessary to navigate digital environments safely. Thailand views DT as an opportunity while also acknowledging the challenges related to digital health, committing to online training programmes to ensure the quality and safe use of digital technologies [23]. Similarly, the Philippines' Commission on Higher Education (CHED) emphasizes mental health support within the digital learning environment, advocating for the use of digital tools and services to support the well-being of both students and staff [24].

Areas for improvement:

- **Lack of supportive policies and resources:** Integrating digital well-being considerations into existing policies across various areas – from workload management to student support services – is another crucial aspect. This could involve:

  - **Work-life balance policies:** Encouraging faculty and staff to disconnect from work emails and digital platforms outside working hours.
  - **Digital well-being resources:** Offering workshops and support programmes to raise awareness about technology addiction, responsible technology use, and healthy digital boundaries.
  - **Integration with existing student support services:** Offering resources for online stress management, cyberbullying prevention, and healthy digital habits within existing student support structures.

2.3.2.4. Component 1.4. Digital Organizational Changes

Emerging trends in HE policies across SEA indicate a significant shift towards embracing digital organizational changes. These trends highlight a collective recognition of the transformative potential of digital innovation, data, and technology in enhancing the educational landscape. This section explores how the HE sectors in the region is navigating these changes and possible gaps in their policies.

Emerging trends:

- **Leadership in DT:** Effective management of DT requires setting clear, achievable goals and overseeing the implementation of digital initiatives. The Philippines has adopted policies to support the

transition to flexible learning modalities, utilizing digital tools to ensure education accessibility during the COVID-19 pandemic. By incorporating technology skills into school curricula, the country aims to enhance students' ability to use ICT effectively, improving learning experiences and promoting sustainable development [25]. This demonstrates a strategic approach to managing digital change, enabling institutions to adopt new technologies while maintaining operational continuity. In Lao PDR, universities are demonstrating leadership in digital transformation by actively recognizing the potential of online learning and working towards a hybrid model that integrates both face-to-face and online education. These institutions are leading efforts to establish e-learning regulations and develop Massive Open Online Courses (MOOCs), thereby positioning themselves to better utilize technology in education and prepare for future challenges, such as those posed by the COVID-19 pandemic [26]. Similarly, Timor-Leste's National Education Strategic Plan showcases leadership in digital transformation by emphasizing equity and inclusivity in the digital shift, with a particular focus on developing robust distance learning systems to ensure educational access for all students [27].

- **Understanding the transformative nature of digital technologies:** University leaders across SEA are increasingly aware of the transformative impact of digital technologies on education for both students and staff. This recognition is reflected in strategic investments in digital infrastructure and the adoption of data-driven decision-making. For instance, the National University of Singapore (NUS) is at the forefront of incorporating digital innovations into both curriculum and administration, improving learning outcomes and operational efficiency. The Singapore government also aims to enhance learning spaces using artificial intelligence, enabling students to personalize their learning paths and access diverse educational resources [28]. Thailand similarly focuses on learner-centered DT, ensuring that students are equipped with the skills necessary to enhance their learning and become global citizens [29].

Areas for improvement:

- **Strategic foresight:** Current HE policies across SEA lack a comprehensive analysis of emerging technologies and trends, leaving institutions unprepared for their potential impact on curriculum delivery, research methodologies, and administrative processes. There is a need for foresight planning to anticipate the influence of technologies such as artificial intelligence, blockchain, and virtual reality on HE systems.

- **Risk mitigation strategies:** Many policies fall short in addressing the potential disruptions caused by DT, such as job displacement or over-reliance on specific technologies. While Indonesia is aligning its education services with future economic and social development needs—emphasizing technological mastery to promote sustainable economic growth—its policies do not address the risks that DT may pose, such as technological unemployment or dependency [30]. Similarly, Cambodia's HE policy highlights the importance of digital skills in the context of the Fourth Industrial Revolution, focusing on fields like software development, telecommunications, artificial intelligence, and data science. Scholarship programmes support students in meeting career demands, but the policy lacks provisions to manage risks related to labor market volatility or over-dependence on technology [31].

- **A culture of adaptability:** Thriving in a rapidly changing digital environment requires cultivating a culture of continuous learning and adaptability. Universities must promote transparent communication regarding their DT plans and challenges, fostering openness and inclusivity. Encouraging experimentation with new technologies among faculty, staff, and students is essential, as it fosters innovation and a willingness to embrace change. This approach can help institutions stay agile and responsive to the evolving digital landscape.

2.3.3. Component 2: Knowledge Creation and Innovation

This section gains insights into the "knowledge creation and innovation" component within the HE sector of SEA countries, examining key aspects, including digital vision and horizon scanning, research, innovation, and wider impact.

Table 3. Trends and areas for improvement in knowledge creation and innovation

Aspect	Emerging trends	Areas for improvement
Digital vision and horizon scanning	• Learning international experiences • Empowering leadership for future planning	• A "futures-thinking" mindset • Collaborative horizon scanning • Systematic investigation of trends
Research	• Investing in digital research infrastructure • International research collaboration	• Developing a comprehensive digital research strategy • Provision of specialist support to researchers • Cultivating an inclusive digital research culture
Innovation	• The advent of digital innovation projects • Addressing reward systems & workload	• Developing and leading innovative digital systems • Fostering collaborative innovation • ecosystems with local community and businesses
Wider impact	• Dissemination of knowledge assets • Support for digital media professionals	• Systematic impact assessment • Critiquing technology decisions

2.3.3.1. Component 2.1. Digital Vision and Horizon Scanning

HE in SEA is undergoing transformative changes, particularly in the realm of “digital vision and horizon scanning.” This involves anticipating and preparing for the impact of current and future digital trends on educational priorities and strategies. Senior leaders are adopting a “futures-thinking” mindset to gather insights and inform decision-making, supported by systematic investigation of trends and collaboration with diverse stakeholders. By fostering digital creativity and embracing international perspectives, institutions are better positioned to navigate opportunities and challenges in an increasingly technology-driven world.

Emerging trends:

- **Learning from international experiences:** Current DT policies in SEA’s HE encourages collaboration with leading global universities through faculty exchange programmes, joint research initiatives, and participation in international conferences focused on the future of education. Vietnam and Thailand demonstrate a strong awareness of the importance of learning from global best practices in digital education. Vietnam’s initiatives, including partnerships with international universities and active participation in global education forums, aim to integrate international digital education trends into national strategic planning [32]. Similarly, Thailand emphasizes the need to align its education system with international standards. The Thai government supports collaboration between public and private sectors to learn from global experiences, ensuring that students are equipped with the knowledge and confidence to compete in both domestic and international job markets [33]. Additionally, Lao PDR’s Education and Sports Sector Development Plan 2021-2025 outlines activities to foster lecturer exchanges and technical knowledge sharing with foreign universities, further promoting global collaboration in education [34].

- **Empowering leadership for future planning:** HE in SEA is undergoing reforms aimed at fostering DT, with the success of these efforts largely dependent on the vision and planning of educational leaders. Current policies across the region focus on equipping administrators and faculty with digital strategies and innovation skills to guide institutions through this transition. For example, Lao PDR

faces challenges related to digital infrastructure and access, yet the Ministry of Education and Sports has prioritized the development of digital skills among both educators and students. Empowering leadership within Lao universities involves not only enhancing digital competencies but also fostering a culture of innovation and experimentation with new technology-enabled teaching methods [35]. Brunei Darussalam similarly underscores the importance of integrating ICT into teaching, with a long-term strategy to ensure digital teaching and learning become the standard. In Brunei Darussalam's approach, digital technology serves as both a tool for delivering education and a means for lecturers and managers to share knowledge through digital platforms and resources [36]. This focus on digital competency and collaboration reflects a broader commitment to preparing educators and institutions for the demands of DT in education.

Areas for improvement:

- **A "futures-thinking" mindset:** A critical policy area was identified to foster "futures-thinking" mindsets among leaders. This goes beyond reacting to current trends and prepares for the evolving digital landscape in HE. Many institutions lack a strategic approach. For example, Myanmar's National Education Sector Strategic Plan (2016-2021) emphasizes technology integration but lacks a specific roadmap for future technological advancements. Policy improvements can address this by incorporating foresight-oriented training for leaders. This could involve:

  - **Leadership development programmes:** Integrating modules on technological trends and their impact on HE into leadership development programmes can equip leaders with the necessary foresight.
  - **Scenario planning workshops:** Facilitating scenario planning workshops with diverse stakeholders allows HEIs to explore different future possibilities and develop adaptive strategies.

- **Collaborative horizon scanning:** Policy frameworks should encourage establishing dedicated groups tasked with monitoring industry and sectoral movements, including their DT trends. These groups can comprise faculty, staff, students, and industry representatives to leverage diverse perspectives. For example, Lao PDR' Higher Education Strategic Development Plan (2016-2025) mentions collaboration with stakeholders but lacks specifics on forming dedicated technology-focused groups. Benchmarking with leading HEIs globally would further enrich this process, including:

  - **Cross-functional working groups:** Establishing cross-functional working groups responsible for horizon scanning fosters collaboration and ensures inclusivity in policy development (OECD, 2019).
  - **Benchmarking with global leaders:** Implementing policies that encourage benchmarking with international institutions can provide valuable insights into best practices for digital integration and well-being (European Commission, 2017).

- **Systematic investigation of trends:** HEI policies should encourage systematic investigation of future trends influencing technology and HE to anticipate opportunities and threats. For instance, the Cambodian Education Strategic Plan 2019-2023 prioritizes technology but lacks a focus on dedicated research into future trends. Policy revisions advocating for establishing research units or commissioning foresight studies could address this gap. This could entail:

  - **Investments in research units:** Establishing dedicated research units or partnering with existing research institutions serves to investigate emerging technologies and their potential impact on the sector.
  - **Commissioning foresight studies:** Funding foresight studies that address specific digital challenges and opportunities can inform policy development and resource allocation (UNESCO, 2015).

2.3.3.2. Component 2.2. Research

HE in SEA has undergone significant changes, particularly in research, driven by swift technological progress and a global shift towards digitalization. This transformation emphasizes improving digital research infrastructures, encouraging international partnerships, and cultivating an inclusive research culture.

Emerging trends:

- **Investing in digital research infrastructure:** A prominent trend across SEA is the significant investment in digital research systems and infrastructure, which is specifically aimed at establishing a robust foundation for advanced research. These efforts not only seek to equip researchers with state-of-the-art software and technology but also facilitate high-impact research activities. Moreover, current HE policies in the region promote cost-effective strategies for infrastructure development, such as leveraging cloud-based solutions and open-source software platforms and fostering collaboration with regional partners to share resources. For instance, Singapore, a regional leader in research and development (R&D), has implemented comprehensive digital infrastructure upgrades across its universities. The National Research Foundation (NRF) has been particularly pivotal in funding and supporting digital research environments, with an emphasis on optimizing costs while ensuring that research quality remains uncompromised. In line with this, Singapore's "Transforming Education through Technology" Masterplan 2030 outlines a strategy to redesign learning spaces, not only to support technology-based learning but also to enhance research capabilities [37]. Similarly, Malaysia's Ministry of Higher Education has launched several projects under the Malaysia Education Blueprint 2015-2025, specifically aimed at enhancing digital infrastructure in research institutions, thereby further promoting the integration of digital tools into R&D [38]. In addition, Timor-Leste, in collaboration with universities and other partners, plans to establish a Digital Accelerator and Capacity Development Center to train policymakers and IT staff. These efforts are directly aligned with the nation's broader DT goals, as well as promoting research and training human resources. Notably, the government is actively promoting the construction of ICT labs to support these objectives [39, 40]. Furthermore, Cambodia's Industrial Development Policy 2015-2025 emphasizes the importance of strengthening HE curricula in fields such as agricultural sciences and other key science-technical disciplines. Accordingly, the upgrading of educational facilities is essential to ensure the quality of education, research, and development [41].

- **International research collaboration:** The policy analysis indicates that international research collaboration is a priority in several SEA countries. This emphasis is evident in initiatives such as funding scholarships for research exchanges, visiting fellowships, and joint research projects with international partners. Many countries, including the Philippines and Cambodia, promote support programmes that facilitate international staff mobility for researchers. In the Philippines, the Commission on Higher Education (CHED) has been particularly proactive in fostering international research collaborations, especially in areas of mutual interest like marine biodiversity and digital agriculture. These partnerships not only provide Filipino researchers with access to global expertise and funding but also raise the international profile of the country's research outputs. Additionally, the Philippines aims to create and commercialize intellectual property through science, research, and innovation, promoting national brands on a global scale [42]. Cambodia's Digital Government Policy 2022-2035 prioritizes actions that promote digital research and innovation. The policy encourages research and digital technology transfer between the public and private sectors within education. Furthermore, digital research collaborations with both domestic and foreign institutions are highlighted as essential for acquiring and applying new technologies [43].

Areas for improvement:

- **Developing a comprehensive digital research strategy:** To enhance policies in DTxHE across SEA, emphasis should be placed on infrastructure, asset management, open research, collaboration, and fostering a supportive digital culture. Investments in computing power, advanced software, and secure data storage are crucial, alongside effective research asset management to optimize

resources. Singapore has made significant strides through its Research, Innovation, and Enterprise 2020 Plan, which prioritizes digital infrastructure and international collaboration. However, there is room for further focus on open research and knowledge exchange to improve transparency and accessibility [44]. Meanwhile, countries like Vietnam and the Philippines are still in the early stages of integrating digital strategies into their research policies. Clear policies that focus on both infrastructure development and efficient management of digital research assets would significantly benefit these nations [45].

- **Cultivating an inclusive digital research culture:** The promotion of EDI within a digital research culture is crucial. However, some countries in the region lack policies that advocate for inclusive practices that ensure all researchers, regardless of background, have equal access to digital tools, resources, and opportunities for collaboration. For example, Thailand's National Research Council has made efforts to support research that addresses social challenges and promotes inclusivity. However, broader policies that explicitly embed EDI principles in digital research cultures across the region are needed. Such policies would ensure that the DT of research is not only technologically advanced but also socially inclusive. Additionally, regional policies should promote training programmes that incorporate EDI principles into research design, methodologies, and dissemination, ensuring research outcomes benefit diverse populations and address societal challenges [46]. Moreover, policies must support the development of inclusive research infrastructure, making it accessible to researchers with disabilities, and encouraging collaboration with partners from diverse backgrounds to foster a more equitable research environment [47].

- **Provision of specialist support to researchers:** The need for specialist support for researchers—encompassing research management, IT services, and skills development—is increasingly acknowledged across SEA, but its implementation remains inconsistent due to policy gaps. To address this, policies should prioritize robust IT support tailored to researchers' specific needs, including training in data analysis tools, cybersecurity, and research data management best practices. While Malaysia's Education Blueprint 2015-2025 outlines strategies to strengthen research capabilities, it lacks a focus on research management support. However, initiatives like the Malaysia Research and Education Network (MYREN), which provides high-speed internet and collaboration tools, serve as a strong model. Expanding these initiatives to include comprehensive research management and skills development could significantly improve research outcomes [48].

2.3.3.3. Component 2.3. Innovation

DT's "innovation" aspect in HE policies across SEA is becoming increasingly significant as institutions aim to foster creativity, entrepreneurship, and digital leadership. This section explores how current policies support innovation and what potential challenges may be caused by the limitations of current policies.

Emerging trends:

- **The advent of digital innovation projects:** This is being actively promoted through policies across SEA, with HEIs encouraged to align these projects with their strategic objectives. Current policies emphasize the allocation of dedicated funding for faculty and student-led digital innovation initiatives, as well as the establishment of innovation hubs within universities. In Singapore, the launch of the Research Program in AI and Data Governance awarded a 5-year research grant to Singapore Management University in June 2018. This initiative aims to enhance the quality of AI and data-related research and improve access to international expertise [50]. Similarly, Thailand is focused on transforming its economy through innovation and technology. Its policies encourage universities to engage in national innovation projects and foster collaborations between industries and educational institutions. These projects prioritize digital technologies, sustainable solutions, and creative industries, aligning with the country's strategic goals to enhance economic growth and competitiveness [51].

- **Addressing reward systems & workload:** HE policies in SEA are increasingly focused on revising faculty reward and promotion systems to incentivize innovation in teaching and research, alongside flexible workload management to give academics the time needed for innovation. Many countries have introduced awards and recognition programmes

to celebrate outstanding achievements, fostering a creative academic culture. In Malaysia, explicit goals aim to enhance university governance and reward systems, supporting flexible workloads and recognizing contributions to innovative teaching and research through awards [52]. Similarly, the Philippines' Commission on Higher Education (CHED) has implemented policies to promote innovation, revising faculty reward systems and introducing grants and awards for outstanding projects [53]. In Lao PDR, the Education and Sports Development Plan 2016-2020 encourages innovation with increased funding for scientific, technological, and educational research from both government and non-government sources [54].

Areas for improvement:

- **Developing and leading innovative digital systems:** There is an increasing need for policies that not only encourage but also provide clear guidance for institutions in creating and utilizing innovative digital tools and services. While the Philippines' CHED has initiated programmes to integrate digital technology into teaching and research, a more structured approach to fostering innovation in digital systems could significantly enhance the sector's overall effectiveness. Policies should include detailed strategies for developing in-house digital solutions tailored to institutional needs, promoting a culture of innovation from within [55].

- **Fostering collaborative innovation ecosystems with local communities and businesses:** Collaboration between HEIs and local communities and businesses is vital for regional development. Policies should explicitly promote partnerships that focus on identifying social and economic challenges within the region and co-creating innovative solutions through collaborative research and development initiatives. While countries like Vietnam and Malaysia have made progress in engaging universities with industry partners, there is potential for policies to further support these collaborations with an emphasis on innovation. Vietnam's National Strategy for Science and Technology (Decision No. 569/QD-TTg, Promulgating the Strategy for Development of Science, Technology and Innovation by 2030) highlights technology transfer but places limited emphasis on fostering community and industry partnerships for regional development. Policy revisions could encourage universities to collaborate more closely with local businesses and communities to address regional challenges through innovative solutions [56]. Similarly, while Malaysia's Higher Education Blueprint includes measures for university-industry engagement, it could place greater emphasis on universities as drivers of local and regional innovation, in close collaboration with industry partners. Strengthening these initiatives would not only promote economic and social development but also enhance the practical relevance of academic research and innovation [57].

2.3.3.4. Component 2.4. Wider Impact

The "wider impact" concept highlights the importance of extending the reach and application of academic research to benefit society at large, beyond the confines of academia by utilizing digital technologies. Although Southeast Asian countries have progressed significantly in HE, effectively fostering and realizing the wider impact of research is still a challenge. This analysis explores the current policy trends and identifies the challenges these policies face in enhancing the dissemination and societal application of academic research.

Emerging trends:

- **Dissemination of knowledge assets:** Effective dissemination strategies are essential for maximizing the impact of research and innovation. In SEA, there is a growing emphasis on tailoring the communication of research findings to reach various stakeholders. Malaysia's Higher Education Blueprint (2015-2025) highlights the importance of innovation and research translation, advocating for the creation of platforms that make research accessible to non-academic audiences. This marks a shift toward more flexible communication strategies, ensuring that research outcomes have a broader societal impact [58]. "Thailand 4.0" initiative stresses the role of research and innovation in driving economic and social development. A key element of this strategy is enhancing universities' ability to package and disseminate research outputs via digital media, aiming to effectively engage industry, government bodies, and the general public [59]. Cambodia's Masterplan 2020 promotes the production and dissemination of electronic lectures on various topics, published on open-access platforms and

mobile phones, alongside efforts to establish an e-learning distribution network [60]. Lao PDR, meanwhile, has proposed the development of AI research and training, with a focus on disseminating AI achievements [61]. These initiatives reflect a regional push towards making research more accessible and impactful through innovative dissemination methods.

- **Support for digital media professionals:** The role of digital media professionals in enhancing the visibility and impact of academic research and innovation is increasingly recognized across SEA. Policies in many countries support the development and utilization of these professionals' skills in areas such as website design, digital branding, reputation management, and content production. Singapore's universities have strengthened their global standing by actively recruiting top digital media professionals and fostering collaborations with leading research centers specializing in digital innovation [62]. Similarly, Malaysia's Education Blueprint 2015-2025 outlines a clear strategy to attract and nurture talent in digital media, prioritizing the recruitment of local and international experts in digital technologies. The Ministry of Education emphasizes providing targeted support for these professionals to enhance digital media research, develop cutting-edge digital teaching tools, and drive innovation in university administration and management [63]. These efforts demonstrate the increasing recognition of digital media professionals and international expertise in boosting academic research's global reach and impact.

Areas for improvement:

- **Systematic impact assessment:** There is a pressing need for policies that mandate the systematic analysis and recording of how university research, enterprise, and innovation affect various sectors. For example, in Malaysia, the HE Blueprint (2015-2025) emphasizes the economic and social contributions of university research. However, it could further detail processes for systematically recording these impacts across different communities and business sectors. Implementing such processes would enable institutions to demonstrate their value more explicitly and align future research endeavors with societal needs.

- **Critiquing technology decisions:** The impact of technology investment and usage within universities extends well beyond educational outcomes, significantly influencing environmental sustainability. Key decisions, such as adopting energy-efficient technologies, sustainable procurement practices for digital devices, and cloud-based solutions, can considerably reduce an institution's environmental footprint. For example, using green technology and renewable energy can lower carbon emissions, while digital tools can minimize paper use, reduce waste, and enhance energy efficiency through smart campus initiatives. By aligning their technology strategies with sustainability goals, universities can not only reduce their ecological impact but also serve as leaders in promoting responsible innovation. Singapore's Smart Nation initiative highlights this integration of technology and sustainability, yet there is room for more policies across the region to guide universities in ensuring their technology investments prioritize long-term environmental and societal benefits.

2.3.4. Component 3: Knowledge Development

This section gains insights into the knowledge development component in DTxHE policies in SEA countries, examining key aspects such as curriculum development, digital learning, digital teaching, and learner experience.

Table 4. Trends and areas for improvement in knowledge development

Aspect	Emerging trends	Areas for improvement
Curriculum development	• Digital learning resources strategy • Expanding learning opportunities • Innovations in pedagogy	• Crafting a cohesive digital learning vision • Aligning TEL strategies with organizational strategies • Digital assessment strategy
Digital learning	• Investment in self-access resources • Building a robust support system • Encouragement of self-regulated independent learning	• Recognizing the diverse landscape of digital learners • Acknowledging previous digital experiences • Optimizing the use of digital tools and resources • Academic Integrity in the Digital Age
Digital teaching	• Development of digital pedagogy skills among staff • Investment in digital teaching infrastructure • Management of digital platforms for diverse learning modes	• Integration of Workplace Skills in Digital Teaching • Investment in industry-aligned technologies • Ethical Use of Learning Analytics
Learner experience	• Building a data-driven approach • Recognizing and Rewarding Digital Skills	• Support mechanisms for student well-being. • Consistent experiences from pre-enrolment to post-qualification

2.3.4.1. Component 3.1. Curriculum development

In the context of SEA, policies in the HE sector are increasingly reflecting a commitment to DT in curriculum development. This transformation encompasses not only the adoption of digital learning resources but also the exploration of innovative delivery models and pedagogical practices. The following analysis outlines policy directions and some potential challenges related to curriculum development in the digital era.

Emerging trends:

- **Digital learning resources strategy:** The governments in SEA region are increasingly focusing on the development of digital learning resources to enhance curriculum development. Policies across the region aim to foster the creation and adoption of these resources, particularly emphasizing open educational resources (OERs) and strengthening e-learning curricula (https://www.aaou.org/). These initiatives not only aim to reduce educational

costs but also promote regional collaboration and knowledge sharing. The Philippines' Commission on Higher Education (CHED) is actively promoting OERs to improve accessibility and affordability for educational institutions [64]. In Thailand, efforts to integrate digital resources such as e-books and e-journals into the curriculum are being supported by the Digital Economy Promotion Agency (DEPA), with the "Open Education Resource Center" playing a key role in providing open-source materials for curriculum development [65]. Singapore's National Library Board has invested heavily in e-book platforms and online journal subscriptions, expanding access to academic resources. This strategy, which includes extensive online databases for students and faculty, supports both research and learning and is essential for effective digital curriculum planning [66].

- **Expanding learning opportunities:** There is a notable shift in SEA towards models that extend learning opportunities beyond traditional classroom settings. Policies are increasingly encouraging experimentation with blended and hybrid learning models, which combine face-to-face instruction with online components. Platforms like Coursera and edX are gaining popularity, enabling universities to offer specialized MOOCs to a global audience. Vietnam's HE policies allow universities to develop blended learning programmes, with a restriction that online learning must not exceed 30% of the total credit load [67]. Similarly, Malaysia's HE Blueprint includes provisions for increasing access through distance learning, MOOCs, and blended learning, part of a broader strategy to enhance flexibility and accessibility for students while extending institutional reach both domestically and internationally [68]. In Cambodia, the government encourages students to use Learning Management Systems (LMS) for self-study. The Masterplan 2020 focuses on developing eLearning programmes and IT applications to deliver educational content, aiming to raise the education level to the regional average, reduce illiteracy, and provide equal opportunities for high-quality education [72]. Lao PDR' Education and Sports Development Plan 2021-2025 outlines a strategy to create a legal framework for hybrid and online education, including developing blended learning programs and pilot teaching initiatives [70]. Timor-Leste has proposed plans to establish flexible and distance learning systems and build an online learning repository [71].

- **Innovations in pedagogy:** The emphasis on cultivating a culture of learning and teaching excellence is evident in SEA's approach to curriculum development. Governments in the region are dedicating resources to researching the pedagogical effectiveness of digital learning strategies, ensuring that curriculum development remains evidence-based and responsive to the evolving needs of students. Additionally, involving students in the design process, as seen in Singapore's Future Skills initiative, ensures their needs and perspectives are reflected in the learning experience [73]. Faculty development programmes, such as those offered by the Philippines' CHED, are also crucial in equipping educators with the tools to integrate technology effectively and adapt their teaching practices [74]. Finally, keeping the curriculum aligned with industry trends and workforce demands through close collaboration with industry stakeholders, as Cambodia has done in developing teacher capacity for communication technologies, ensures that the curriculum remains relevant and forward-looking. This approach fosters a dynamic, evidence-based curriculum that evolves alongside the needs of students and the broader educational landscape [75].

Areas for improvement:

- **Crafting a cohesive digital learning vision:** SEA nations are actively integrating technology into HE curricula. However, current policies can be further strengthened to ensure a seamless DT in curriculum development. Developing a cohesive national or institutional strategy for digital learning is crucial. This strategy could encompass:

  - **Technology-Enhanced Learning (TEL) framework:** This framework would define key principles and best practices for integrating technology into curriculum design, delivery, and assessment. Countries like Singapore, with its "National Infocomm Competency Framework," could build upon existing frameworks to address specific needs in HE.

  - **Implementation support:** The framework should be accompanied by resources and support structures to guide departments and services in implementing TEL effectively. This could include professional development programmes for faculty and staff on digital pedagogy and curriculum design.

- **Aligning TEL strategies with organizational strategies:** For a successful DT, TEL strategies need to align with other organizational goals. Specifically:

  - **IT and digital strategies:** Curriculum development should leverage existing IT infrastructure and digital platforms to ensure optimal user experience. For example, Thailand's "Education 4.0" initiative emphasizes technology integration but could benefit from further alignment between its curriculum development goals and national IT strategies.

  - **Transnational education aspirations:** If universities aim to expand reach through online or blended learning programmes, curriculum development needs to consider international student needs and accessibility. For example, Malaysia, a leader in transnational education, can further refine its curriculum policies to cater to the diverse learning styles and technological capabilities of students across borders.

- **Digital assessment strategy:** The shift towards digital assessment or electronic management of assessment (EMA) is an emerging trend, yet its adoption varies widely. A national or institutional framework for digital assessment or EMA should be established. This framework could define acceptable practices for e-exams, online quizzes, and other technology-based assessment methods. Thailand has made strides with initiatives to adopt digital assessment tools in universities, facilitated by the Office of Higher Education Commission (OHEC). These tools are designed to streamline assessment processes and provide more flexible, accessible methods for evaluating student performance. However, the challenge remains in developing policies that not only encourage the adoption of digital assessment strategies but also support their implementation across departments and services. Comprehensive support mechanisms, including training for faculty and investment in necessary technologies, are required to realize the full potential of digital assessment in enhancing learning outcomes.

2.3.4.2. Component 3.2. Digital Learning

As institutions navigate their DT journeys, the digital learning component is increasingly central to HE policies across SEA. Policies not only emphasize new technology adoption but also ensure that the digital shift enhances educational access, quality, and relevance.

Emerging trends:

- **Investment in self-access resources:** Investing in self-access resources is increasingly prioritized by Southeast Asian countries to enhance digital capabilities among learners. Current DTxHE policies emphasize the development of online resources such as tutorials, simulations, and e-learning modules to support independent learning. For instance, Vietnam is investing in national e-learning portals, offering students self-paced opportunities to improve their digital literacy skills [76]. Similarly, Myanmar's Ministry of Education, through its 2018-2022 Universal Service Strategy, supports the establishment of alternative digital learning centers that provide access to ICT for both students and individuals outside the school system. This strategy includes content and applications designed to promote digital empowerment, particularly for rural and low-income populations [78].

- **Encouragement of self-regulated independent learning:** An emerging trend in SEA is the encouragement of self-regulated, independent learning through digital platforms. Current policies aim to create opportunities for learners to take control of their learning paths. Indonesia has been actively promoting digital platforms that support autonomous learning, offering clear guidance on the technical requirements for courses. This approach is bolstered by offering various learning modes—online, on-campus, and blended—to meet diverse student needs and circumstances. The push towards e-learning platforms with a range of courses and resources is designed to foster independent learning, ensuring students are well-prepared for digital education [82]. Similarly, Thailand's "Education 4.0" initiative emphasizes the development of self-directed learning skills, encouraging students to take ownership of their educational journeys and adapt to evolving digital environments [83].

- **Building a robust support system:** Governments across SEA are building comprehensive support systems to strengthen digital learning. Key initiatives include developing training programmes for faculty in online pedagogy and establishing technical support teams to assist students with technological challenges. Current policies focus on providing clear course descriptions that outline hardware, software, and internet requirements, ensuring that students are well-prepared for digital learning environments. The HE curriculum frameworks are also being updated to incorporate digital competencies aligned with diverse career paths. Singapore's "Media and Information Literacy Framework", developed by the Ministry of Communications and Information, identifies essential digital skills across industries, ensuring that graduates are well-prepared for the digital workforce [79]. Similarly, Malaysia's HE Blueprint emphasizes the creation of digital learning support centers within universities, designed to help students navigate digital environments and use digital tools effectively [80]. Cambodia's "National Education Technology Roadmap" is building a strong foundation for integrating technology into education. The government is investing in infrastructure to ensure reliable internet and digital tools in schools, while also providing comprehensive teacher training to equip educators with the skills to effectively use digital resources. Online platforms offer easy access to curated content and interactive materials, and ongoing technical support ensures smooth implementation. Through partnerships with local and international stakeholders, Cambodia is creating a flexible and adaptable digital education ecosystem to meet the evolving needs of students [81].

Areas for improvement:

- **Recognizing the diverse landscape of digital learners:** Effective digital learning must cater to the diverse needs of all students, particularly those facing barriers due to socioeconomic challenges, such as disability or geographical locations. Policymakers should acknowledge that poverty can limit access to technology and reliable Internet, and targeted support for students with disabilities remains underdeveloped. For instance, while the Philippines' "Free Internet Access in Public Places Act" improves connectivity, more focused policies are needed to support learners in remote areas or with disabilities. Additionally, international students and those from diverse ethnic backgrounds may encounter language barriers and differing cultural learning approaches. To promote inclusivity, policies should encourage multilingual platforms and culturally sensitive content, alongside alternative formats like audio descriptions and closed captions. Ensuring compatibility with assistive technologies and providing tailored support for disadvantaged learners would significantly enhance access and participation, fostering a more inclusive digital learning environment.

- **Acknowledging previous digital experiences:** The diverse digital backgrounds of students, especially international students who may come from regions with differing levels of digital adoption, present another challenge. Policies need to acknowledge and bridge these varying levels of digital readiness to create a more inclusive digital learning environment. Policymakers need to consider:

  - **International student integration:** International students may have prior experience with different online learning platforms or learning styles. Policies should encourage institutions to provide orientation programmes that familiarize students with the specific online learning tools and expectations of their chosen university.

  - **Recognizing informal learning:** Students may have developed digital skills through online gaming, social media, or independent learning platforms. Policies can be revised to acknowledge these experiences and potentially build upon existing digital knowledge.

- **Optimizing the use of digital tools and resources:** The availability and effective use of digital tools, including third-party and AI-driven platforms, are essential for improving learning outcomes. While SEA countries have integrated digital technologies into HE, there is a need for more guidance on their responsible and effective use. Malaysia's HE 4.0 initiative promotes the adoption of advanced digital tools but could further stress training students on academic integrity and online research methodologies. Faculty development in digital pedagogies is equally important, as proficient educators can significantly enhance the quality of digital learning. Indonesia's "Merdeka Belajar" (Freedom to Learn) policy, which encourages

innovative teaching methods like digital learning, reflects progress. However, expanding these efforts to include comprehensive training on emerging digital technologies is necessary to keep pace with advancements in the field.

- **Academic integrity in the digital age:** Policies promoting digital literacy should address issues of plagiarism and proper citation practices within the online learning environment. Universities can develop workshops and resources to equip students with the skills to navigate scholarly databases and avoid unethical practices in online learning.

2.3.4.3. Component 3.3. Digital Teaching

The DTxHE in SEA is reshaping the way teaching and learning take place. The policies regarding digital teaching are centered around investing in digital infrastructure, supporting diverse learning modes, developing digital pedagogy skills among staff, and ensuring inclusivity and real-world relevance in digital education.

Emerging trends:

- **Development of digital pedagogy skills among staff:** Acknowledging the distinct skills required for effective digital teaching, SEA policies emphasize professional development opportunities for educators. Universities are fostering online communities and mentorship programmes to encourage collaboration and knowledge sharing on best practices for digital teaching. Faculty development programmes focus on areas such as online course design, interactive teaching methods, and the effective use of digital assessment tools. Policies also promote investment in platforms that support live online sessions, asynchronous resources, and blended learning models, catering to diverse student learning styles and needs. For example, Thailand's ICT Master Plan (2017-2021) at Kasetsart University outlines a strategy to train lecturers in the use of ICT, equipping them with new skills for teaching [84]. Professional development for teachers is further emphasized in joint statements on DT in education, advocating for pedagogical skills enhancement through professional learning communities (PLCs) [85]. Lao PDR' Education Sector Development Plan (2016-2020) proposes improving pedagogical knowledge, including IT skills, through face-to-face and online training [86]. Similarly, Cambodia implements capacity development programs to equip trainers with modern pedagogical methods and enhance their ICT proficiency [87]. As a long-term strategy, Brunei Darussalam's Ministry of Education is implementing a DT plan to ensure that digital teaching and learning become the norm, offering a framework to support educators in integrating ICT into their practices [88].

- **Investment in digital teaching infrastructure:** Investing in digital teaching infrastructure is gaining momentum across SEA as countries recognize the need for robust systems to support effective digital education. Singapore has made significant strides with its virtual learning environments (VLE) and learning management systems (LMS), notably through the AI-enabled, resource-rich "Singapore Student Learning Space (SLS)", which integrates advanced tools like e-portfolios and analytics to enhance learning experiences [89]. Malaysia's "HE 4.0" initiative emphasizes the development of digital assessment systems and the use of augmented reality (AR) and virtual reality (VR) technologies to create immersive learning environments [90]. Similarly, Lao PDR is promoting the application of ICT in education management, curriculum development, and teaching, with a focus on investing in eLearning tools to support inclusive education. The government is also working to expand affordable internet bandwidth for educational purposes [91].

- **Management of digital platforms for diverse learning modes:** The management of digital platforms supporting diverse learning modes—on-campus, online live, and asynchronous—is increasingly a priority. A shift towards a multi-platform approach is evident across SEA. In the Philippines, initiatives have been launched to improve internet connectivity on campuses, ensuring efficient access to online resources for students and staff. This is complemented by using multiple platforms to facilitate both synchronous and asynchronous learning experiences [92]. The integration of third-party tools is also gaining attention, with policies recognizing the value of educational apps and collaboration tools in supporting different learning modes. Singapore's "Tech for Learning Initiative", for example, provides resources to help faculty effectively incorporate these tools into their teaching [93].

Areas for improvement:

- **Integration of workplace skills in digital teaching:** Embedding real-world workplace skills into digital teaching is recognized as crucial for preparing students for the workforce. This involves not only integrating relevant skills into curricula and assessments but also leveraging digital tools that simulate professional environments. Policymakers may consider investing in physical and virtual learning spaces equipped with suitable connectivity and technology for supporting diverse digital teaching and learning activities. Furthermore, the HE curriculum must equip graduates for the digital workplace by:

  - **Mapping industry skill needs:** Policies should encourage collaboration between universities and industry leaders to identify in-demand skills. This informs curriculum development and the integration of relevant digital tools and platforms that mimic real-world work environments.

  - **Project-based learning with technology:** Policy frameworks should promote the use of digital tools and platforms for project-based learning activities that require collaboration, problem-solving, and critical thinking skills valued by employers.

- **Investment in industry-aligned technologies:** Investing in technologies that provide students with 'real-world' experiences is crucial. Thailand's initiative to incorporate AR and VR in HE exemplifies the potential of such technologies to offer authentic practice opportunities. Yet, a concerted effort is required to ensure that investments in technology are closely aligned with industry demands and future workplace environments across SEA. This includes not only adopting cutting-edge technologies but also ensuring that faculty are trained to integrate these tools effectively into teaching.

- **Ethical use of digital tools:** The ethical use of digital tools and AI presents an opportunity to tailor teaching and curriculum development to meet students' needs better. There is a regional need for policies that provide clear guidelines for the ethical collection, analysis, and application of educational data. This includes ensuring student privacy and using digital tools to support, rather than penalize student learning.

2.3.4.4. Component 3.4. Learner Experience

Learner experience within the DT of HE in SEA is shifting towards a holistic view of education encompassing curriculum, learning environment, including emotional and personal wellbeing, and other aspects.

Emerging trends:

- **Building a data-driven approach:** A data-driven approach is becoming a priority in SEA's HE policies, with an increasing emphasis on data collection and analysis to enhance digital learning. A key emerging trend is the initiative to baseline and benchmark digital learning experiences across institutions. Policies encourage the ethical use of learning analytics from online platforms to identify at-risk students and personalize interventions, improving engagement and academic success. This approach also involves assessing the quality of digital education offerings to identify areas for improvement. Universities are implementing online surveys and feedback platforms to capture student experiences with digital resources, curriculum design, and platform usability. However, there remains a need for broader adoption of these practices to ensure all institutions have clear benchmarks for digital learning quality. Singapore's approach exemplifies this trend, with systematic evaluation and feedback mechanisms designed to gather insights from students about their digital learning experiences [94].

- **Recognizing and rewarding digital skills:** A significant trend in HE policies across SEA is the growing recognition and reward for students developing digital capabilities, acknowledging these skills as essential graduate attributes. This shift includes initiatives such as:

  - **Digital badges and micro-credentials:** Governments and universities are increasingly exploring the use of digital badges and micro-credentials to acknowledge specific digital skills. These credentials can be displayed on online portfolios and job applications, helping students

showcase their competencies to potential employers.

- **Digital capability as a graduate attribute:** Policy frameworks are embedding digital literacy as a core attribute, ensuring that universities equip students with the digital skills required for employability in the modern workplace. Thailand formally recognizes digital capability as a key graduate attribute, incorporating it into curricula and assessment frameworks. This recognition extends beyond technical proficiency, covering independent learning, critical thinking in digital environments, and the ethical use of digital tools [95]. Malaysia's "Higher Education Blueprint (2015-2025)" also emphasizes digital literacy, with provisions for integrating it into curricula and awarding digital badges, co-curricular awards, and personal development opportunities, motivating students to enhance their digital skills [96]. Vietnam's "5-Good Student" award recognizes well-rounded students, with proficiency in digital skills as a requirement for achieving this distinction, which is a criterion for scholarships, study abroad, and recruitment [97]. Similarly, Lao PDR promotes technological access and innovation by organizing AI competitions at various levels, encouraging participation in domestic and international events [98].

Areas for improvement:

- **Support mechanisms for student well-being:** The provision of support for students' personal well-being through both in-person and digital channels is critical. While countries like Malaysia and Thailand have initiated wellness programmes and mental health services for students, there is a need for policies that explicitly advocate for the expansion of these services into digital domains. This includes:

  - Policies must place greater emphasis on incentivizing universities to develop robust online communities where students connect with peers, faculty, and alumni. These virtual communities can provide a space for social interaction, knowledge sharing, and peer support. For instance, Singapore's approach to digital education, as part of its Smart Nation initiative, includes platforms that encourage collaboration and community building among students. Nevertheless, a more region-wide policy directive encouraging the integration of digital tools that promote social interaction and community engagement is needed.

  - Policy frameworks can encourage the development of online resources promoting healthy study habits, time management techniques, and stress management strategies. Telehealth and online counselling services can further enhance well-being support for students.

- **Consistent experiences from pre-enrolment to post-qualification:** Ensuring a consistent learner experience throughout the student journey, from pre-enrolment to post-qualification, is another area for policy enhancement. The use of technology to streamline processes, provide orientation, deliver curricula, and support career development needs to be more uniformly applied across the region. For example, the Philippines' adoption of a Unified Student Financial Assistance System for Tertiary Education (UniFAST) utilizes technology to simplify scholarship applications and financial aid, providing a consistent support system for students. Expanding such initiatives to encompass the entire student lifecycle can significantly improve the learner experience, ensuring that students receive uniform support and guidance at every stage of their educational journey.

2.3.5. Component 4: Knowledge Management and Use

This section gains insights into the "knowledge management and use" in DTxHE policies in SEA countries, examining key aspects including information management and use, data management and use, business intelligence, and decision making.

Table 5. Trends and areas for improvement in knowledge management and use

Aspect	Emerging trends	Areas for improvement
Information management and use	• Support for library and information services staff: • Development of information literacies: • Transforming library and information services • Building a Strategic Information Framework	• Effective digital management of intellectual property (IP) • Information access should be equitable and inclusive
Data management and use	• Inclusive data collection and requirement mapping	• Building a data governance framework • Ethical management and use of personal digital data • Fostering a culture of data-driven innovation
Business intelligence	• Not mentioned	• Leverage business intelligence to optimize efficiency and competitiveness
Decision making	• Embracing evidence-based decision making	• Integration of digital tools for evidence-based decision-making

2.3.5.1. Component 4.1. Information Management and Use

Information management and use has emerged as a critical aspect of DTxHE policies. Policies around this component aim to streamline the processes around collecting, organizing, storing, and sharing information to enhance efficiency and compliance, reflecting the needs of a diverse range of stakeholders. This section gains insights into the policy directions and its potential challenges regarding information management and use within the region.

Emerging trends:

- **Support for library and information services staff:** Providing support for library and information services staff is increasingly recognized as crucial in the digital age. Investments in professional development programmes ensure that these staff members are equipped with the skills needed to manage and curate both digital and physical collections, aligning with the evolving demands of the academic community. Current policies emphasize training in data and information management, intellectual property rights, digital resource curation, and information security, enabling library staff to navigate the complexities of the digital knowledge landscape. Malaysia's policies focus on enhancing the capabilities of library professionals in areas such as digital resource management, information literacy, and digital preservation [99]. Similarly, Cambodia emphasizes strengthening the effectiveness of organizations in evidence-based decision-making and knowledge sharing, promoting capacity building in managing educational data through digital systems [100]. These efforts underscore the growing importance of library and information services staff in supporting academic institutions in a digitally transformed world.

- **Development of information literacies:** Policies across SEA are increasingly encouraging universities to integrate information literacy skills development into curricula, training programmes, and research support services. This includes workshops, online learning modules, and assignments designed to teach students how to critically evaluate information sources, conduct effective online research, and navigate digital environments with confidence. By embedding these skills, universities empower students and researchers to effectively gather,

assess, and apply information in the digital age. Singapore's "Find, Think, Apply, Create" framework strengthens students' digital competencies and technology skills by focusing on nine key digital competencies to deepen digital literacy in schools [101]. Similarly, Cambodia highlights digital competence as a critical factor in advancing national education technology development [102]. These initiatives reflect a growing recognition of the need for comprehensive information literacy education in the digital landscape.

- **Transformation of library and information services:** Transforming library and information services in SEA is a key focus of DTxHE policies, with two main directions emphasized:

  - **User-centric service delivery:** Policies highlight the importance of delivering library services tailored to the specific needs of faculty, students, and researchers. This involves conducting user needs assessments to customize both digital and physical resources, ensuring they align with the academic community's requirements.

  - **Building digital collections and promoting open access initiatives:** Policy frameworks encourage libraries to invest in building robust digital collections and supporting open access initiatives. These efforts enable wider dissemination of research outcomes and facilitate knowledge exchange across the academic community. For example, Brunei Darussalam's HE seeks to harness technology to improve the efficiency of teaching and service delivery [104], while Vietnam promotes e-library systems that provide students with access to free online services, enhancing knowledge access and reducing costs [105].

Areas for improvement:

- **Effective digital management of intellectual property (IP):** Managing IP generated through research, learning, teaching, and external partnerships is a complex challenge requiring clear policies, especially in the digital realm. SEA countries are at various stages of addressing this issue, but a more unified approach is needed across the region to ensure that creators understand their rights and obligations, and that institutions can effectively manage and commercialize their intellectual assets.

  - **Clear IP ownership guidelines:** Policy frameworks should prioritize the development of clear guidelines for the ownership and licensing of digital IP generated through research, teaching, and collaborations. This would ensure transparency and protect the rights of both universities and creators.

  - **Digital IP management infrastructure:** Universities should be incentivized to establish digital platforms for recording, tracking, and managing their digital IP assets. Such systems would streamline the identification, protection, and commercialization of valuable intellectual property.

- **Information access should be equitable and inclusive:** Policies should prioritize initiatives that bridge the digital divide, ensuring equitable access to digital learning environments. This includes providing students from disadvantaged backgrounds with the necessary hardware, software, and internet connectivity to fully engage in digital education. Additionally, policy frameworks should encourage the creation and dissemination of open educational resources (OERs), reducing learning material costs and promoting broader access to high-quality educational resources for all students. Moreover, policies can support digital scholarship by offering access to appropriate software, training in computational research methods, and data analysis tools. These initiatives empower researchers to harness the full potential of the digital environment, fostering innovation and expanding the reach of academic inquiry. Promoting these frameworks ensures that both students and researchers are equipped to succeed in an increasingly digital educational landscape.

2.3.5.2. Component 4.2. Data Management and Use

SEA's DTxHE hinges on responsible data management. This analysis explores emerging policy trends and challenges regarding data management and use.

Emerging trends:

- **Inclusive data collection and requirement mapping:** Current policies related to DTxHE in SEA often overlook data management and utilization. However, an emerging trend is the emphasis on inclusive data collection strategies to ensure that the needs of diverse student groups—such as international students, transnational education (TNE) participants, students with disabilities, and those with caregiving responsibilities—are addressed. Policies should prioritize the development of data requirement mapping exercises, which can guide service provision and policy development to ensure all students receive tailored support and resources. Thailand has made strides in improving its educational data systems by incorporating more detailed student information, helping to customize support services and educational programs [107]. Similarly, Lao PDR is working on building a database of Lao students studying abroad and foreign students studying within the country, further enhancing their ability to provide targeted support [108]. These efforts reflect the growing importance of comprehensive data management in creating more inclusive and responsive HE systems.

Areas for improvement:

- **Ethical management and use of personal digital data:** The ethical management and use of personal digital data are paramount, especially as HE institutions increasingly rely on digital platforms for learning, teaching, and administrative functions. There are various approaches to this issue across SEA. Enhancements in policy should focus on:

  - **Data literacy training programmes:** Policies should promote data literacy training programs for faculty, staff, and administrators. Such training equips individuals with the skills to understand, interpret, and utilize data ethically and effectively in their respective roles.

  - **Role-specific data use guidelines:** Policy frameworks can incentivize the development of role-specific data use guidelines. Such guidelines provide clear guidance on appropriate data access, analysis, and utilization practices tailored to different job functions across an institution.

  - **Building a data-driven culture:** Policies should promote a culture that values responsible data use. This can involve creating awareness campaigns, establishing data governance committees, and celebrating successful data-driven initiatives. For example, Singapore's Personal Data Protection Act (PDPA) provides a robust framework that educational institutions must adhere to, ensuring the protection of personal data within digital systems [109].

- **Fostering a culture of data-driven innovation:** Policies should pay attention to the exploration of new data-driven applications. The current policies in the region incentivize universities to invest in data management infrastructure but lack focus on promoting initiatives in learning analytics. This move, if it happens, allows data-driven insights into student learning patterns, informing pedagogical approaches and personalized learning interventions. Besides, developing dedicated research data repositories and training programmes in research data management practices should be encouraged. This empowers researchers to manage, share, and preserve valuable research data effectively.

- **Building a data governance framework:** Policy frameworks should move towards stronger data governance, including:

  - **Clear ownership and responsibilities:** Policies should establish clear guidelines around data ownership, access controls, and user permissions. This ensures data accountability and mitigates potential misuse.

  - **Data quality management protocols:** Policy frameworks should emphasize data quality management protocols. This includes data cleaning procedures, data standardization practices, and data validation processes to ensure the accuracy and reliability of information used for decision-making.

  - **Data security and compliance:** Policy frameworks promote robust data security measures and compliance with relevant privacy regulations. This includes data encryption practices, user access controls, and incident response protocols

2.3.5.3. Component 4.3. Business Intelligence

The business intelligence component encompasses the strategic collection, management, and utilization of data for informed decision-making to enhance institutional efficiency and competitive positioning. In SEA, the integration of business intelligence in HE is at different stages of development, with most policies focusing broadly on digital infrastructure and capabilities without specifically addressing Business Intelligence.

Policies in SEA's HE sector should explicitly establish clear guidelines for the collection, analysis, and management of data relevant to institutional performance, student success, and market positioning. In other words, HE institutions can unlock new opportunities for data-driven decision-making. It will enhance institutional competitiveness and contribute to the broader goals of educational excellence and innovation in the region.

2.3.5.4. Component 4.4. Decision Making

Emerging trends:

- **Embracing evidence-based decision-making:** Policy frameworks in SEA are increasingly focusing on the use of data and evidence to guide strategic decisions in HE. Singapore emphasizes the importance of data analytics in facilitating DT, with the Ministry of Education advocating for improved data use in university decision-making and professional development opportunities related to learning data analysis [110]. Similarly, Cambodia's Ministry of Education, Youth and Sports is focused on enhancing evidence-based decision-making and knowledge sharing by promoting the systematic use of digital data collection and governance processes [111].

  - **Performance measurement frameworks:** Policies encourage the development of standardized data collection and analysis tools to measure key performance indicators (KPIs) across areas like student learning outcomes, program effectiveness, and resource allocation. These frameworks enable universities to make data-driven decisions to improve strategies and optimize resource use.
  - **Data analytics capabilities:** Policy frameworks also promote investment in data analytics capabilities, including staff training in data analysis techniques and the establishment of dedicated data analysis units within universities. These initiatives empower institutions to derive valuable insights from the data they collect.

Areas for improvement:

- **Integration of digital tools for evidence-based decision-making:** Using integrated organizational systems and digital tools to collect and analyze digital evidence is fundamental for informed decision-making. While some SEA countries have recognized such needs within their DT strategies, explicit policies detailing the implementation and use of such tools are often lacking. By introducing policies that promote effective data utilization, HE institutions in SEA should leverage digital tools for better decision-making:

  - **Integrated data systems and evidence-based decisions:** Policy frameworks should emphasize the development and use of integrated data systems that collect information from across the institution. This consolidated data can then be analyzed to inform decisions on resource allocation, program development, and strategic planning initiatives.
  - **Breaking down silos and sharing best practices:** Policies should encourage cross-departmental collaboration and information sharing. This allows for the exchange of best practices in data analysis and utilization across different university units, leading to more informed decision-making at all levels.
  - **Fostering a culture of horizon scanning:** Policy frameworks should promote activities that scan the horizon for emerging trends and future challenges in the global education landscape. By anticipating future developments, universities can make strategic decisions that ensure their long-term prosperity and competitive edge.

Table 6. Trends and areas for improvement in knowledge exchange and partnership

Aspect	Emerging trends	Areas for improvement
Communication	• Investment in digital communication infrastructure • Investment in digital media production and dissemination	• Respectful communication in digital media
Collaboration	• Cross-institutional collaboration • Investing in collaborative learning platforms	• Risks associated with digital collaboration • Developing policies and protocols for digital collaboration
Community participation	• Community-based research through digital collaboration	• Translating research into knowledge exchange • Scaling up community-based learning with digital tools
Relationship management	• Engagement with stakeholders through digital networks	• Promoting institutional vision and identity

2.3.6. Component 5: Knowledge Exchange and Partnership

This section gains insights into the knowledge exchange and partnership in DTxHE policies in SEA countries, examining key aspects, including communication, collaboration, community participation, and relationship management.

2.3.6.1. Component 5.1. Communication

Emerging trends:

- **Investment in digital communication infrastructure:** An emerging trend in DTxHE policies in this region is the emphasis on promoting respectful communication within digital media. Current policy frameworks are prioritizing investments in digital communication infrastructure, both for internal and external purposes. This includes:

  - **Internal communication platforms:** Policies encourage the development of internal communication platforms like digital forums, learning management systems (LMS), and mobile apps. Such platforms facilitate knowledge exchange, collaboration, and information sharing among staff and faculty. In Singapore, the "Singapore Student Learning Space (SLS)" initiative integrates AI to provide equal access to digital resources from primary to tertiary levels. SLS also serves as a common platform for teachers to share, apply, and adapt new pedagogical approaches, addressing students' and educators' diverse learning needs [112].

  - **Enhanced external communication channels:** Policies across SEA are increasingly promoting the development of user-friendly websites, social media presence, and online portals to enhance access to university information and strengthen ties with prospective students, alumni, and the broader community. These initiatives aim to improve accessibility and foster stronger connections with external stakeholders. In Cambodia, an internal network connects national and local offices into a unified system, ensuring resilience through adequate security and offline replication [113]. Meanwhile, Lao PDR' development plan includes creating a HE website to promote scientific research activities by university lecturers and share information about Lao students abroad and foreign students in Lao PDR. This platform serves as both a communication tool and a means to raise awareness of Lao education [114].

- **Investment in digital media production and dissemination:** Investing in infrastructure for digital media production and dissemination is increasingly recognized as essential for HE institutions to enhance their digital communication capabilities. Such investments ensure that services for creating and sharing digital content are accessible to all faculty, students, and staff, enabling them to benefit from advanced digital tools. Policies are fostering investment in "Media Production Resources", including multimedia production labs, online video editing software, and training programmes focused on digital content creation. These resources empower faculty and students to develop engaging learning materials and effectively disseminate research findings through digital media. For instance, Lao PDR has implemented a strategy to improve the dissemination of educational information by enhancing television programmes, newspapers, magazines, and other media. The government has invested in establishing studios to produce educational content and is considering the creation of radio and television stations dedicated to education [115]. This approach highlights the importance of media infrastructure in promoting educational outreach and knowledge sharing.

Areas for improvement:

- **Respectful communication in digital media:** One significant area for improvement is the development and implementation of comprehensive digital communication policies that explicitly address respect and etiquette in online interactions. The national digital literacy programmes should provide more specific guidelines within HEIs that outline expectations for respectful digital communication among students, faculty, and staff. This involves embedding digital communication skills into the curriculum and providing staff development opportunities that focus on ethical and effective online communication.

- **Digital citizenship education:** Policy frameworks should encourage integrating digital citizenship education into existing curricula. This equips students with the skills to navigate digital environments responsibly, critically evaluate information online, and communicate respectfully with diverse audiences.

- **Staff development in digital communication:** Policy frameworks need to promote training programs for staff and faculty on the effective use of digital tools for communication, including training on online collaboration platforms, social media communication best practices, and ethical considerations in the digital space.

- **Mechanisms for reporting and addressing digital misconduct:** Implementing effective mechanisms for reporting and addressing instances of digital misconduct is essential. Currently, policies across the region vary widely in their approach to managing online harassment, cyberbullying, and other forms of digital misconduct. Establishing clear, accessible channels for reporting incidents, along with prompt and appropriate response protocols, can help create a safer digital environment for all members of the academic community.

2.3.6.2. Component 5.2. Collaboration

Emerging trends:

- **Cross-institutional collaboration:** Cross-institutional collaboration is increasingly recognized as essential for fostering innovation and sharing best practices in HE. Policies are promoting virtual exchange programmes that connect students and faculty across universities for collaborative projects, seminars, and research. Regional consortia are also encouraged, facilitating cooperation in curriculum development, resource sharing, and faculty exchanges. Vietnam's efforts, for example, to enhance its research profile through international collaborations would benefit from policies that provide frameworks and incentives for cross-border partnerships, leveraging digital technologies to overcome geographical barriers [116]. Malaysia emphasizes digital collaboration among universities, industry partners, and international stakeholders to drive innovation [117]. Singapore has established a robust network of EdTech partnerships, both nationally and internationally, involving government agencies and research centers [118]. Lao PDR prioritizes cooperation within and beyond its borders, promoting technical exchanges and regional networks in HE [119]. These initiatives underscore the importance of digital tools and collaboration in advancing educational and research outcomes in the region.

- **Investing in collaborative learning platforms:** A notable trend in SEA is the investment in digital platforms that support collaboration within institutions and with external partners.

  - **Cloud-based collaboration tools:** Policy frameworks encourage universities to adopt cloud-based tools, such as document-sharing platforms, online workspaces, and video conferencing software. These tools enable seamless collaboration on projects, group discussions, and real-time document editing, regardless of location.

  - **Interactive learning management systems (LMS):** Policies also promote using interactive LMS features, such as online discussion forums, collaborative document annotation tools, and peer review platforms. These features foster dynamic learning environments where students actively engage in shared knowledge construction and teamwork. For instance, Indonesia launched the "Kedaireka" platform in December 2020 to facilitate cooperation between businesses and HEIs, aimed at strengthening collaboration and enhancing the education system [120].

Areas for improvement:

- **Risks associated with digital collaboration:** While the push towards digital collaboration brings numerous benefits, it also introduces risks that must be carefully managed. These risks include data security breaches, privacy concerns, and the potential for increased digital divides. Current policies across SEA vary in their approach to these challenges. For instance, the Philippines has made strides in addressing cybersecurity through its National Cybersecurity Plan, but specific guidelines for HE institutions remain limited. To improve, policies should mandate the development of clear protocols for data management and security within collaborative digital environments. This includes guidelines for the ethical use of digital tools, the protection of sensitive information, and the maintenance of privacy standards. Additionally, there should be provisions for regular training and awareness programmes for staff and students to navigate digital collaboration tools safely and responsibly.

- **Developing policies and protocols for digital collaboration:** The development of comprehensive policies and protocols that guide digital collaboration in HE is essential. Such policies should be based on a thorough understanding of the technological landscape and informed by stakeholder needs and preferences. They should also include mechanisms for ongoing evaluation and adaptation to ensure they remain relevant in the face of rapidly evolving digital technologies. Moreover, policies should aim to promote inclusivity in digital collaboration, ensuring that all members of the academic community, regardless of their technological proficiency or access to digital resources, can participate fully in collaborative endeavors. This includes investing in accessible digital infrastructure and providing targeted support for underserved groups.

2.3.6.3. Component 5.3. Community Participation

Emerging trends:

- **Community-based research through digital collaboration:** Community-based research and learning have gained prominence in HE policies across SEA, emphasizing the integration of academic activities with community needs. The Philippines' Commission on Higher Education (CHED) supports service-learning programmes, encouraging students to engage in community service as part of their coursework, utilizing digital tools for coordination and impact assessment [121]. Singapore's DTxHE similarly promotes partnerships between universities and community organizations for collaborative research, leveraging digital platforms for data collection, project management, and dissemination of findings. These initiatives demonstrate how digital tools can enhance community participation and strengthen the impact of academic research [122].

Areas for improvement:

- **Translating research into knowledge exchange:** Another area for improvement is translating the wealth of fundamental, applied, and practice-based research generated by HEIs into meaningful knowledge exchange activities that can drive economic and social impact. While some SEA countries have made strides in this regard, comprehensive policies are needed to facilitate collaboration with the public, voluntary, and commercial sectors. Policies should allow:

- Allocating resources for HEIs to engage professionals and develop resources that support stakeholders in navigating digital platforms for participation in institutional decision-making and community activities.

- Encourage HEIs to establish formal mechanisms for knowledge exchange with external partners. Policies could provide incentives for projects that demonstrate clear economic and social impacts, facilitating the translation of research into tangible community benefits.

- Encourage universities to develop accessible online platforms that showcase ongoing research projects, community outreach initiatives, and educational resources for the public. This fosters a culture of open knowledge exchange and empowers the community to engage with university knowledge production.

- Policy frameworks should incentivize collaborative research projects that involve local communities and stakeholders from the outset. This fosters meaningful co-creation of knowledge and ensures research findings translate into tangible benefits for the wider community.

- **Scaling up community-based learning with digital tools:** Policy frameworks emphasize the importance of digital technology in fostering partnerships with external stakeholders:

  - **Stakeholder networking platforms:** Policy frameworks should encourage universities to establish online networking platforms that connect them with alumni networks, industry partners, and local NGOs. These platforms facilitate knowledge exchange, joint research projects, and collaborative problem-solving efforts that address regional challenges.

  - **Global online learning platforms:** Policy frameworks should promote the development of online learning platforms that offer university courses and resources accessible to international partners and community members. This fosters knowledge exchange on a global scale and promotes cross-cultural collaboration.

2.3.6.4. Component 5.4. Relationship Management

Emerging trends:

- **Engagement with stakeholders through digital networks:** The use of digital networks and media for stakeholder engagement is an emerging trend in HE policies. The DTxHE policies increasingly focus on leveraging technology to connect diverse learning environments and facilitate collaboration across various stakeholder groups. Malaysia's "Higher Education Blueprint (2015-2025)" highlights the role of digital technologies in engaging with businesses, local communities, and international partners. This includes using social media, online forums, and virtual networking platforms to foster community engagement, disseminate information, and support collaborative projects [123]. Similarly, Thailand's digital education reform emphasizes the use of digital networks to connect educational institutions with industry partners, creating cohesive ecosystems that support innovation and learning [124].

Areas for improvement:

- **Promoting institutional vision and identity:** An essential component of relationship management in the digital age is the use of digital media to promote the vision and identity of educational institutions. This involves strategic content creation and dissemination across digital channels to articulate the institution's values, achievements, and offerings. While individual institutions have made strides in this area, there is a space for HE policies to provide clearer directives and support for these activities, ensuring that institutions can effectively leverage digital media to enhance their visibility and reputation both locally and globally.

2.3.7. Component 6: Digital and Physical Infrastructure

This section gains insights into the "digital and physical infrastructure" component in DTxHE policies in SEA, examining key aspects, including robust digital infrastructure, digital connectivity, digital support, and estates management.

Table 7. Trends and areas for improvement in digital and physical infrastructures

Aspect	Emerging trends	Areas for improvement
Robust digital infrastructure	• Prioritizing investments in technology and equipment • Developing secure and reliable digital platforms • Building capacity for digital infrastructure management	• Investing to ensure data security and privacy • Maintenance and upgrades
Digital connectivity	• Ensuring high-availability bandwidth and network connections • Secure and mobile access to resources	• Addressing the digital divide infrastructure gap: • Strengthening cybersecurity measures and data security
Digital support	• Building a skilled IT workforce	• None
Estate management	• Integrating virtual and physical infrastructure • Managing access and utilization of physical spaces	• Inclusion of diverse user groups

2.3.7.1. Component 6.1. Robust Digital Infrastructure

Emerging trends:

- **Community-based research through digital collaboration:** Community-based research and learning have engaged with stakeholders through digital networks. The use of digital networks and media for stakeholder engagement is an emerging trend. DTxHE policies also focus on leveraging technology to connect different sites of learning and facilitate collaboration across various stakeholder groups. Malaysia prioritized improving bandwidth capacity and wi-fi coverage for video streaming and teleconferencing. At the same time, hardware and software devices are also focused on investment [125]. Cambodia proposes to upgrade infrastructure, connectivity, and equipment for educational institutions. In addition to bolstering network bandwidth to increase efficiency, the government plans to equip local education offices with standardized system and equipment designs to promote IT transformation [126].

- **Developing secure and reliable digital platforms:** The DTxHE policies in SEA place a strong emphasis on the importance of secure and reliable digital platforms, focusing on two key areas:

  - **Cloud-based infrastructure:** Policies encourage universities to adopt cloud-based solutions for data storage, application hosting, and online learning platforms. Cloud systems provide scalability, enhanced security features, and cost-effectiveness, which are particularly beneficial for universities managing large volumes of data and supporting extensive online learning initiatives.

  - **Cybersecurity measures and data protection:** Policies prioritize the development of robust cybersecurity protocols to protect sensitive data and student privacy. This includes investing in firewalls, intrusion detection systems, and data encryption technologies. Singapore's "Cybersecurity Strategy" (2016) outlines initiatives for building resilient infrastructure, creating secure cyberspaces, and promoting cybersecurity education in collaboration with educational institutions [127]. Cambodia's Ministry of Education, Youth, and Sports also focuses on promoting media literacy, user privacy, and the ethical use of IT, alongside efforts to prevent cyberbullying and ensure the safe use of technology [128].

- **Building capacity for digital infrastructure management:** The current policies acknowledge the need for skilled personnel to manage complex digital infrastructure, highlighting the following areas:

  - **IT skills training for staff:** Promote programmes that equip IT staff with the latest skills to manage, troubleshoot, and maintain university networks and digital platforms. This ensures efficient operation and timely support for technology-based teaching, research, and administrative processes.

  - **Investment in research and development:** Encourage universities to invest in research and development initiatives focused on educational technology solutions and infrastructure development. It fosters innovation in the digital learning space and empowers universities in SEA region to contribute to advancing educational technology on a global scale. For example, Lao aims to improve its educational management and administration system by using ICT. The government promotes capacity development for IT technical staff at central and local levels [129]. Malaysia aims to develop MOOCs for flexible and adaptable education. Malaysia Education Blueprint 2015-2025 states that it needs to focus on building the capacity of trainers and support staff to be able to develop MOOCs [130].

Areas for improvement:

- **Investing to ensure data security and privacy:** With the growing reliance on digital platforms, the security and reliability of digital infrastructure have become crucial. Policies should regularly audit cybersecurity audits and data protection protocols and manage security risks, ensuring the protection of institutional and student data.

  - **Cybersecurity policies and training:** Policy frameworks need to prioritize the development and implementation of comprehensive cybersecurity policies in universities. This includes measures such as data encryption, secure user authentication systems, and regular cybersecurity training programmes for faculty, staff, and students.

  - **Data privacy regulations and compliance:** Policy frameworks should establish clear data privacy regulations and protocols aligned with international best practices. This ensures the responsible collection, storage, and use of student and faculty data, fostering trust within the digital learning environment.

- **Maintenance and upgrades:** Maintaining and regularly upgrading digital infrastructure to keep pace with technological advancements is another area for improvement. Current policies seem to lack clear guidelines on the maintenance and lifecycle management of digital technologies. There is a need for policies that outline standards for regular updates, upgrades, and the eventual replacement of outdated technologies. This includes supporting ongoing staff training in new digital tools and technologies.

2.3.7.2. Component 6.2. Digital Connectivity

Emerging trends:

- **Ensuring high-availability bandwidth and network connections:** One of the foremost trends is the emphasis on establishing and maintaining high-availability bandwidth and resilient network connections. This is crucial for accommodating the surging demand for online services, including digital learning platforms and administrative systems. Current policy frameworks in the region are promoting strategies for robust and future-proof networks. Timor-Leste, through its “National Policy for Information and Communications Technologies (2017-2019)”, focuses on developing IT infrastructure to enable widespread Internet access, particularly in rural areas, under the “Broadband for All” initiative [131]. Similarly, Cambodia’s “ICT Master Plan 2020” encourages the Ministry of Education, Youth, and Sports to install broadband internet infrastructure in both rural and urban schools under the “Building IT Infrastructure in Schools” programme [132]. Lao PDR is also advancing its DTxHE by promoting the use of smart digital tools and expanding affordable internet access for educational purposes [133]. These initiatives highlight the region’s commitment to strengthening digital infrastructure and ensuring the resilience of online learning environments.

- **High-bandwidth Internet connectivity:** Encourage universities to invest in high-bandwidth Internet connections to support the growing demand for online learning resources, video conferencing, and other bandwidth-intensive applications.

- **Network redundancy and backup systems:** Emphasize the importance of network redundancy and backup systems to ensure uninterrupted operation and data security in case of outages. These systems are critical for business continuity, minimizing disruptions to online learning activities.

- **Secure and mobile access to resources:** Another emerging trend is the focus on providing staff and students with secure and flexible remote access to systems, services, and content. The shift towards blended and fully online learning modalities, accelerated by the COVID-19 pandemic, has underscored the importance of ensuring that educational resources are accessible from any location. DTxHE policies in the region tend to invest to secure and flexible access to resources.

- **Cloud-based learning platforms:** Policies should encourage universities to adopt cloud-based learning platforms that provide students and faculty with secure access to learning materials, online resources, and collaboration tools from any location, on-campus or off-campus.

- **Virtual private networks (VPNs):** Policies should promote using VPNs to provide secure remote access to university resources for faculty, staff, and students. This facilitates flexible learning environments and empowers students to learn at their own pace. Singapore's goal of flexible, multifunctional learning spaces is to focus on classrooms and spaces designed to adapt quickly and easily to meet learning needs. Technology is seen as the key to overcoming physical space constraints, students can connect learning anytime, anywhere [134].

Areas for improvement:

- **Addressing the digital divide infrastructure gap:**

  - **Targeted infrastructure investment:** Policy frameworks need to prioritize investments in expanding Internet access across university campuses and underserved communities. This includes utilizing public-private partnerships, government subsidies for internet connectivity, and infrastructure development initiatives to bridge the digital divide.

  - **Sustainable funding mechanisms:** The policies should establish sustainable funding streams for maintaining and upgrading digital infrastructure. This could involve exploring innovative financing models such as user fees, industry partnerships, and international grants specifically dedicated to digital infrastructure development.

- **Strengthening cybersecurity measures and data security:**

  - **Cybersecurity awareness programmes:** Policies need to emphasize the importance of cybersecurity awareness programmes for faculty, staff, and students. Such programmes can educate stakeholders on best practices for secure online behavior, phishing scams, and password management.

  - **Data encryption and security standards:** The policies should establish clear data encryption protocols and security standards for university networks and online platforms. These fosters trust and ensure the responsible handling of student and faculty data within the digital learning environment.

2.3.7.3. Component 6.3. Digital Support

Emerging trends:

- **Building a skilled IT workforce:** HE institutions in the region are paying attention to attracting and retaining skilled IT professionals.

Areas for improvement:

- **Attracting and retaining talent:** Universities in SEA are increasingly addressing the challenge

of attracting and retaining skilled IT professionals. This includes offering competitive salaries, providing professional development opportunities, and creating clear career paths for IT staff within the university structure to enhance their commitment and growth.

- **Promoting collaboration across departments:** Policies also encourage collaboration between IT departments and academic faculties to develop IT services and resources that cater to the specific needs of teaching, research, and learning. This cross-departmental collaboration fosters the alignment of technological solutions with academic goals. In Indonesia, Article 4 of "Presidential Decree No. 78/2021" assigns the National Innovation Research Agency the responsibility for developing policies related to professional development and talent management in science, technology, and innovation [135]. Thailand's Institute for the Promotion of Teaching Science and Technology (IPST) focuses on developing scientific and technological talents among teachers and students [136]. Similarly, Malaysia is creating a digital education framework to nurture a digitally savvy generation by equipping students with the knowledge, skills, and ethics needed for the effective use of technology [137].

2.3.7.4. Component 6.4. Estate Management

SEA's DTxHE necessitates a reimagining of physical campus spaces to integrate seamlessly with virtual infrastructure. Policy frameworks emphasize the development of "smart campuses" that leverage technology to optimize resource utilization, enhance learning experiences, and create a more sustainable learning environment.

Emerging trends:

- **Integrating virtual and physical infrastructure:**
  - **Blended learning spaces:** Promote the design of flexible learning spaces that can accommodate in-person, online, and hybrid learning models. This includes equipping classrooms with technology like smart boards, video conferencing systems, and collaborative software platforms.
  - **Digital signage and information systems:** Encourage the use of digital signage and information systems across campus grounds. This provides real-time information on course schedules, room availability, and campus events, fostering a more connected and efficient learning environment. For example, Malaysia's "Smart campus" in the period of 2021-2025 focuses on building and investing in a smart environment, including smart classrooms and labs, interactive teaching and learning using augmented reality (AR) and virtual reality (VR) [138]. Timor-Leste aims to establish remote and flexible learning systems, including e-learning [139].
- **Managing access and utilization of physical spaces:**
  - **Online booking systems for classrooms and equipment:** Policy frameworks encourage the development of online booking systems for classrooms, labs, equipment, and other shared resources. This streamlines access management and ensures efficient utilization of physical spaces.
  - **Remote access and flexible working:** Policy frameworks promote policies that allow for remote access to university resources and flexible working arrangements for faculty and staff. This fosters a more mobile and technology-enabled work environment.

Areas for improvement:

- **Inclusion of diverse user groups:** Policy frameworks need to encourage the inclusion of diverse user groups, such as international students, part-time staff, and visiting researchers, during the planning and design stages of new development and refurbishments. It will ensure a wider range of perspectives are considered, and diverse needs are met.

2.4. Limitations of the Policy Analysis

This research provides valuable insights into the policies driving DTxHE across SEA. However, it is also important to acknowledge research limitations to better interpret the results.

- **Scope of desk research:** One of the primary limitations of this study is the scope of the desk research conducted. The authors did not undertake an exhaustive review of all available data, studies, documents, and reports related to DTxHE across SEA. The vastness of the region, coupled with the dynamic nature of DT policies and initiatives, means that some information might have been missed in the analysis.

- **Language of reviewed documents:** The analysis was restricted to documents available in English. SEA is a linguistically diverse region, with many critical policy documents, studies, and reports potentially available only in local languages. This language constraint means that important insights and nuances related to the DTxHE that are documented in non-English sources may have been overlooked.

- **Focus only on national-level policy documents:** While national policies play a crucial role in shaping the HE landscape, they do not always capture the complete picture. Local policies and initiatives, often tailored to specific educational, cultural, and technological contexts, can also significantly impact DT efforts in HE. The exclusion of local documents from the analysis means that the study may not fully reflect the diversity of approaches and challenges faced by individual institutions or localities within the region.

- **Policies continually evolving:** The dynamic nature of DT means that the situation is continually evolving, and policies and initiatives that were relevant at the time of the research may have since been updated, replaced, or expanded.

Despite the above limitations, this chapter offers valuable insights into the current state of DTxHE in SEA. It highlights the region's commitment to leveraging digital technologies to enhance educational outcomes and addresses some of the challenges and opportunities that lie ahead.

2.5. Conclusion

DTxHE in SEA represents a dynamic shift towards a more integrated, innovative, and inclusive educational landscape. This transformation is driven by emerging trends in key domains such as digital culture, knowledge creation, infrastructure, and partnerships. While notable progress has been made, critical areas for improvement remain to fully leverage the potential of DT.

Organizational digital culture is evolving, with institutions embracing innovation, fostering collaboration, and promoting digital fluency. However, comprehensive strategies are needed to enhance digital literacy, faculty development, and digital equity. Policies must focus on fostering adaptability, strategic foresight, and aligning internationalization with digital identity, alongside risk mitigation strategies.

Knowledge creation and innovation are advancing through international collaboration, leadership empowerment, and investment in digital research infrastructure. Yet, a more forward-thinking approach is needed, including collaborative horizon scanning and a comprehensive digital research strategy. Cultivating an inclusive digital research culture and assessing the impact of technology decisions will be crucial in building robust innovation ecosystems.

Knowledge development is focused on enhancing digital learning resources and pedagogy innovations. However, aligning technology-enhanced learning (TEL) strategies with organizational goals remains a challenge. Institutions must emphasize academic integrity, ethical use of learning analytics, and support for student well-being to provide a consistent digital learning experience.

Knowledge exchange and partnership highlight the importance of digital communication

infrastructure and collaborative platforms. Strengthening respectful communication policies, promoting digital collaboration, and scaling community-based learning with digital tools are key areas for growth. Effective knowledge exchange will promote institutional identity and foster meaningful digital engagement.

Knowledge management and use underscore the importance of supporting library services and developing information literacies. Improving the digital management of intellectual property, creating a data governance framework, and ensuring ethical data use are essential for evidence-based decision-making and inclusive data collection.

Digital and physical infrastructure has seen considerable investment, but challenges such as ensuring data security, addressing the digital divide, and enhancing cybersecurity measures persist. Strategic investment in diverse user group needs and robust infrastructure planning are necessary for long-term resilience.

Chapter 3. Critical Analysis of DTxHE Cases in Southeast Asia

Chapter 3. Critical Analysis of DTxHE Cases in Southeast Asia

Abstract

The systematic literature review and policy analysis study have indicated some classifications of six components of DTxHE in SEA, which suggest interesting cases for this chapter. This chapter presents three cases: Singapore, Cambodia, and Vietnam. These cases are chosen for at least two reasons. First, they are representative of different stages of DTxHE development in both policy and practice. Singapore has become one of the leading digitalized countries with outstanding DT policies, investment and implementation for the last four decades. Due to its historical context, Cambodia is among the less developed economies in the region, while there is room for its HE system to improve. However, the government seems to have paid attention to DT and DTxHE through its rounded policies. The right strategic vision of DT is vital, not only for Cambodia but also for other countries in the world. Vietnam was chosen because its digital development seems similar to that of many other developing countries in the region and around the world: while policy implementation varies across institutions, the government has made efforts to strengthen coherence through national digital transformation roadmaps and cross-ministerial initiatives. Second, the successes, challenges, and issues experienced by these countries are all helpful for other countries in and outside this region to learn and enhance their DTxHE accordingly.

The syntheses of the three cases are triangulated based on various sources of data. They are from the systematic review analysis study, policy analysis study, 44 interviews with HE managers in Vietnam between May 2020 and May 2024, and website information of relevant universities and ASEAN University Network.

3.1. Singapore: An Exemplar Case of a Successful DTxHE Case

Singapore became an independent and sovereign democratic nation in 1965. It experienced population growth from 2.41 million in 1980 to 6.05 million in 2024. According to World Bank's data, Singaporean GDP per capita increased from $428.10 in 1960 to $82,807.60 in 2022. It is the most developed country in the region despite having limited natural resources. There are currently six public universities and six world-class (private) universities, mainly from the United States and one from France, hosting around 80,000 students (Singapore's Department of Statistics, 2024).

The policy analysis shows that Singapore has not issued many policies on DT and DTxHE in the last decade, because the Singaporean government developed policies to build the National Computerization Programme with its National Computer Board Act in 1981. The country considers ICT to be its unique choice for developing the country. Singaporean government's vision is "Digital to the Core, Serves with Hearts". Its well-developed and implemented policies in the early days have played a concrete foundation for developing infrastructures and a mindset for DT for the country and its HE. Singapore has been seen as one of the world pioneers in DT, including DTxHE. The nation's journey of successful DT is illustrated in Figure 23.

Figure 23. Singapore's journey of DT's showcase

With a developed ICT infrastructure but limited natural resources, Singapore soon recognized the value and significance of human resources. In the 1990s, Singapore started to pursue an ambition to be a hub of talent by developing it as an education hub and attracting world-class universities to open their campuses in Singapore. The Singapore Global Schoolhouse initiative was launched in 2002 to promote diversity and autonomy in the HE sector and attract talent in Asia (Lo, 2014), with roughly 55,000 foreign students each year for the last decade (Statista, 2024). With the flux of talent joining HEIs in Singapore as students, researchers, and academics, Singapore seems to have fulfilled its ambition of being a talent hub. In 2012, Singapore announced it as an Asian Innovation Hub. Also,

after more than two decades of working with top universities worldwide, Singaporean HEIs have benefited substantially from their DT, including the development of micro-credentials and MOOCs. For example, the National University of Singapore (NUS) has used several digital platforms, such as Coursera and edX, to offer online courses and MOOCs.

Singaporean universities also seem to follow the Triple Helix of Innovation model (Etzkowitz 2003; Etzkowitz & Zhou 2006) effectively by working closely with the government and industry. As mentioned before, the government provided resources and digital infrastructures for universities along with its implementing policies on ICT and Smart Nation. The Smart Nation Initiative was launched in 2014 in Singapore. This initiative aims to advance technology to improve the lives of citizens, including in the education sector. It promotes the use of data analytics, AI, and the Internet of Things (IoT) in HE. In 2015, Singapore introduced the SkillsFuture programme, which allows people aged 25 years and above to receive a credit of $500 to upskill or reskill into new areas outside of their current field. This national programme encourages lifelong learning and skills mastery, with a significant emphasis on digital literacy and technology-enhanced learning. In 2018, Singapore Management University (SMU) secured a 5-year research grant from the Singaporean Research Programme in AI and Data Governance. That research programme aimed to improve the quality of research and academia related to AI and data, and access to international knowledge. These DT initiatives and programmes in Singapore took place before the COVID-19 pandemic.

At the same time, Singaporean universities work closely and effectively with industry during their DT process. For example, in 2019, SUM partnered with Google Singapore to offer the SMU-Google Squared Data & Analytics Programme. It was the first time Google extended its programme to undergraduates of a local university. In 2020, Nanyang Technological University (NTU) partnered with Microsoft to shape the future of education through innovation and technology at the University's Smart Campus. Ms. Tan Aik Na, NTU Senior Vice President for Administration, said, "This DT in partnership with Microsoft marks a significant milestone in our commitment to embrace a culture of innovation, promote maximum efficiency, foster sustainability and improve the lives of our students and employees through empowered learning and living experiences" (NTU's website).

Thanks to the Smart Nation (and Smart Universities) policies in the last decade, NUS, NTU, and SMU have integrated AI-driven systems for personalized learning and administrative automation. For example, NTU's Smart Campus initiative includes deploying IoT devices and digital infrastructure to support a tech-enhanced learning environment. It is not a surprise that NUS, NTU, and SMU are now ranked as world-class universities. It would not have been possible for them without their government's right moves on DT in the last century.

3.2. Cambodia: A Transparent and Well-Developed Policy Case

Cambodia's population increased from 6.2 million in 1980 to 17.12 million in 2024 (Worldometer, 2024)). According to World Bank's data, Cambodian GDP per capita increased from $247 in 1993 to $1760 in 2022. The first university in Cambodia was founded in 1960. However, the entire Cambodian education system was severely disrupted during the Khmer Rouge regime (1975-1979). With assistance from other countries, universities in Cambodia were gradually restored in the 1980s. Since then, the country has begun to expand and restructure HE with 79 public and 110 private HEIs, hosting 284,599 students as of 2023 (MoEYS, 2025) .

However, its comprehensive, inclusive, and extensive policies on DT over the last decade emerged as a phenomenon itself for at least two reasons.

First, the policy analysis shows that most policies are in the public domain and easily accessed, even by outsiders who do not know Khmer (the Cambodian official language). Such publicity and transparency make it easier for people to follow. For example, in its Digital Government Policy 2022-2035, Cambodia aims to "establish a digital government to improve the citizens' quality of life and build their trust through better public service provision". In addition, Cambodia has introduced its first Digital, Media, and Information Literacy (DMIL) Competency Framework, which identifies eight

core competencies that Cambodian digital citizens should possess, along with related behavioral knowledge, to ensure the wise, responsible, efficient, and safe use of technology (Ministry of Posts and Telecommunications and UNESCO, 2024). Having an effective digital government could help to boost DTxHE.

Second, the policy analysis shows that, unlike other nations with a similar level of socio-economic development in SEA and elsewhere, which focus more on digital and physical infrastructures, and knowledge development, the Cambodian government developed policies that cover all six components of DTxHE.

Component 1 - Organizational Digital Culture. The policy analysis shows that Cambodia stands out with an emphasis on fostering a digital mindset and integrating digital practices within educational institutions. Cambodian ICT policy and strategy promote safeguarding organizational digital identity through online safety, ICT ethics, preventing cyberbullying, and using secure technology.

Component 2 - Knowledge Creation and Innovation. Cambodia shows a strong policy drive towards fostering research and collaborative innovation. For example, in the Digital Government Policy 2022-2035 and the DMIL Competency Framework, Cambodia sets out priority actions on digital research and innovation. The government encourages knowledge transfer from HE to the private sector, and digital research collaborations with domestic and foreign institutions to acquire and apply new technologies. This is similar to Singaporean strategies in the late 1990s and early 2000s.

Component 3 - Knowledge Development. Cambodia's policies show a high level of commitment to enhancing digital learning and pedagogical skills. From 2019 to 2020, the Ministry of Education, Youth and Sports implemented capacity development to equip trainers with modern pedagogical methods and techniques and enhance their ICT usability. The aim is to raise Cambodians' education level to the average of SEA countries, reduce illiteracy, and provide equal opportunities for high-quality education, which consequently enhances its knowledge development capacity.

Component 4 - Knowledge Management and Use. Cambodia again stands out with a high focus on the organization, dissemination, and application of knowledge. For example, in its Policy and Strategy on ICT in Education in 2018, Cambodia's Ministry of Education, Youth and Sports aims to enhance the effectiveness and ability of evidence-based decision-making and knowledge sharing through the systematic use of information while strengthening the capacity for digital data collection, operations, and governance. The Strategic Education Plan 2019-2023 emphasizes the effectiveness and capacity of organizations in evidence-based decision-making and knowledge sharing through the systematic use of information and promoting capacity in managing, operating, and collecting educational data through digital systems. In the EduTech Roadmap 2022, the National Council of Science, Technology and Innovation highlights digital competence, for example, the ability to find, evaluate and share information professionally, as a core factor for DT. The roadmap for DT in education aims to strengthen management systems to upgrade services and simplify procedures, especially library services, and student management.

Component 5 - Knowledge Exchange and Partnership. Cambodian policies again exhibit a substantial emphasis on collaborations among stakeholders and knowledge-sharing mechanisms in the HE sector. For example, the Policy and Strategy for ICT in Education in 2018 states that in the long term, its education system must engage with 100% non-public sector stakeholders to provide equipment. Prominently, the Cambodia EduTech Roadmap in 2022 highlights the need to build ecosystems that embed all stakeholders in its DT process. The Country Paper 2017 reports that the Royal University of Phnom Penh has become a leading institution in providing research, consultancy and community services and connecting gains in ICT education to social and economic development via education, knowledge exchange and partnership.

Component 6 - Digital and Physical Infrastructure. Like many other SEA developing countries, Cambodia prioritizes this component of its DT process. For example, its Policy & Strategy in ICT in Education 2018 proposes upgrading infrastructure (e.g., Internet broadband in rural and urban areas), connectivity and equipment for educational institutions to increase efficiency.

Cambodia Digital Government Policy 2022-2035 focuses on building and improving an educational information management system to enhance the quality of service.

In short, despite being a less developed country in the region, Cambodian HE deserves recognition for its DT policy development in the recent decade. Nevertheless, the DTxHE process, from policies to implementation, requires a speedy level of investment, resilience, and agility from all stakeholders in Cambodia, which has not been clearly evident in its knowledge creation and development.

3.3. Viet Nam: Key Features of an Evolving DTxHE Landscape

Viet Nam gained independence in 1945 and subsequently experienced the Vietnam War until 1975. Its population increased from 52.97 million in 1980 to 99.50 million in 2024 (Worldometer, 2024). According to the World Bank's data, Vietnam's GDP per capita increased from $235.70 in 1985 to $4,163.50 in 2022. Its economic growth has been seen as one of the fastest in SEA. Vietnam issued the Information Technology Law in 2006 with the aim of promoting information technology applications, development and commercialization.

According to the Ministry of Education and Training, there were 244 universities in Vietnam in 2023, of which 172 were public ones. These universities host over 2.1 million students nationwide (Vietnamese government web portal, 2023). In January 2017, the government issued a policy to enhance ICT applications in supporting and improving research and education quality. However, not many Vietnamese HEIs paid much attention to it until the COVID-19 pandemic, when the whole country was locked down in February 2020. The interviews conducted for this report show that the pandemic sped up the DT that should have taken place a decade before. Still, many HEIs in remote areas seem to still struggle with DT due to lacking sufficient digital infrastructure. In June 2020, the Government of Vietnam approved the National Digital Transformation Program for 2025 with a vision for 2030. Since then, HEIs have increasingly invested in digital infrastructure and teacher development.

At the same time, digital literacy is being elevated through national policy initiatives, a recent example being the issuance of Circular 02/2025 by the Ministry of Education and Training (MOET), which establishes a national Digital Competency Framework for learners at different learning levels. This framework provides practical guidance education institutions to strengthen digital skills development among students and educators, aligning institutional efforts with national digital transformation goals.

Reflecting on the JISC DTxHE framework (2023), the systematic review and policy analysis in this report show that Vietnamese HE has, in general, focused more on building digital and physical infrastructure and knowledge development and less on knowledge exchange and partnerships, organizational digital culture, knowledge creation and innovation, and knowledge management and use.

Few empirical studies have examined the digital divide among Vietnamese universities, even as the Vietnamese Prime Minister announced to leave no one behind in the national DT process (An, 2022). Expert interviews revealed a wide gap between public and private HEIs in digital transformation. While private universities generally enjoy more operational flexibility, recent policy reforms, such as the Revised Higher Education Law (2018) and Decree 99/2019/ND-CP, are progressively granting greater autonomy to public HEIs as well. A tight budget and tensions about autonomy have hindered DTxHE substantially. According to local experts[4], despite investments to modernize the three largest national universities, mainly focusing on DT, the DT journey of those universities are still in the early stages of their digital transformation journey.

On the other hand, private universities seem to have more autonomy (e.g., they can make decisions on what and when to do) than public universities because they receive no public funds and can better mobilize resources from their mother companies or investors. Hence, according to local experts, some

[4] The case study is informed by data collected through interviews and may include individual opinions and perspectives.

private universities, particularly those focused on technology, seem to be more confident in their DT process.

Universities use different and incompatible digital learning systems, including self-invented ones.

Local experts view that with the booming HE market, universities tend to compete more than collaborate with one another. The lack of coordination in DTxHE may limit the sector's ability to align with the broader digital economy, potentially affecting graduates' readiness for evolving labor market needs.

Conclusion & Recommendations of the Report

The studies in this report show that, to a certain extent, all countries in the region have been aligning their policies with resources in DTxHE but at different speeds. However, digital technologies have developed much faster than HE anticipates. The emergence of ChatGPT and at least 50 other generative artificial intelligence (GenAI) web products globally presents a challenge and opportunity for DTxHE, as they were not yet addressed in policy and research on DT when the studies for this report were conducted. There are hardly any empirical studies in SEA on how HEIs integrate GenAI into their DT, though many discussions have been held on GenAI in HEIs in the region recently.

Since 2023, GenAI has been seen a significant disruption, which has put HEIs in a dilemma of "to use or not to use GenAI" and is changing DTxHE toward an uncertain future. Many universities, at first, banned students from using GenAI, some gradually opened to GenAI usage with caution, and some now embrace it. It will take a while for the scholarly community to fully understand GenAI. It will take a while for the scholarly community to fully understand GenAI. This caution in HE has its key reasons, among many other concerns. First, there are ethical issues regarding the legitimacy of the materials used to train GenAI (Schlagwein & Willcocks, 2023; Wach et al., 2023), as well as concerns about the academic integrity of students using GenAI to plagiarize in their written assignments and exams (Chan 2023). Second, it is about the sustainability of the world, which could be significantly impacted by AI if its development proceeds without appropriate regulation (Wach et al., 2023).

The application and integration of GenAI in DTxHE, again, largely rely on the universities' research-informed evidence, resources, and autonomy. The COVID-19 pandemic and GenAI are critical disruptions that accelerate the DTxHE process. Much more efforts need to be invested into DTxHE to strategically guide the next generations through disruptions and complexity toward responsibility and sustainability. By systematically implementing these strategies, universities in SEA can foster a more dynamic and inclusive digital culture, better positioning themselves to lead and thrive in the evolving global educational landscape.

The following five strategic pillars for HEIs to accelerate their DT process are proposed, if they have not gone through the six components of the JISC framework.

Strategic pillar 1: Teacher professional development (TPD) - enhancing digital skills and digital pedagogy

Objective: Develop a comprehensive digital literacy strategy that enhances critical thinking, creativity, digital ethical behaviors and capability in digital and GenAI-embedded pedagogies to facilitate effective digital learning environments among HE academics, staff and students.

Actions:

- **Digital literacy curricula:** Implement mandatory digital literacy courses for all university stakeholders, integrating modules on ethical digital usage, critical thinking, and creative problem-solving.
- **Digital innovation labs:** Create cross-disciplinary labs where students and academics can digitally collaborate on projects, encouraging experimentation and innovative thinking.
- **Digital ethics in education:** Integrate digital ethics, including the use of GenAI, into all curricula to ensure that staff and students understand the responsibilities and impacts of digital interactions.
- **Peer learning groups:** Establish faculty-led peer learning groups to share digital teaching strategies and tools, fostering a collaborative learning environment.
- **Digital teaching recognition:** Implement a reward system to recognize and promote faculty who innovate in their teaching using digital tools and methods.

Strategic pillar 2: Digital equity and inclusion

Objective: Ensure all university members have equitable access to digital resources and opportunities, particularly those from disadvantaged backgrounds.

Actions:

- **Digital access initiatives:** Partner with tech companies to provide devices and Internet access to underprivileged students.
- **Inclusion workshops:** Organize regular workshops on digital inclusivity, focusing on accommodating diverse needs within digital platforms and content.
- **Monitoring and evaluation:** Conduct periodic assessment of digital equity initiatives to ensure they meet the diverse needs of the student population.

Strategic pillar 3: Digital organizational identity (DOI)

Objective: Foster a strong DOI that aligns with the university's mission, the digital economy, and global digital trends.

Actions:

- **Digital identity workshops:** Organize frequent training sessions for students and staff on managing their digital footprints and building a positive online identity.
- **Standardization of DT metrics:** Develop and implement a standardized framework for measuring DT progress.
- **Global digital collaboration:** Enhance internationalization by promoting and showcasing digital collaborations through the university's digital channels.

Strategic pillar 4: Digital well-being

Objective: Integrate digital well-being into the university's wellness programmes to manage the impacts of digital usage.

Actions:

- **Digital detox initiatives:** Develop policies that encourage regular breaks for staff and students to disconnect from digital devices.
- **Well-being workshops:** Implement programmes that address technology addiction, online stress management, and cyberbullying.
- **Integration with student services:** Embed digital well-being resources within existing student support structures, making them part of the overall wellness framework.

Strategic pillar 5: Digital change management

Objective: Equip staff and students to adapt to and benefit from emerging digital technologies and trends, including GenAI.

Actions:

- **Strategic foresight committee:** Establish a committee to continuously analyze emerging GenAI technologies and other digital trends and their potential impacts on HE.
- **Risk mitigation framework:** Develop strategies to identify and mitigate risks associated with DT, such as technology over-reliance and job displacement. Some of the biggest threats include security and privacy issues. A risk mitigation framework should be comprehensive and holistic.
- **Culture of adaptability:** Promote an institutional culture that values adaptability and continuous learning, collaboration, open communication, and experimentation with new technologies.

Limitations of the Report

Like any other research, it is important to highlight several limitations of this report so that its findings are carefully interpreted and critically applied. First, the systematic review study aimed to be comprehensive by covering all publicly available publications on DT in the region. However, not all publications have the same values. Some studies were properly conducted, and others may not, as knowledge development in SEA is not equally good and consistent.

Second, the policy analysis study sought to be inclusive, but some policy documents might have been overlooked. This is because they come from various ministries and departments, and some may not be in the public domain in some countries.

Third, DT has evolved dramatically since the COVID-19 pandemic and the introduction of ChatGPT in November 2022. ChatGPT and other GenAI tools started to draw attention from HE. However, these GenAI tools are not yet at the mature stage of development. Their applications are in the early stages in the HE sector, and feedback on using them in DTxHE is still diverse and inconsistent. Therefore, it needs more time to study the impact of GenAI on DTxHE.

Footnotes

Please refer to Table 1 for the list of cited policy documents.

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4 QUALITY EDUCATION

Sustainable Development Goals