EDUCATIONAL TRANSFORMATION IN THE DIGITAL ERA: A DEVELOPING COUNTRY PERSPECTIVE

Vichaya Lipipun *, Chatwarun Angasinha **

* *Corresponding author*, College of Social Innovation, Rangsit University, Pathum Thani, Thailand
Contact details: College of Social Innovation, Rangsit University, 52/347 Phahon Yothin Road, Muang Eke, Pathum Thani 12000, Thailand
** College of Social Innovation, Rangsit University, Pathum Thani, Thailand

Abstract

In the digital age, education harnesses technology for transformative learning. Siemens (2008) introduced connectivism education theory that best described the digital environment of education. Lifelong learning and informal learning through open resources are fundamental to connectivism. Students are influenced by their teachers' method of teaching. Their guidance will shape students' learning experience and skill sets (Villegas-Ch et al., 2021). Tavenner (2019) advocates student-centered, personalized learning aligned with connectivism. However, challenges persist: 1) optimizing interactive, 2) meaningful education and 3) adequately supporting teachers in this context. Our study addresses these issues for Thai educators and learners, offering practical recommendations. This research aims to elucidate current obstacles faced by Thai educators and learners in the digital age and provide suggestions to enhance learning experiences. Using purposive sampling, we conducted 18 in-depth interviews with stakeholders spanning Thailand's grades 1 to 12, representing public, private, and non-profit sectors. Employing content analysis, findings reveal Thailand's digital infrastructure is primed for educational transformation. Yet, scarcity of human resources and systemic constraints impede progress. Despite educators widely sharing open materials, learners struggle to effectively utilize these resources, limiting their benefits. This study underscores the need for concerted efforts to bridge these gaps and fully leverage available educational resources.

Keywords: Online Education, Digital Education, New Digital Age

1. INTRODUCTION

Since the adoption of wireless communication and the Internet, users are slowly converting into digital citizens as they enter into the digital realm of an informational society. Along with the COVID-19 pandemic, people are changing their behaviors, perceptions, and interactions with technology. Education, too, is inseparable from technology. All stakeholders in education are required to adapt and constantly learn new ways of transferring and gaining knowledge. Online platforms for education were not a popular mode for teaching and learning prior to the COVID-19 pandemic in Thailand, although online teaching and learning formats were not new. Although there were tremendous efforts to assist distance learning by using technology as tools of education outreach, due to a lack of adequate staff and teachers in rural areas, the uptake was limited. The COVID-19 pandemic took all educators by surprise in rushing the transitioning of education into a digital format in a way unlike any prior implementations in the history of education. The pandemic, as a catalyst, was a change agent that granted an opportunity to explore new methods of digital teaching and learning. Whether or not all educators and learners are willingly or unwillingly adopting technology in education, it is an inevitable education practice that is the only option available in a time of crisis. While tech-savvy educators and learners have thrived in the online teaching and learning format, the majority of the Thai population still lags behind in accepting and adopting this online technology. As a new paradigm appears in the 21st century, wireless communication and the Internet have rapidly converged to be the leading platform for education. This raises an important question:

RQ1: How can the Thai education system become more responsive and reflective of the new digital realities?

Several studies on digital education have been conducted, particularly during the COVID-19 pandemic. For instance, Sanjaiprom (2021) conducted a comprehensive literature review to assess the state of eLearning in Thailand prior to the COVID-19 pandemic. Khamkaew (2021) studied the effects of integrating online learning in schools during the outbreak of COVID-19 in Thailand from mid-March 2020 to July 2020. Songkram and Osuwan (2022) examined the acceptance of technology and behavioral intentions to use digital learning platforms of K-12 in Thailand. Few studies have, however, explained current obstacles that Thai educators and learners are experiencing to provide recommendations for improving the learning experience. The present study, therefore, sought to understand the current phenomena of teaching and learning in Thailand, address the obstacles and limitations, and provide recommendations to alternative teaching and learning methods that are more reflective and responsive to digital education.

The remainder of this paper is organized as follows: after the introduction, Section 2 presents the literature review; Section 3 provides the methodology, and Section 4 includes the results. Section 5 demonstrates the discussion of results, and Section 6 offers conclusions and recommendations.

2. LITERATURE REVIEW

The present paper applies concepts and theories by Castells (2001, 2010a, 2010b), Qiu (2009), Siemens (2008), Khan (2012), and Prensky (2001) into a research study focusing on five main frameworks: 1) the Internet and infrastructure in the digital society, 2) connectivism education theory, 3) education and technology, 4) digital natives and immigrants, and 5) lifelong learning. According to Castells (2001), the Internet is the basis for the new communication environment and the technological pillar for society in the digital era. This socio-technical transformation is creating new social practices and behaviors in education and ways of teaching and learning. The new society is a networked society that is constructing a new timeless culture of virtuality in the global flows that occupy virtual space (Castells, 2010a). Not everyone has equal access to the basic infrastructure of the Internet, however, and according to Castells (2010b), "*the penalty for being outside the network increases with the network's growth because of the declining number of opportunities in reaching other elements outside the network*" (p. 70). Qiu (2009) furthers Castells' work about the digital inequality and segments groups along the digital divide into: 1) the information have, 2) information have-less, and 3) information have-not. This classification is based on the access that people have to the Internet, wireless communication, and electricity infrastructure. The information have, have-less, and have-not are people with access to the Internet and infrastructure that ranges from full access to digital infrastructure to partial or limited access, and ultimately to no access.

Siemens (2008) introduced a new education theory, *connectivism*, to describe learning principles and processes reflective of current social digital environments. Key trends in digital teaching and learning for the 21st century consist of lifelong learning, and informal learning has become a significant aspect of learning experience. Practical knowledge is supplemented by knowing where to find knowledge. Accessibility to the required knowledge applicable to evolving digital knowledge and education is thus a key aspect for learners to succeed and thrive in the digital age. According to Khan (2012), "*the old classroom model simply doesn't fit our changing needs. It's a fundamentally passive way of learning, while the world requires more and more active processing of information*" (p. 1). Khan's pedagogy was designed to have instruction meet technology, so anyone can learn anything (Khan Academy, n.d.). Technology, along with the Internet and wireless communication, should be integrated in education so that it can free everyone from limitations and make education accessible, flexible, portable, and personal (Khan, 2012).

According to Prensky (2001), digital citizens can be split into two groups based on distinct behaviors and mindsets: digital natives and digital immigrants. *Digital natives* are the ones born with technology, who have known or been exposed to the Internet and technology early in life. *Digital immigrants*, on the other hand, are digital citizens who have adopted technology later in life and have been exposed to the Internet and technology in their adulthood. The generation gap among educators and

learners between digital natives and digital immigrants must be addressed to design an engaging learning experience that fosters an active learning approach. Tavenner (2019) proposed three concepts of student-centered approach: 1) mentoring, 2) project-based learning, and 3) self-directed learning. Students who have opportunities to be mentored by an adult mentor tend to achieve better outcomes. Effective learning approach comes from hand-on projects or assignments where students can develop cognitive skills and critical thinking. Self-directed learning is a habit that educators must introduce to their students and develop students into active learners. A design of creative assignments and delivery methods can boost students' engagement (Ashour et al., 2021). Villegas-Ch et al. (2021) emphasized that teachers are influential in shaping the learning environment. "*Whether or not teachers make use of digital education technologies, provided that they are available, therefore largely depends on their confidence in the technologies' effectiveness as well as their perceived self-efficacy*" (Organisation for Economic Co-operation and Development [OECD], 2023, p. 71).

The Thailand national policy review of the Thailand National Strategy 20-Year Plan (2018–2037) (Office of the National Economic and Social Development Council, 2018c), Master National Strategy Plan (2018–2037), (Office of the National Economic and Social Development Council, 2018a), National Reformation Plan (2021) (Office of the National Economic and Social Development Council, 2021), National Economic and Social Development Plan (2023–2027) (Office of the National Economic and Social Development Council, 2018b), Thailand National Education Plan (2017–2036) (Ministry of Education, 2020), and Thailand Education Strategy Plan (2020–2022) (Office of the Education Council, 2017) showed that all plans aligned with global trends in moving education into the digital era. Competency-based curricula, personalized learning, free online open sources for education, and lifelong learning are key directives that the government has set for the digital transformative education.

Learning is a lifelong endeavor that exists in both formal and informal settings. Lifelong learning is the pathway among which learners translate their knowledge into action (McGarrah, 2015). As its name suggests, the learning process can be applied to learners of all ages, as well as the aging process of learners: "*adaptability and the ability to acquire new skills and competences is therefore paramount*" (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2023). The emphasis on self-learning and peer-based learning is acknowledged for lifelong learning processes; essentially, active learning can be self-taught through free open-source material available online.

3. METHODOLOGY

This study adopted a qualitative research methodology and utilized in-depth interviews as its primary research strategy. The objective of qualitative research is to comprehend the contexts that influence individuals' or groups' decision-making processes and observable behaviors, offering insights and explanations for the phenomena under study. In-depth interviews foster a two-way exchange of information, allowing for the acquisition of supplementary data and demanding a profound grasp of the subject matter. These interviews empower researchers to pose inquiries that transcend the scope of semi-structured surveys, thereby augmenting the effectiveness of data collection and subsequent investigations. For participant selection, purposive sampling, a qualitative research technique, was employed. This approach involves researchers deliberately selecting individuals who possess relevant expertise and knowledge, based on the researchers' own expertise. The goal is to gain a comprehensive understanding of a particular phenomenon or population.

To ensure eligibility for participation, specific inclusion criteria were established. First, participants needed to be legally recognized adults, 18 years of age or older. Second, they were required to be residents of Thailand, currently residing within the country's geographical boundaries. Third, the targeted population consisted of individuals with specialized knowledge and expertise in the field of education. Finally, candidates were expected to be key stakeholders in Thailand's education sector, encompassing grades 1 to 12[1], and including individuals from public, private, and non-profit sectors. The interview data was gathered during the period of November 2022 to April 2023 (see Appendix).

In addition, the documentary method was applied to collect relevant dissertations, journals, publications, literature, and theories supporting the study from several sources, such as ProQuest Dissertation & Theses, Sage Journals, EBSCO Open Dissertations, Google Scholar, and ECSCOHost databases. The documents sought were both digital in nature and older publications that had been converted into digital formats. In addition to databases, information on the Internet is also extracted to support the study from applicable public, private, and non-profit organizations. Often, combining document analysis with other qualitative techniques like interviews enriches the understanding of the research subject holistically. This methodology relies on a wide array of data sources, encompassing historical context, policy papers, and media portrayal. This collective approach enables the examination of complex social phenomena (Altheide & Schneider, 2013).

Content analysis is a qualitative methodology that aims to comprehensively and objectively examine and quantify specific phenomena by making valid inferences based on verbal, visual, or written data. The content analysis approach was thus employed to examine the qualitative data obtained from the interviews.

4. RESULTS

Distance Learning Television (DLTV) is intended to solve the problem of insufficient teachers in remote areas, as teachers in those locations are generally

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[1] Participants are adults who are involved in education level from grade 1 to 12. They are teachers, educators, or parents of the students from grade 1 to 12. The students who are interviewed are 18 or above. This is to indicate that the study only focuses on study materials from grade 1 to grade 12.

homeroom teachers who need supplemental resources to assist with study materials that they are not familiar with. Most of these areas have limited access to electricity, the Internet, and wireless communication. DLTV is thus designed to be taught through satellite communication. The targeted schools have 120 students or less and the initiative started with 15,500 participating schools. In 2017, DLTV launched a website[2] where all recorded teaching sessions are available online. Currently, there are 13,800 schools using DLTV as a part of their instruction, of which 300 schools still have no access to the Internet.

DLTV can assist teachers in remote areas with distance learning. Although it was created to solve insufficient human resources in public schools, the initiative paved the way to digital education. The teaching setting generates a new learning environment that allows educators and learners to learn through technology, and they do not have to physically co-present for learning to happen. During the COVID-19 pandemic, students who have television at home could view the scheduled air time for the teaching sessions. Students with limited Internet access could view the recorded session at any time. However, students with no access to either television and the Internet remained vulnerable, as not all of them could come to school to use the resources they needed to continue their education. The digital divide thus still exists in Thailand, and technology can become an additional barrier to learners with no access to basic digital infrastructure.

Distance Learning Information Technology (DLIT) was launched in 2015 to introduce a new format of information and technological integration into teaching and learning methods. Its contents were initially available for high school students on a website[3], where they could self-learn. Later, the contents were expanded from kindergarten to grade 12 and were uploaded on YouTube. The platforms are available for both teachers and students. The teacher section provides assistive tools for teaching sessions, including interactive quizzes, experiments, assessments, and course guidelines. There is also an online community for teachers to share and exchange knowledge and experiences. Teachers familiar with DLIT can integrate the contents into their teaching sessions. However, most teachers do not find these resources useful, as the DLIT website is hard to navigate and content is difficult to find.

The Office of the Basic Education Commission (OBEC) Content Center was introduced in 2020 during the COVID-19 pandemic to mitigate problems created when the DLIT was unable to meet the demand from teachers and students accessing the contents online. Additional resources were added, including electronic books, multimedia, podcasts, sample quizzes and examinations, and homework and assignment templates. The platform sought to add more resources for students so they could learn online with minimal assistance. The platform is accessible via a website[4] or is downloadable through an application on Android and Apple devices. The website is comprehensive

and relatively user-friendly. Although the OBEC Content Center sought to achieve a centralized data center of knowledge, links to other platforms such as DLTV, DLIT, and Learning Space are not available. Links to outside resources, such as other private and non-profit entities in Thailand and international knowledge centers, are also not available. The contents are limited to what the OBEC has created, although the site claims to be a centralized data center for knowledge. While teachers use this platform extensively, students do not find it attractive.

The Institute for the Promotion of Teaching Science and Technology (IPST) is responsible for science, technology, engineering, and mathematics (STEM) online contents and created an application called Learning Space that is accessible via a website[5] or downloadable through an application on Android and Apple devices. The target audiences are high school students and teachers in the STEM fields. The website is comprehensive and user-friendly. The responsible entity has extensive training sessions throughout the year for teachers to integrate these resources into their teaching sessions, as well as to develop teachers' technological skills in designing interactive virtual classrooms, integrating other applications in teaching sessions, and new programming languages. A group of role model teachers has been built to help train other teachers to make training more effective, help develop teachers as peer-to-peer mentors, and build a community for sharing and exchanging teaching experience and methods. The entity is focusing on implementation under the directive from the Ministry of Education and puts less priority on feedback from schools and teachers to improve the platform.

While all applications and platforms have been pushed by the government to integrate technology into education, the mass population of learners is not aware of their existence and the benefits to be gained from these resources. Inadequate training of teachers has made the implementation of these platforms less effective. Educators trained by the OBEC and IPST often utilize online open sources extensively, while others still avoid adopting technology.

Non-profit organizations started the idea of free education for all through a self-learning and lifelong learning approach. The goal is to offer an opportunity for teachers to develop their capabilities in education and students to learn beyond the classroom and textbooks. The free open-source library led by Sakdibhornssup Foundation and Khan Academy Thailand is a form of free educational open-source material[6] from founders who value education and personalized learning. They recognize that the current educational system is not responsive to the current demand for education in the digital era. "*We do not want publicity. We want to help teachers and students who have passion in learning like us to succeed in their endeavors. With proper guidance and skillsets, they can go a long way to succeed in teaching and learning in the digital ecology*" (Interviewee, personal communication, 2022). Through work that is driven by volunteers and word of mouth publicity,

the benefits that they can offer to young learners are limited. These organizations have limited resources and space to train teachers and students. Only self-motivated active educators and learners can find these resources online if not have been introduced to them by word of mouth.

Most teachers find Learning Space to be the best public online source. While DLTV, DLIT, and OBEC Content Center are beneficial to them, they do not use these resources extensively. Teachers tend to create their own content rather than integrate available content in their teaching sessions. Young teachers (*digital natives*) apply outside free open-source material into their teaching sessions. "*I prefer using outside open-source materials because they are more interesting and easier to use. One particular tool I use in teaching is Brainingcamp because it is interactive. I can engage students in learning mathematics. Students can visualize the concepts of mathematics better than reading of the textbook*" (Interviewee, personal communication, 2023). Young teachers who are proficient in other languages can also apply foreign material into their teaching. They tend to be more creative in applying various digital media into teaching and integrating them into assignments. With school support, some teachers have been able to introduce integrated assignments in which a student is assigned one assignment that covers study materials from two or three subjects. Teachers who participate in an integrated assignment grade the assignment as it relates to their responsible subject.

Older teachers (*digital immigrants*) face challenges in adopting technology into their teaching methods. Teachers who can co-learn with students will build a better relationship with their students and tend to adopt technology better. Teachers who can relate study materials to real-world situations can generate an active learning environment where students tend to participate more in class, particularly when class sessions are held virtually. Lack of adequate training and resources for teachers is deterring the transformation of teaching and learning methods. Only during COVID-19, were the majority of teachers who resisted change forced to adopt technology and integrate open-source contents from the public entities discussed above. *Active learning teachers* were proactive in attaining new knowledge and skill sets to excel in their teaching during the COVID-19 social distancing measures. They learned through their mistakes and made progress as they adapted to new situations of technological adoption. *Passive learning teachers* waited until they had no other option to integrate technology into their teaching, and they invested less effort in adjusting their teaching styles to the new environment. As a result, the virtual classroom was full of black screens (with cameras turned off), making it more difficult to observe students' attention and behavior in class.

Students who are *active learners* will thrive in any kind of learning environment. The deep root of the *passive learning* style being taught in Thailand is an ingrained culture from which it is hard to break free. In Thailand, being an active learner can be viewed as impolite, for example, when asking a lot of questions in class. Being an active learner can also be viewed as an aggressive in Thai culture when

the intent is to be assertive. Being an active learner does not fit into a norm in which active learning is discouraged. It is thus necessary to change the mindset of all key stakeholders to understand that introducing a competency-based curriculum requires more than just an execution of the plan. It requires a redesign of the education system that reflects the current digital reality. Through proper guidance and coaching, students can learn to utilize the resources being taught to them and know where to search for additional knowledge when necessary.

Parents' support of students' education plays a key role in making or breaking a career path that students want to pursue. With support from the family, students can thrive in any environment if they are willing to learn and see the importance of education. "*My level of involvement between my two kids are totally different. While the younger child is in grade 6, he*[/she] *is far more responsible in finishing his homework on time and very attentive in a virtual classroom. The older kid, on the other hand, needs more nagging to make sure he*[/she] *completes his assignments and attends online classes*" (Interviewee, personal communication, 2022). Self-learning can then be developed with the assistance of the parents and teachers. Once students adopt the skill set required in the digital era, searching for knowledge is only just the tip of the iceberg. All of the resources that are overly abundant online can be accessible and beneficial to self-growth and development.

4.1. Current practices: Thailand teaching and learning methods

Currently, there are four main current practices of teaching and learning implemented by schools and teachers in Thailand: 1) onsite, 2) on-air, 3) online or on-demand, and 4) on-hand delivery methods.

Onsite is the conventional face-to-face model. Even with an onsite approach, digital content, materials, applications, and technological devices are integrated within the teaching session.

On-air is a method dedicated to schools with no access to the Internet. They rely on satellite communication to connect to DLTV channels at the scheduled air time to assist teachers in teaching their classes. As of 2022, there are 300 schools in rural areas in Thailand that fall in the information have-not group (with no access to the Internet, wireless communication, and electricity).

Online or on-demand is an online session of a virtual classroom. During the COVID-19 pandemic, online sessions were not necessarily conducted synchronously. The flexibility in the online delivery method allowed students to participate in real-time or watch the recorded session at a later time. DLIT, the OBEC Content Center, and the IPST Learning Space applications are the public applications and tools for teachers to use in their teaching sessions.

On-hand is the last resource for students who are unable to attend classes onsite, on-air, or online. On-hand is the method that teachers use when students are in need of help or falling behind. Such face-to-face and one-on-one interaction is sometimes necessary to accommodate students given the circumstances. "*I have to make a visit to some of my students' houses to ensure that they can make progresses with their learning. Their family*

socio-economic background deterred them from attending a class online. One student, in particular, goes out to the sea a few days each trip to help his father catching fish for a living. It is my duty to make sure he[/she] graduates high school at least. On-hand is the only method that works with this student" (Interviewee, personal communication, 2022).

The right mix of the four delivery methods should be flexible to adapt to situations and unforeseeable circumstances so that everyone can be better prepared for an abrupt change in education similar to that which occurred during the COVID-19 pandemic.

4.2. Digital infrastructure readiness

According to Mongkhonvanit and Dipendra (2021), 97.47% of schools in Thailand have access to electricity, computers, and the Internet. Only 75% of households have connected to the Internet, most of which are connected to the Internet via wireless communication through mobile devices. By analyzing the data and correlating it with Castells' (2001, 2010a, 2010b) and Qiu's (2009) work on the digital divide, the following classifications can be made: 1) 75% of Thai teachers and students are considered information-have digital citizens who can empower their knowledge through a connection of the Internet and wireless communication; 2) 24% of Thai teachers and students are considered information have-less digital citizens who have barriers to basic digital infrastructure mainly because of their socioeconomic status. They can, however, maximize their potential at school provided there is support from schools are available to assist their learning; 3) just 1% of Thai teachers and students are still out of the network and are in the information have-not group. As the technology advances in its form, this 1% will surely diminish and eventually this group of educators and learners will catch up with the rest of the population. The outlook for the digital infrastructure in Thailand is thus promising to empower education through technology.

4.3. Limitations to digital education transformation

This study revealed that there are two main limitations preventing Thai transformative education from being realized as intended: human resource deficiency and the rigid structure and culture of the education system.

The deficiency of human resources appeared prominently in the research findings. The execution and implementation of free open-source material provided by the Ministry of Education are only possible for those who are aware of their existence. The adoption of free open-source material from public, private, and non-profit sectors is only beneficial to those who are trained to use the resources, so the benefits that these resources can offer are not reachable to all learners. When the researchers use keywords such as "*free open resources*" on the Google search engine, not all resources are listed in the Google search results, and some appear after the fifth page of the results. This makes resources hard to find for learners who are actively searching for knowledge. "*It requires extensive training to introduce technological mindset

into teaching and learning for teachers who do want changes. We really appreciate the COVID-19 pandemic. The pandemic gave us a chance to finally make changes that we have been pushing for*" (Interviewee, personal communication, 2023). In addition, Thai teachers and students have language limitations that deter them from using foreign open-source material as a part of their teaching and learning. Inadequate training among teachers to maximize technology as a teaching tool is also causing ineffective teaching and learning styles that do not fit with the current digital transformation.

A traditional education system that is *rigid in structure* makes it difficult to initiate and implement changes in the curriculum and other processes. Feedback from schools is recommended and encouraged to improve the system for the better. In practice, however, negative feedback is not welcomed and is viewed as a threat instead of an opportunity to advance the educational agenda. "*Our school principal is pressured by the public entities to provide feedback of digital platform implementation. But we always have been told to provide positive feedback. Negative feedback should be avoided. If honest feedback is not welcomed and reflected of the situation, how can we even advance our curriculum?*" (Interviewee, personal communication, 2022). Negative feedback should thus be viewed as constructive feedback to improve the process and the curriculum. When facing repetitive barriers, teachers are discouraged from actively participating in making progressive changes in Thai education. The administrative tasks that are added to teachers' responsibilities slowly become a burden to them. Ultimately, teachers have to allocate their time to administrative tasks that are repetitive, and they are unable to spend good quality time with their students. While the system has been designed with a top-down approach to directives of execution and implementation, 21st century technological advancement is creating pressure for change in flexibility and adaptability. The new introduction of competency-based curriculum, mentioned in the 2021 Thailand National Reformation Plan Office of the National Economic and Social Development Council, 2021), also follows the global trend that the UNESCO International Bureau of Education published to advocate and build capacity to support people and institutions to develop evolutionary education (Rabinovitch, 2019). However, the enormous challenges to introduce more appropriate educational curricula in the new digital age require extensive resources to change a deeply embedded traditional education foundation: "*In fact, competency-based education is a redesign of the culture and structure of school systems to support effective instruction and learning*" (Sturgis & Casey, 2018, p. 10).

4.4. Leading role models among educators and learners

"*At every moment, we are both students and teachers; we learn by studying, but we also learn by helping others, by sharing and explaining what we know*" (Khan, 2012, p. 12). Two dedicated young leading role models were identified among

educators and learners that can set a new trend of Thai transformative digital education.

The educator role model is an innate *active learner* and *active teacher*. This teacher is able to apply free online open-source material in the class session and can use foreign open resources in Korean and English as a part of the learning session. During the COVID-19 social distancing measures, this teacher was able to have full attendance in which all students turned on their cameras and participated in the virtual classroom. Students view this teacher as their education idol and consultant, with whom they feel comfortable openly discussing their career paths and, education difficulties even in subjects irrelevant to the teacher's knowledge, as well as family issues that influence their attention to education. By building a relationship with students, the teacher can generate trust and belonging in an environment where students can become active learners and are not afraid to voice their opinions and make mistakes. To create a transformative education experience, the teacher can introduce integrated assignments. As a mathematics teacher, for example, the ability to design an assignment in partnership with English and sciences to generate critical thinking and applied knowledge is a true transformative integrated education. All teachers involved in the integrated assignment then grade the students according to the subjects for which they are responsible. The most astonishing assessment is the open-ended examination that is unique for each student. For example, this teacher will have 23 unique open-ended examinations for 23 students. Not only will this eliminate academic dishonesty, the time spent in making examinations and grading them extensively evaluates students' ability to apply their knowledge and solve mathematics. "*I always look forward to see my students' answers when grading exams. I get to see all kinds of creativity among my students in solving math problems. Now, I do not have to worry about academic dishonesty. Students know what are expected of them so they pay attention in class and know how they are being assessed*" (Interviewee, personal communication, 2023). This teacher can achieve a tremendous transformative teaching style through support from the school and students' families. Tracing back to when the teacher was a high school student, the support this teacher received from co-learning experience was uncommon during the time. As a result, the active learning trait was passing along to this young teacher to become a 21st century teacher for the digital age.

The learner role model is an *active digital native learner*. This student can converse fluently in English with self-learning through free, online open resources. This student attended public schools from primary to high school, where the study materials are mainly presented in Thai. With the passion and interest in learning English, this student was empowered by access of the Internet to learn English through various media online. This student discovered Khan Academy and was able to join the Khan Academy Thailand team as a volunteer to help translate content into Thai to make it accessible to those with language limitations. "*I enjoy browsing the Internet to find new resources that I can develop myself to become more proficient in English. Khan Academy was one of the things I can learn and give*

back to the community of learners. If I can be a part of the team that can make the differences, why not volunteering?" (Interviewee, personal communication, 2022). From the influence of Khan Academy and family support, this student decided to pursue a career in teaching to become a contributor who can change Thai education in the era of digital education.

5. DISCUSSION

The researchers were able to apply Qiu's (2009) work on the digital divide to Thai educators and learners to explain the phenomena of current access to digital education. If one is not connected to the network through the Internet or wireless communication, there is less opportunity to grow and thrive in the digital era, as all activities are within the network. As networks keep growing, people are increasingly required to be connected and cannot live without being connected to the network (Castells, 2010b). Thai educators and learners who used to be the information have-not are becoming information have-less as they have access to the Internet and wireless communication. "*In 2022, only 300 schools had no access to the Internet and wireless communication*" (Interviewee, personal communication, 2023). The 1% of the remaining population of information have-not will not be left behind, as the government has committed to eliminate their lack of access. The focus of technology accessibility should be on the information have-less groups. These learners have limited to no access to the Internet when at home but are able to gain such access when at school. This makes schools ideal places for education beyond school hours. By arranging after-school hours and weekends schedules for students to come to the schools or libraries, the gap of accessibility can be bridged to empower students to gain the privilege of a free education.

While the majority of Thai learners have access to the Internet, wireless communication, and mobile devices, the factor impeding learners from adopting digital education lies in the lack of skills necessary to search for knowledge. As Siemens (2008) has stated, "*know-how and know-what is being supplemented with know-where*" (p. 2), makes the ability to know where to find the knowledge necessary for all citizens of the Internet. According to Siemens (2008), "*knowledge that resides in a database needs to be connected with the right people in the right context in order to be classified as learning*" (p. 6). With the assistance of teachers and schools, ensuring learners understand how and where to find the knowledge is essential to the learning process. The role of educators is important to build capable young digital citizens who can search for data, filter information, and make connections to the abundance of data environments online. Educators must be flexible and adaptable in their roles as instructors, moderators, facilitators, mentors, or coaches, as the circumstances vary in certain environments, to foster an active learning environment among students. Co-learning between teachers and students can also encourage the embrace of active learning. Teachers are not required to be experts in all subject matters to help students attain knowledge. Learning

along with students is a form of co-learning that can pave the way to a lifelong learning skill set for everyone.

In the era of connectivity through technology, educational institutions must be creative in their delivery method toward open-source content and student-centered approaches to learning. This is a leading path that can provide exceptional learning experience in a model that is adjustable to time, place, and even in crises. The ability to recognize the differences in the generation gap of digital immigrants and digital natives will assist teachers in designing coursework to increase engagement in both onsite and online sessions. Creative assignments and assessments that foster critical thinking and applied knowledge will demonstrate how well students can translate what they learn to their ability to solve problems and complete the assigned task. Years of teaching through memorization and receiving education passively are no longer applicable to the current situation of progressive advances in technology. The deep-rooted conservatism in Thai education, which conserves a passive learning style and discourages active learning, is a major obstacle impeding transformation. Thai culture is very resistant to change, accepting newness, and embracing creativity. It requires extensive training to change the mindset of teachers and staff to become active learners so they can pass along these traits to their students. In agreement with the connectivism education theory that learning and knowledge consist of a diversity of opinions (Siemens, 2008), teachers who can accept and embrace diversity will thrive in an active learning environment and so pass along the inclusion process to their students. To be able to thrive as an active learner, as Siemens (2008) stated, the willingness to learn is more critical than what is already known.

According to OECD (2023), there is a wide variety of online risks that educators and learners are exposed to such as cyberbullying, privacy invasion, harmful overuse of technology, ergonomic problem from prolonged use of electronic devices, and scammers. While endless opportunities in an online ecology can develop students' growth, students may be exposed to personal information leak unintentionally, share and distribute inappropriate content, plagiarize other works, and use technology for academic dishonesty (United Nations International Children's Emergency Fund [UNICEF], 2022). The education systems that are digitally in nature are also vulnerable to cyber security attacks. The study did not examine the potential risks involved with digital technology adoption. The limitation on negative impacts that educators and learners are at risk should be examined for a future study to provide a more comprehensive evaluation of the digital education environment.

Aside from the government's efforts to create free open-source education for all, there are a few astonishing non-profit organizations that share the same vision to offer free education for all to advance Thai education and reduce disparities in educational opportunities. The Sakdibhornssup Foundation is a Thailand network of free education that offers training and study materials similar to Khan Academy. The online courses offered for students include Thai, English, mathematics, sciences, social studies, and ordinary national educational test (O-NET) examinations. The study materials cover grade 1 to grade 12. In addition to free online open resources for learners, the foundation also provides training sessions for teachers to become more effective in their teaching skills and help building their capabilities. The foundation is the first organization partnering with Kasetsart University to launch the first translation of Khan Academy into Thai. Khan Academy Thailand was later established and partnered with Chulalongkorn University and Kamnoetvidya Science Academy, which recruited volunteers to help translate content into Thai and dub the recordings. Khan Academy Thailand is currently a partial translation site that the Sakdibhornssup Foundation is now leading a joint effort to make into an active full site. While the foundation is known through word of mouth and stays low-key in terms of publicity, the benefits that the foundation can offer to young learners in Thailand is tremendous. There is an opportunity for public and nonprofit entities to collaborate in making education truly transformative and accessible for all. A push by the Ministry of Education to allow an open forum or platform for other entities to collaborate and co-create a new vision of Thai education could push forward change in a comprehensive manner.

6. CONCLUSION

Education has an important social impact and a wisely planned educational approach can build a nation of capable citizens that contribute greatly to the workforce. Although the Thai government recognizes the importance of education and the necessity to adopt digital education, the implementation process is not yet fully realized as planned. Policymakers need to examine policy coherence on building capacity for digital education. The nation's digital infrastructure and open resources are readily available but cannot provide the learning opportunities as intended. A cultural unlearning of the passive teaching and learning ingrained in the Thai education system is no easy task. It requires an extensive redesign of the system with intellectual, emotional, and social support from all stakeholders to transform relearning that can lead to behavioral changes in educational practices (Grose, 2014). The development of teaching human resources should become a top priority in education policy to address the deficiencies that are preventing Thailand from making the transition. The policymakers should allocate adequate fundings in human resources (teachers, technical staff, and school administrators) investment. Smart investments of the government budget are not limited to only digital infrastructure and technologies. Human resources investment through annual and semi-annual trainings should be mandatory for all educators to stay current with digital education technologies and pedagogies. The more confident these educators have in technology, the more likely they will reap the benefits from the digital education technology available to them (OECD, 2023). Policymakers and schools should design incentive mechanisms and

career reward programs for teachers to encourage digital education engagement.

A collaborative learning culture starts with the main key educators generating a positive, supportive, and welcoming experience in a technology-rich environment. Despite the success of government entities under the Ministry of Education in launching many platforms such as the DLTV channels, DLIT, OBEC Content Center, and IPST Learning Space, a centralized online library that holds all education resources is not yet available. Although the OBEC Content Center aimed to achieve a centralized data center of knowledge, the links to other platforms within the Ministry of Education are not available, nor are links to outside resources such as other private and non-profit entities in Thailand and international knowledge centers. It is recommended for the Ministry of Education to assign an oversight entity dedicated to digital education. Currently, four public applications and online resources are under different units of the Ministry of Education. They are operating without collaborative efforts in consolidating resources, providing supports across applications, and applying different digital technologies. The oversight unit can ensure their alignments and make sure all digital open resources are interlinked for ease of browsing. The vision of transformative education in Thailand in written documents cannot be realized without actually implementing the plan and ensuring the effectiveness of the execution process.

The study did not examine education and learner protection measures in digital learning environment. Ramifications of cyber-attacks, personal data breaches, scammer threats, social media abuses, and harassments are of great importance. To design a new educational system for digital education, further study is recommended to provide comprehensive risks and drawbacks of technology. A lack of incentives and rewards for teachers is evident in the study findings. It is recommended for future study to assess a current reward system if any and provide insightful recommendations to motivate digital adoption. This study is interdisciplinary research of which is intended to provide a holistic view of the digital education transformation. Specific subsets of topics are suggested to be further evaluated and analyzed in proposing solutions to specific problems pertaining to digital education.

There is no right or wrong approach to pedagogy, but rather there is a need for flexibility to adapt and utilize different approaches to teaching based on the situation to generate participatory learning sessions. Even digital immigrant teachers can thrive in the digital era with a learning mindset and awareness of where to obtain knowledge. Similarly, not all digital natives will be naturally active learners, proper guidance to develop self-learning and life-long learning is crucial in the teaching and learning process. The study suggests that schools should have training in place for teachers to share, exchange, and learn from one another in achieving course design to promote active learning. An online community based for teachers is recommended so that all teachers can have outside-of-their-network support to assist their development of digital education design, delivery, and assessment.

Everyone is both a learner and a teacher at one point in time. Digitally transformative education can succeed within one's power as a digital citizen to acquire a skill in the digital world and know where to search for information and knowledge when necessary. Adopting active learning skills can lead to self-learning and self-teaching through free open resources that are readily available over the Internet. Life-long learning can essentially become a habit in which all learners become savvy in navigating the Internet galaxy of knowledge.

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APPENDIX. QUESTIONNAIRE

The questions used in the interviews are listed below:

1) What do you think of "Free Open-Source Education"?

2) What are the differences between free open-source education and formal education with tuition fees?

3) What are the motivators of starting (DLTV/DLIT/OBEC Content Center/Learning Space/SciMath/non-profit organization)?

4) Is the education program that you offer related to an intention of offering life-long learning? What are the positive outcomes of this program?

5) Are there any gaps in current formal education that does not meet the business requirements in skillsets, critical thinking, and knowledge? Are we generating capable graduates to enter the workforce?

6) Do you see educators' roles changing as we adopt new pedagogy of online teaching prior to and during the COVID-19?

7) Do you see learners' roles changing as we adopt online education? Are they becoming active or passive learners?

8) With the data abundance over the Internet, what do you think is a learning process essential for this new type of education?

9) Would you mind sharing your experience both positive and negative experience through the program, new pedagogy style, and online teaching and learning?

10) Are there changes in our mindset and perception of education? Are we changing our behaviors as we adopt new ways (new normal) of education?

11) Are we ultimately changing as a society? What are some of the phenomena that you think contribute to social transformation as we adopt technology in education?

12) Is free open-source education a game changer to education? How is this ideology affecting us as a person, learner, educator, and society?

Not all questions are asked to every respondent. Some questions are omitted as they are selected to appropriate respondents.